
FOR·THE·INCREASE·
AND·DIFFVSION·OF·
KNOWLEDGE·AMONG·MEN·
PER
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ADVERTISEMENT.

The scientific publications of the National Museum consist of two series—Proceedings and Bulletins.

The Proceedings, the first volume of which was issued in 1878, are intended primarily as a medium for the publication of original papers based on the collections of the National Museum, setting forth newly acquired facts in biology, anthropology, and geology derived therefrom, or containing descriptions of new forms and revisions of limited groups. A volume is issued annually or oftener for distribution to libraries and scientific establishments, and, in view of the importance of the more prompt dissemination of new facts, a limited edition of each paper is printed in pamphlet form in advance. The dates at which these separate papers are published are recorded in the table of contents of the volume.

The present volume is the forty-fifth of this series.

The Bulletin, publication of which was begun in 1875, is a series of more elaborate papers, issued separately, and, like the Proceedings, based chiefly on the collections of the National Museum.

A quarto form of the Bulletin, known as the "Special Bulletin," has been adopted in a few instances in which a larger page was deemed indispensable.

Since 1902 the volumes of the series known as "Contributions from the National Herbarium," and containing papers relating to the botanical collections of the Museum, have been published as Bulletins.

RICHARD RATHBUN,
Assistant Secretary, Smithsonian Institution, in charge of the United States National Museum.

DECEMBER 5, 1913.

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TREESHREWS: AN ACCOUNT OF THE MAMMALIAN FAMILY TUPAIIDÆ.

By Marcus Ward Lyon, Jr.,
Formerly of the Division of Mammals, United States National Museum.

INTRODUCTION.

This review of the treeshrews, constituting the mammalian family Tupaiidæ, was originally contemplated in 1904 by Mr. Gerrit S. Miller, jr., curator of mammals, United States National Museum, but owing to pressure of other work he was unable to carry it out. In 1910, shortly after I severed my active connections with the Division of Mammals, United States National Museum, Mr. Miller suggested to me the desirability of making a study of the treeshrews. I took up his suggestion and the present paper is the result. At that time he turned over to me some preliminary notes on the group he had made during a visit to European museums when he was primarily engaged in other lines of research. The increase of new material, both in the United States National Museum and in other museums, made it imperative that the entire field be gone over again. The collections in Washington were first studied, and during the summer of 1911 I visited most of the museums which Mr. Miller's previous work showed contained material valuable for this revision.

Specifically, the material examined consists of about 800 specimens, all of which are listed in the tables of measurements and distributed as follows:

British Museum, 355 specimens, 27 types.

United States National Museum, 324 specimens, 29 types.

Civic Museum of Natural History, Genoa, 37 specimens, no types.

Royal Zoological Museum, Berlin, 29 specimens, 1 type.

Museum of Natural History, Paris, 20 specimens, 1 type.

American Museum of Natural History, New York, 14 specimens, 1 type.

Natural History Museum of Geneva, 3 specimens, no types.

Natural History Museum of Turin, 1 specimen, no types.

In addition to the specimens mentioned above, in most museums, particularly the older ones, there are a number of specimens of very uncertain or generalized localities, which are unsuitable for systematic work, and they are not included in the above figures.

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In addition to examining specimens in these museums, I have also had for study specimens sent to Washington from the following institutions:

Museum, Philippine Bureau of Science, 12 specimens, 1 type.

Selangor Museum, Selangor, Straits Settlements, 8 specimens, no types.[1]

Academy of Natural Sciences, Philadelphia, 6 specimens, no types.

I was unfortunate in my time of visiting the Natural History Museum in Leyden. The director, Dr. F. A. Jentink, who has direct charge of the mammals, was on his vacation and I was unable to examine the specimens of Tupaiidæ in that museum. The material contained there as listed by Jentink[2] does not appear vitally important for a systematic review of the group, yet it contains some very interesting and historical specimens, which I regret not having seen. Among them are the unique type of *Dendrogale murina* and the only skeleton of the genus *Ptilocercus* that I know of existing in museums and the cotypes of *Tana dorsalis*. *Dendrogale murina* is the only species of treeshrew of which I have not seen examples.

I take pleasure in here expressing my thanks to the directors of the museums which I personally visited for giving me the privilege of studying the available material in their institutions, or from which material was borrowed.

The importance of the explorations of Dr. W. L. Abbott in our knowledge of the treeshrews can not be lost sight of. With the exception of less than a dozen specimens in the United States National Museum the entire series of treeshrews there was collected through his untiring efforts. This means that more than a third of the specimens of treeshrews in all the museums of America and Europe have been personally collected by Doctor Abbott. Among them are 29 types. Indirectly he is also responsible for the treeshrews collected by Messrs. Kloss and Robinson on the Malay Peninsula, or adjacent islands.

The text figures of the skulls and teeth of the various genera were made by Mr. A. J. Engel Terzi.

Measurements.—All the measurements are in millimeters. With the exception of those of the head and body and of tail of skins, they have all been made by the writer, including those of the hind foot, which includes the claws. In most cases the measurements of the head and body and tail were made by the collector in the flesh. In the tables of measurements where the head and body and tail measurements are followed by ±, those measurements were made by the writer from the dried skin or mounted specimen. Head and body and tail measurements of specimens preserved in alcohol were also

[1] There are, however, in the Selangor Museum, 4 types, none of which I have seen.

[2] Cat. Ostéol. Mamm. Mus. Hist. Nat. Pays-Bas., vol. 9, 1887, and Cat. Syst. Mamm. Mus. Hist. Nat. Pays-Bas, vol. 12, 1888.

made by the writer. Measurements of the skull followed by ± indicate that the measurement is only approximate owing to damage to the skull. Hindfoot measurements followed by ± are also only approximate. In the tables of measurements the specimens in the United States National Museum will be recognized by simple catalogue numbers, as 104362, without qualifying initials or footnotes; those in the British Museum by the well-known separation of these numbers into sections by means of periods, as 99. 6. 12.3; specimens in other museums will be found designated by appropriate and self-explanatory initial letters or by footnotes.

HISTORICAL ACCOUNT.

The earliest published account of treeshrews is that of Ellis,[1] one of the surgeons of Captain Cook's expedition. On Tuesday or Wednesday, 25th or 26th of January, 1780, Ellis remarks: "Our sportsmen * * * having seen only a few monkies, squirrels, and a cock and hen, the latter of which they shot. According to Linnæus this island is their native place." The island referred to is Pulo Condore, off the coast of Cochin China. The squirrels mentioned in the account are not squirrels, but Tupaias. One of them was evidently shot. A rough but very accurate sketch of the animal was made by Ellis and a Latin diagnosis of it written in his journal. This description of the animal was published by Gray in 1860.[2] Through the courtesy of the officials of the British Museum a reproduction of a photograph of Ellis's drawing is here printed. There can be no doubt from Ellis's picture or description that his squirrels were Tupaias (pl. 1).

Tupaias as such were first brought to the attention of the world by M. Diard, a French naturalist, at one time an assistant of Sir Thomas Stamford Raffles, in November, 1820, under the designation of *Sorex glis*.[3]

Six months later, May, 1821, the genus *Tupaia* was first proposed by Sir Thomas Stamford Raffles,[4] and the species *ferruginea* and *tana* described, the latter in the present paper being made the type of a new genus.

Specimens of Tupaias had been seen by Europeans several years earlier, and one even sent to Europe. Geoffroy [5] remarks:

> The discovery of this remarkable group of Insectivores has been attributed to both M. Diard and Sir Raffles. The fact is that it belongs to neither of these celebrated travelers, but to Leschenault de la Tour, who had sent in 1807 to the Museum of Paris an individual of the species which has since been called *Tupaia javanica*. Nevertheless it is only since 1820 that the attention of naturalists has been called to Tupaias, and that these animals have really entered the domain of science.

[1] Voyage by Capt. Cook and Capt. Clerke in ships *Resolution* and *Discovery*, 1776, 1777, 1778, 1779, and 1780, vol. 2, 1782, p. 340.

[2] Ann. Mag. Nat. Hist., ser. 3, vol. 5, 1860, p. 71.

[3] Asiatic Journ. Month. Reg., vol. 10, p. 478, November, 1820.

[4] Trans. Linn. Soc. London, vol. 13, p. 256, May, 1821.

[5] Belanger, Voyage aux Indes-Orientales, Zoologie, p. 104, 1835.

Geoffroy was naturally quite unaware of the existence of Ellis's manuscript notes and drawings. Since Diard's and Raffles's time the group has become better and better known and its geographic range widely extended. The most important discoveries in regard to the group since 1821 have been the announcement of the genus *Ptilocercus* by Gray,[1] 1848, of the group now called *Dendrogale* by Schlegel and Müller,[2] the discovery of treeshrews in the Philippine Islands by Whitehead, about 1879,[3] now forming the genus *Urogale*, and the discovery of treeshrews in India by W. Elliot, about 1849.[4]

DEFINITION AND RELATIONSHIPS.

The Tupaiidæ are diurnal insectivorous mammals characterized by a general squirrel-like aspect, more or less arboreal habits, orbits completely encircled by bone, alisphenoid canal present, malar bone with a more or less enlarged perforation, separate radius and ulna, and separate tibia and fibula, dental formula $I\ \frac{2}{3}\ C\ \frac{1}{1}, Pm\ \frac{3}{3}\ M.\ \frac{3}{3}$, upper molars with typical W pattern. The family is composed of two very distinct groups for a long time regarded as genera, the typical members of the family, *Tupaia* and the aberrant *Ptilocercus*. The old genus *Tupaia* has gradually been seen to be a composite genus, and up to the present time has been divided into three separate genera: *Tupaia*, *Dendrogale*, *Urogale*. In the present paper two more genera are recognized. These genera are now for the first time grouped to form the subfamily Tupaiinæ. The single genus *Ptilocercus* is here regarded as forming the subfamily Ptilocercinæ. *Hylomys* of the Erinaceidæ was formerly associated with the treeshrews, but was removed in 1874 by Anderson.[5]

TUPAIINÆ.	PTILOCERCINÆ.
Tail bushy or close-haired throughout its entire extent.	Tail with terminal portion distichously tufted, naked, and scaly basally.
Ears small and cartilaginous.	Ears large and membranaceous.
Footpads of moderate development.	Footpads relatively large and soft.
Supraorbital foramen well developed.	Supraorbital foramen absent.
Foramen rotundum entirely distinct from sphenoidal fissure.	Foramen rotundum confluent with sphenoidal fissure.
Second upper incisor unicuspid.	Second upper incisor with a distinct posterior cusp.
Upper molars with well-developed bifurcated mesostyles.	Upper molars without mesostyles.
Upper molar teeth without a distinct cingulum.	A distinct cingulum encircles the upper molar teeth.
Lower molar teeth without a cingulum.	Lower molar teeth with a cingulum on outer surface.

[1] Proc. Zool. Soc. London, 1848, p. 23.
[2] Verh. Nat. Gesch. Nederl. Overz. Bezitt., p. 167, 1839–44.
[3] Thomas, Ann. Mag. Nat. Hist., ser. 6, vol. 9, p. 250, March, 1892.
[4] Waterhouse, Proc. Zool. Soc. London, 1849, p. 107.
[5] Trans. Zool. Soc. London, vol. 8, 1874, pp. 453–467.

Genera and their types.	Genus and its type.
Tupaia RAFFLES, 1821, *Tupaia ferruginea.*	*Ptilocercus* GRAY, 1848, *Ptilocercus lowii.*
Anathana, new, *Tupaia ellioti.*	
Dendrogale GRAY, 1848, *Tupaia murina.*	
Tana, new, *Tupaia tana.*	
Urogale MEARNS, 1905, *U. cylindrura* (= *T. everetti.*)	

The nearest relatives of the Tupaiidæ are the Macroscelididæ, terrestial Insectivores of Africa. Many authors [1] place the two families in a superfamily or subordinal group, the Menotyphla or Tupaioidea as distinguished from all the other living Insectivores the Lipotyphla.

This grouping appears to me to be a natural one, and the differences that we now find between the Tupaiidæ and the Macroscelididæ are in large measure due to the very different modes of life of the two families, the Tupaiidæ being quite arboreal in their habits, and the Macroscelididæ, terrestrial and saltatorial. The geographic distribution of the two families taken together show many resemblances to the present day distribution of the Tragulidæ, rhinoceroses, elephants, anthropoid apes, Cercopithecidæ, and Megachiroptera, a circumstance lending some weight to their probable common origin. In spite of their great difference there is scarcely an osteological structure in the Macroscelididæ that does not have some counterpart in the Tupaiidæ, and the opposite, the most conspicuous difference being the absence of the alisphenoid canal in the former and its presence in the latter, and the complete bony orbit of the Tupaiidæ absent in the African family. The skull of the Macroscelididæ bears most general resemblance to that of *Ptilocercus*, and it is interesting to note that a supraorbital foramen is lacking in both, but is a conspicuous feature of the Tupaiinæ. The main differential points between the two families are seen in the following table:

TUPAIIDÆ.	MACROSCELIDIDÆ.
Alisphenoid canal present.	Alisphenoid canal absent.
Supraorbital foramen present (except in *Ptilocercus*).	Supraorbital foramen absent.
Orbit completely surrounded by bone.	Orbit not completely surrounded by bone, even postorbital processes lacking.
Radius and ulna separate bones.	Radius and ulna fused.
Tibia and fibula separate bones.	Tibia and fibula fused.
Metatarsals not unusually elongated.	Metatarsals unusually elongated.
Premolars, 3 above and 3 below.	Premolars, 4 above and 4 below.
Molars, 3 above and 3 below.	Molars, 2 above and usually 2 below (sometimes 3 below).[2]

[1] Weber, Die Säugetiere, 1904, p. 377. Gregory, Bull. Amer. Mus. Nat. Hist., vol. 27, 1910, p. 268. Gill, Bull. Geol. Geogr. Surv. Terr., No. 2, ser. 2, May 14, 1875, p. 20. Osborn, Age of Mammals, 1910, p. 522.

[2] See Gregory, Bull. Amer. Mus. Nat. Hist., vol. 27, 1910, pp. 280–285; also Thomas (Proc. Zool. Soc. London, 1890, pp. 445, 446) who remarks on dentition of *Petrodromus* and the other genera.

Although the general appearance of the molariform teeth of the Macroscelididæ is quite different from the typical W-patterned teeth of the Tupaiidæ, yet it is easy to see how the teeth of the former may have been derived from those of the latter. The teeth of the Macroscelididæ show a greater departure from the more typical tritubercular teeth of the Tupaiidæ, just as the limb bones have shown a greater departure from the normal.

OSTEOLOGY.

The skeleton of the Tupaiidæ, as represented by the genera *Tupaia* and *Tana*, has been rather carefully studied by Blainville,[1] Mivart,[2] Anderson,[3] and Gregory.[4] In the British Museum is most of the skeleton of the type of *Urogale everetti*, and in the Leyden Museum is a skeleton of *Ptilocercus*. I have not seen the latter, but Jentink[5] has published a few notes on it. It is the only skeleton of that genus that I know of existing in museums. I have not seen skeletons of the genera *Anathana* or *Dendrogale*, and know of none in collections. Skeletons of Tupaia are found in most of the larger museums, and in the United States National Museum are the following:

Cat. No. 124317, *Tupaia glis ferruginea*, Singapore.
Cat. No. 174609, *Tupaia demissa*, Sumatra.
Cat. No. 49468, *Tupaia lacernata wilkinsoni*, middle of Malay Peninsula.
Cat. No. 111782, *Tupaia nicobarica nicobarica*, Great Nicobar Island.
Cat. No. 154593, *Tupaia javanica*, western Java.
Cat. No. 174611, *Tana tana tana*, Sumatra.

The observations on the skeleton which follow are based upon an examination of these skeletons of the genera *Tupaia* and *Tana* and skulls of the other genera. I have also made free use of the observations of Mivart, Anderson, and Gregory.

Skull.—The skull of the genus *Tupaia* is characterized by its rather generalized structure; it is widest just posterior to the middle, and tapers toward either extremity both laterally and supero-inferiorly, the tapering being much more pronounced anteriorly, especially so in the genera *Tana* and *Urogale;* posteriorly the skull is gently rounded off. The brain case is relatively large and inflated and widest at the zygomatic roots. The orbit is completely surrounded by bone, is large, directed mainly laterally but at the same time slightly inclined upward and forward. Posterior to the orbit is a temporal fossa of moderate size. The temporal ridges are rather prominent and distinct except for a short distance in front of the lambdoid crest, where they unite to form a short sagittal crest. In *Ptilocercus* the temporal

[1] Ostéog. Mamm. Insect., 1840, pp. 31–35.
[2] Journ. Anat. Physiol., vol. 1, 1867, pp. 292–295, and vol. 2, 1868, pp. 145–146.
[3] Zool. Res. West. Yunnan, 1879, pp. 108–123.
[4] Orders of Mammals, Bull. Amer. Mus. Nat. Hist., vol. 27, 1910, pp. 269–280.
[5] Notes Leyden Museum, vol. 7, 1885, p. 7.

ridges remain separated and in *Urogale* they unite early to form a much more conspicuous sagittal crest than they do in *Tupaia*. The lambdoid crest is well marked and gently arched. It begins faintly on either side near the external auditory meatus and becomes well developed along the upper border of the supraoccipital. The palate is long but neither specially wide nor specially narrow. In front are well marked anterior palatine foramina; posteriorly the palate is slightly concave, and ends in a slightly thickened ridge, and a very small blunt median spine. The most anterior part of the posterior edge is about on a line with the posterior edge of the last molars. In the posterior half of the palate in the genera *Tupaia* and *Tana* are usually irregular vacuities. The other genera, *Urogale*, *Anathana*, *Dendrogale*, and *Ptilocercus*, are usually without defects of ossification in the palate. The external pterygoid fossæ are large, short, and wide, formed by the well marked, pointed, and slightly directed inward pterygoid bones, and the pterygoid plate, rather short and triangular, of the alisphenoid. The choanæ are rather wide, and narrower between the pterygoids than anteriorly. The bullæ are of moderate size and formed of the endotympanic. The outer edge of the bulla is produced outward so as to cover up or enclose the tympanic ring or ectotympanic. The small foramen ovale is almost covered over by the antero-external edge of the bulla. The glenoid fossa is rather wide and shallow and limited in front and behind by short and inconspicuous anterior and posterior glenoid processes. Only the minutest trace of a paroccipital process is present. The alisphenoid is pierced by an alisphenoid canal. The foramen magnum is directed downward and backward.

The external opening of the infraorbital canal is situated above the second premolar. In *Ptilocercus* the canal is much shorter and its external opening is over the last premolar. The internal opening of the canal lies shortly inside the orbit. The lachrymal canal has its opening in a distinct notch except in *Ptilocercus* and is rather more outside of the orbit than inside of it. Except in *Ptilocercus* there is a conspicuous supraorbital foramen at the upper outer angle of the orbit, continuous with a groove under the edge of the roof of the orbit. Except in *Ptilocercus* the optic foramen is separated from the sphenoid fissure by a narrow spicule of bone, and the foramen rotundum lies at the base of the external pterygoid plate. In *Ptilocercus* the optic foramen is separated from the sphenoid fissure by a broad bridge of bone and the foramen rotundum is blended with the sphenoid fissure. The foramen ovale is situated almost under the antero-outer edge of the bulla except in *Ptilocercus* where the opening of the foramen is plainly visible in front of the bulla. In *Tupaia* and *Tana* the malar is pierced by a large fenestra, in the other genera by a small foramen. The external auditory meatus is

situated under the posterior root of the zygomatic process of the squamosal, and is moderately large. Just within its orifice may be seen the tympanic ring.

The mandible shows no points of special interest. In comparison with the Macroscelididæ the coronoid process is well developed and stands about as high above the condyle, as the condyle does above the angular process. In the Macroscelididæ the condyle is drawn upward as high as the coronoid. *Ptilocercus* has a relatively wider and larger coronoid than the other genera of the Tupaiidæ. A well marked mental foramen is found under the first or second premolars,

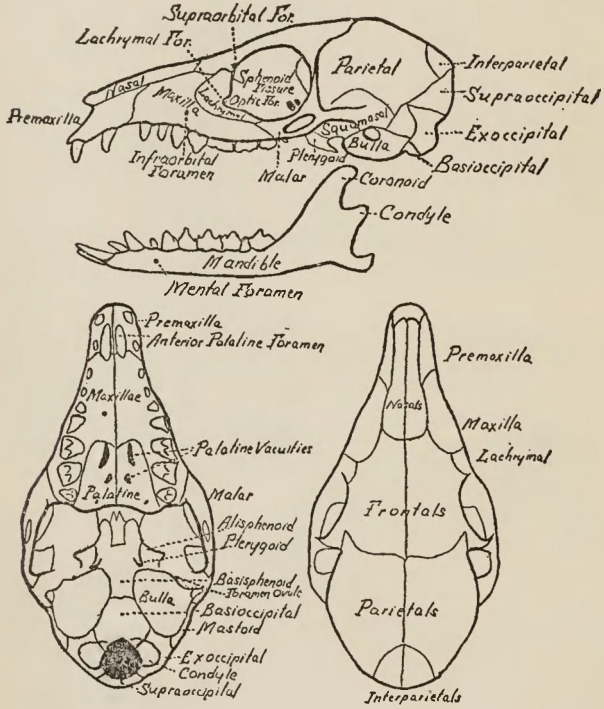


FIG. 1.—DIAGRAM SHOWING THE FORMS AND RELATIONSHIPS OF THE INDIVIDUAL BONES OF THE SKULL OF TUPAIA AS DETERMINED BY EXAMINATION OF YOUNG INDIVIDUALS.

but in *Ptilocercus* the foramen is usually not single and situated slightly more posteriorly.

The relative position and shape of the more important bones of the skull as shown by examination of immature specimens may be seen in figure 1.

Auditory ossicles.—"In the Tupaiidæ the malleus assumes to an extreme degree the neckless and nonlaminated type common in most Cebidæ and some lemurs, as well as in *Sciurus;* but the manubrium is rather of the form prevailing in the above-named primates than

that seen in the squirrels; and so in every respect is the incus. All the ossicula differ from the varied forms in other families of the insectivora, except that the incus somewhat approaches in type that of *Galeopithecus*. Taken as a whole, the ear bones of *Tupaia* are higher in type than in any other family belonging to this order."[1]

Vertebral column—Five skeletons in the United States National Museum have the vertebral formulæ:

Cat. No. 124317, *Tupaia glis ferruginea*, C., 7; D., 13; L., 6; S., 3; C., 24.
Cat. No. 49468, *Tupaia lacernata wilkinsoni*, C., 7; D., 13; L., 6; S., 3; C., 27.
Cat. No. 174609, *Tupaia demissa*, C., 7; D., 13; L., 6; S., 3; C., —.
Cat. No. 111782, *Tupaia nicobarica*, C., 7; D., 13; L., 6; S., 3; C., 28.
Cat. No. 174611, *Tana tana*, C., 7; D., 13; L., 6; S., 3; C., 22.

Certain authors give the lumbar series as 5, 6, or 7.[2] Blainville[3] in the text of Osteography of Mammals says that the number of lumbar vertebræ is seven, but on studying the first plate I can count only six lumbars. By the same author[3] the sacral vertebræ are said to be two, and the caudal 22–23, figures which are confirmed by the plate.

The vertebral formula of *Ptilocercus* is given by Jentink[4] as D. 14, L. 5, S. 3, Cd. 31.

The individual vertebræ are well developed, and with well-defined processes, that is relatively better developed and with better developed processes than in the case of the Macroscelididæ. The first six cervical vertebræ are pierced by vertebral foramina; the atlas is large and relatively heavy, and so is the axis which bears a conspicuous posteriorly directed dorsal spine. On all the other cervical vertebræ dorsal spines are absent or represented by minute projections. As is usual, the under and lateral surface of the sixth cervical is well developed with a prominent costal or pleurapophysial plate. The dorsal vertebræ show no noteworthy peculiarities. The dorsal process on them is rather low and directed backward till the ninth is reached, which has the dorsal process directed upward; the dorsal processes on the three remaining dorsal vertebræ are low and directed forward. The lumbar vertebræ taken as a whole have well-developed anteriorly directed dorsal processes, and still better developed, wide anteriorly directed transverse processes, the processes being smaller on the anterior vertebræ of the series. In Macroscelididæ, represented by a skeleton *Elephantulus roseti*, the transverse lumbar processes are shorter and wider. The sacrum in *Tupaia* and *Tana* is composed of three firmly fused vertebræ, that is, no large foramina exist between the transverse processes of the first and second, and second and third sacrals, as is the case in Macroscelididæ. The first

[1] Doran, Trans. Linn. Soc. London, ser. 2, 1879, vol. 1, p. 444.
[2] See Gregory, Bull. Amer. Mus. Nat. Hist., vol. 27, 1910, p. 275.
[3] Ostéographie des Mammifères, vol. 1, p. 33, pl. 3, lower figure.
[4] Notes, Leyden Museum, vol. 7, 1885, p. 38.

and second sacrals in *Tupaia* are practically devoid of dorsal spines, but the third has a conspicuous one. All three have distinct spines in Macroscelididæ, and that of the first is very large and conspicuous. The sacrum is attached to the ilia by means of the transverse processes of the first sacral vertebra in *Tupaia*, by those of the first and second in Macroscelididæ. The first five caudal vertebræ in *Tupaia* have a neural canal and well-developed transverse processes; in Macroscelididæ it is only the first three.

Ribs and sternum.—There are 13 pairs of ribs in *Tupaia*, of which the first 8 are attached along their ventral border directly to the sternum, the seventh and eighth reaching the sternum together, where the xiphoid segment of the sternum is attached to the fifth mesosternal segment. The ventral ends of the last two pairs of ribs are entirely free, while the ventral ends of the ninth, tenth, and eleventh ribs are attached to the costal cartilages of one another and to that of the eighth rib.

The sternum consists of a large well developed manubrium, the anterior extremity of which is largely expanded, as is usual in mammals with a well developed clavicle, and relatively better developed than it is in Macroscelididæ. The manubrium is followed by five narrow mesosternal segments, and these in turn by the narrow xiphisternum ending in a rather distinct flat rounded piece of cartilage. In Macroscelididæ there are only four distinct and very wide mesosternal segments, and the posterior extremity of the xiphisternum is forked.

Shoulder girdle.—The clavicle is well developed in *Tupaia*, articulating at one extremity with manubrium of the sternum and at the other with the acromion process of the scapula. It appears to be relatively as well developed in Macroscelididæ.

The scapula presents no special peculiarities; its shape may be seen from an examination of plate 2. It possesses a flat wide acromion process and a short blunt metacromion. The coracoid process is well developed. The spine of the scapula is relatively much longer in Tupaiidæ than in Macroscelididæ, and conversely the acromial process relatively shorter.

Pelvis.—All three bones of the pelvis are well developed in Tupaiidæ, the ilia are large and flaring and relatively wide, the tuberosity of the ischium well developed, and the symphysis pubis very long, and the obturator foramen large and oval. In Macroscelididæ the ilia are much narrower, the symphysis relatively shorter, and the obturator foramen more oblique and elongated.

Fore limb.—The humerus is long and well developed and shows no special peculiarities. The deltoid ridge is prominent and begins slightly above the middle of the shaft. A distinct supracondylar foramen is above the internal condyle relatively smaller in Tupaiidæ

than it is in the Macroscelididæ. The radius and ulna are well developed and present as distinct bones, and they and the humerus are subequal in length.

In Macroscelididæ the ulna is intimately fused with the radius and appears but little more than a process at the upper end of the radius. The radius-ulna is much longer than the humerus.

The carpus is composed of a scapho-lunar, cuneiform and pisiform (well developed) proximally, the usual trapezium, trapezoid, magnum, and unciform distally and a distinct os centrale between the two rows.

Hind limb.—The femur is only slightly shorter than the tibia, in Macroscelididæ much shorter. The bone has a well marked head and neck and prominent greater, lesser, and third trochanters.

The tibia is well developed, with a conspicuous ridge in front. The fibula is slender, and perfectly distinct from the tibia, except at the two extremities, where the two bones are in contact, the lower end of the fibula having a distinct surface for articulation with the astragulus. In Macroscelididæ the fibula becomes fused with the tibia slightly above the middle of the bone, and the anterior spine of the tibia is much more pronounced than in Tupaiidæ.

The calcaneum is laterally compressed and narrow and relatively short posteriorly, broad and rather flattened anteriorly. Its posterior portion is relatively much shorter than in the Macroscelididæ. The trochlear surface of the astragulus is relatively wider and much shallower in Tupaiidæ than in Macroscelididæ. The remaining bones of the tarsus, cuboid, navicular, and the three cuneiform bones do not show any special peculiarities in Tupaiidæ. In Macroscelididæ they are all much elongated.

The metatarsals are without special peculiarities. The second, third, fourth, and fifth are all essentially subequal, but among themselves in order of length they stand third, fourth, second, fifth. The first metatarsal is distinctly shorter than the others, but is by no means a short bone like the first metatarsal of Macroscelididæ, in which family the entire first digit is shorter than the second, third, fourth, and fifth metatarsals, which are laterally compressed and much elongated. In Tupaiidæ at the base of the fifth metatarsal is a large unciform process lacking in Macroscelididæ.

There does not seem to be any essential differences between the skeletons of *Tupaia*, *Tana*, and *Urogale*. *Urogale* has relatively heavier and thicker bones than has *Tana*, especially seen in those of legs and feet, and has a higher and much better developed spine on the axis than has either *Tana* or *Tupaia*.

It is not probable that the skeletons of *Dendrogale* and *Anathana* differ essentially from those of *Tupaia* or *Tana*. An examination of a skeleton of *Ptilocercus*, however, would probably reveal differences from the other genera, in correlation with the pronounced cranial and

dental characters. Jentink [1] gives the vertebral formula D. 14, L. 5, S. 3, Cd. 31. He further says: "The ribs are peculiarly broad. The clavicle is well developed; the bones of the forearms and of the hind legs are separate."

TEETH.

The dental formula of the Tupaiidæ is *I.* $\frac{2}{3}$, *C.* $\frac{1}{1}$, *Pm* $\frac{3}{3}$, *M.* $\frac{3}{3}$. The teeth are typically insectivorous and nearly represent the full possible Eutherian dentition; one upper incisor is lacking, and one upper and one lower premolar. As to which of the theoretical teeth are lacking does not seem to me to be a matter of great importance. My own view of the formula is *I.* $\frac{12-}{123}$, *C.* $\frac{1}{1}$ *P.* $\frac{-234}{-234}$, *M.* $\frac{123}{123}$. The reason for considering that the third upper incisor is wanting and not the first is that the third lower incisor is a vanishing tooth and has almost disappeared in *Urogale*. This opinion is the same as that of Gregory.[2] He thinks that in *Ptilocercus* i^3 is lacking and is represented by a minute alveolus. The only reason for assuming *P* $\frac{1}{1}$ are wanting is that at present the most anterior premolar is the smallest of the series, and it seems not unreasonable to assume that at one time it may have had standing in front of it a still smaller tooth; furthermore, all of the premolars are preceded by milk teeth which is usually not the case with the first premolars.

The canines in the family are interesting in that they do not have the form and functions of true canines, but are almost indistinguishable from the premolars. It might with some degree of propriety be said that the ideal number of premolars is present in the family and that the canines are lacking, especially since the canine in *Ptilocercus* and occasionally in the other genera is two-rooted, not a character of canine teeth, and since the canine is situated considerably posterior to the premaxillo-maxillary suture, rather than in or almost in that suture, as in most other mammals. The only exception to this is in *Urogale* where the lower canine has the form and function of a true canine, and although the second upper incisor functions as a canine, yet the canine itself is more caniniform and less premoliariform than is the case in the other genera. The canines are always preceded by milk canines.

For the shape and arrangement of cusps, etc., of the teeth figures on pages 33, 121, 128, 135, 155, and 161 should be consulted. Differences that are useful for purposes of classification will be discussed under each genus.

Eruption of teeth in Tupaiinæ.—The manner and order of eruption of teeth in the subfamily Tupaiinæ shows nothing not commonly seen

[1] Notes Leyden Museum, vol. 7, 1885, p. 38.
[2] Bull. Amer. Mus. Nat. Hist., vol. 27, 1910, p. 271.

in other mammalian groups. The youngest skulls that I have examined have always shown the complete milk dentition, but sometimes the last milk premolar has not been entirely in place. The adult dentition is:

$$\frac{I^1\ I^2 — C^1 — P^2\ P^3\ P^4\ M^1\ M^2\ M^3}{I_1\ I_2\ I_3\ C_1 — P_2\ P_3\ P_4\ M_1\ M_2\ M_3}$$

The youngest dentition seen is:

$$\frac{DI^1\ DI^2\ —\ DC^1\ DP^2\ DP^3}{DI_1\ DI_2\ DI_3\ DC_1\ DP_2\ DP_3}$$

The next teeth to appear are $\frac{DP^4}{DP_4}$, followed by M_1, then M^1, then M_2, M^2, M_3, M^3. All the permanent molars are in place before the milk teeth are shed. The first of those permanent teeth having predecessors to appear in the majority of cases is $\frac{P^4}{P_4}$, the upper and lower seeming to come in about the same time. $\frac{P^2}{P_2}$ appear at nearly the same time as $\frac{P^4}{P_4}$, sometimes just before. $\frac{P^3}{P_3}$ are the last of the permanent premolars to come in, appearing just after $\frac{P^2\ P^4}{P_2\ P_4}$. The canines appear at or about the same time as $\frac{P^4}{P_4}$ or just a little later, arriving with $\frac{P^3}{P_3}$. Of the incisors the lower appear slightly before the upper. I_1 appears about the same time as P_4 and before I^1, and just after I_3. I_2 comes in just after I_1 and I_3. I^2 comes in after all the permanent upper premolars and canines are in place, and is followed by I^1, which is thus the last of the permanent teeth to be in place. By the time the last permanent tooth is in place the molars almost always show slight traces of wear.

The teeth of Tupaiidæ in whole or part have been described and figured by Horsfield,[1] Cuvier,[2] Huschke,[3] Owen,[4] Giebel,[5] and Gregory.[6]

VISCERAL ANATOMY.

The visceral anatomy of Tupaiidæ has been examined by A. H. Garrod in 1875,[7] based primarily on an examination of *Tupaia belangeri* which had just died after living in the gardens of the London Zoological Society nearly two years, supplemented by an examination of *Tupaia splendidula* and *Tana tana* from specimens preserved

[1] Zool. Res. Java, unnumbered plate (*Tupaia, Tana*), 1824.
[2] Dents des Mammifères, 1825, p. 60 (*Tupaia, Tana*).
[3] Isis, vol. 20, 1827, pp. 758-759, pl. 10.
[4] Odontography, vol. 1, p. 419; vol. 2, pl. 111, fig. 3, 1840-1845 (*Tana*).
[5] Odontographie, 1855, p. 18, pl. 5, figs. 6, 15-18, copied from Horsfield and Owen.
[6] Bull. Amer. Mus. Nat. Hist., vol. 27, 1910, pp. 271, 272, figs. 21, 22 (*Tupaia, Ptilocercus*).
[7] Proc. Zool. Soc. London, 1879, pp. 301-305, figs. 1-3, brain.

in alcohol. Nothing unusual or of striking importance was found except that the two specimens of *Tupaia* each possessed a distinct cecum, while the specimen of *Tana* did not.

Cecum.—The presence or absence of a cecum in certain insectivores has been made use of in the superfamily classification of *Tupaia*. Thus Peters [1] grouped the insectivores into those with and without a cecum, in the former group being *Galeopterus*, *Tupaia*, and *Macroscelides*. Gill [2] removed *Galeopterus* as a distinct suborder, and grouped the Tupaiidæ and Macroscelididæ, as the Tupaioidea mainly on the presence of a "large" cecum. Haeckel is said to have proposed the terms Menotyphla for the Tupaiidæ and Macroscelididæ and Lipotyphla for all the other insectivora, terms which have been retained by Weber.[3] Garrod's [4] dissected specimens of *Tupaia belangeri* and *T. splendidula* both showed cecums one-half to three-fourths of an inch in length; *Tana tana* showed no cecum. Chapman [5] states that a cecum is wanting in a specimen of "*Tupaia ferruginea*" from Borneo, as well as in an example of *T. picta*.

All the specimens of *Tupaia* that I have examined possess a small but distinct cecum. Unfortunately, I have not examined the intestinal tract of *Tana tana* and am so unable to confirm Garrod's observations. The specimens in the United States National Museum that I have examined, with length of cecum, are:

	mm.
112660, *Tupaia glis ferruginea*	13
105013, *Tupaia glis ferruginea*	13
124083, *Tupaia belangeri*	12
123989, *Tupaia lacernata lacernata*	10
124698, *Tupaia discolor*	11
121893, *Tupaia chrysogaster*	8.5
111783, *Tupaia nicobarica*	8
144306, *Tupaia siaca*	8

It is not to my mind a "large cecum," and can scarcely have any definite function, being almost as relatively small as the human vermiform appendix.

The Indian genus *Anathana* is said by Anderson [6] to possess a "long and narrow" cecum 1.17 inches in length, that is about 30 mm.

It would not appear that the presence or absence of a cecum is a good character for determining larger groups. The majority of our specimens are so preserved as not to show the soft parts, and the organ being vestigial appears to be absent at times, though as a rule it is present in the majority of the species of *Tupaia*.

[1] Abh. kön. Akad. Wiss. Berlin, 1863, p. 20.
[2] Synopsis of insectivorous mammals, Bull. Geol. Geogr. Surv. Terr., No. 2, ser. 2, May 14, 1875.
[3] Die Säugetiere, 1904, p. 377.
[4] Proc. Zool. Soc. London, 1879, pp. 301-305.
[5] Proc. Acad. Nat. Sci. Phila., vol. 56, 1904, p. 148.
[6] Zool. Res. West. Yunnan, 1879, p. 126.

GEOGRAPHIC DISTRIBUTION.

The Tupaiidæ as a whole range from India on the west to and including Mindanao of the Philippine Islands on the east, and from southern China on the north southward to and including Java and the chain of islands off the southwest coast of Sumatra. They are not found eastward of Java, nor on the Celebes, Formosa, Ceylon, or the Andaman Islands so far as known. I know of no specimens or records of the Tupaiidæ on the island of Bali, off the east end of Java and just west of Wallace's Line. It would not be surprising to find them on Bali when the fauna of that island becomes better known. They are found on practically all the smaller islands of the Malayan Archipelago, within the limits just mentioned, and more frequently than not develop geographic races or species on them.

Zoogeographically the distribution of the Tupaiidæ coincides almost perfectly with what is termed the Oriental Region or Realm of Wallace and most zoogeographers, and serves perhaps better than any other family of mammals to define that region. The only areas in this region where they do not occur so far as known are the islands of Ceylon, Formosa, the members of the Philippine Islands, north of Mindanao, and the Andaman Islands.[1] By Wallace, Ceylon is included in a separate subregion of the Oriental Region.

No one genus of the family has a range coextensive with the range of the family.

The genus *Anathana* occupies an area almost coextensive with Wallace's Indian subregion, but so far as our records of specimens show, does not extend quite so far to the north, or with the Sclaters' Indian subregion excepting Ceylon.

The well-marked genus *Urogale* is confined to Mindanao of the Philippine Islands. This group of islands has not been made a subdivision of the Oriental Region, but the Philippine mammals for the most part are so different from their relatives of the rest of the Oriental Region that it would seem advisable to have them constitute a distinct subregion of the Oriental. *Urogale* is thus one of its characteristic genera.

The genus *Tupaia* has the widest geographic distribution of any of the genera in the family, and if we recognize the Philippine Islands as a distinct subregion, it is characteristic of Wallace's Indo-Chinese and Indo-Malayan subregion, or of the Sclaters' Burmo-Chinese and Malayan subregions. The northern of these two subregions is characterized by but a single species group, the *belangeri-chinensis;* while the southern, the Indo-Malayan or the Malayan subregion is characterized by several well-marked species groups. Of the islands in this subregion Borneo is inhabited by the greatest number of

[1] The absence on the Andamans of treeshrews is rather interesting, as they occur on Preparis Island to the north, and on the Nicobars, or at least the southern islands of the Nicobars to the south.

distinct types, among them Tupaias of the *discolor*, *picta*, *montana*, *gracilis* style. Three of these occur on islands to the westward of Borneo; on Banka, *discolor* and *gracilis* types, on Billiton, *gracilis* type, on Karimata, *gracilis* and *montana* types, thus showing the affinities of these islands with Borneo, and not with Sumatra. Of the two species found on Java, a related form of one of them occurs on some of the small islands of the chain off the southern coast of Sumatra, and of the other apparently the same form occurs on one island of the same chain, and in the mountainous region of the southern coast of Sumatra. The intimate relationship of the Malay Peninsula with the island of Sumatra is shown by the occurrence on both of *Tupaia glis ferruginea* and *T. minor malaccana*. Only one well marked group, *minor*, occurs on both Borneo, Sumatra, and the Malay Peninsula. It is not found on Java. On Palawan the Calamianes, and Cuyos Islands, all politically part of the Philippines, but geographically part of Borneo, is found a rather distinct species group without decided affinities to Bornean forms. On the Nicobars occurs one of the most distinct species in the genus, without any apparent relationship to other members of the genus. So far as known no Tupaias are found on the Andaman Islands.

Dendrogale, with two distinct species groups is found on Borneo, with one of the groups occurring also in French Indo-China. This distribution is so peculiar and not paralleled so far as I know by other forms of mammals, that it seems almost certain that the genus will be found elsewhere in the Indo-Chinese and Indo-Malay subregions. Of the form occurring on Borneo and the Asiatic mainland not a dozen examples are in existence in collections, showing that it is a particularly rare animal. See page 131.

The genus *Tana* parallels that of the Orangs in its distribution, being confined to Borneo and Sumatra, and some of the adjacent islands. It contains two well-marked species groups, the smaller of which is known only from Borneo.

To my mind *Urogale* and *Tana* are derived from the same stock form; but *Urogale* on Mindanao being more restricted in area and more remote from the source of origin, probably Borneo, has become the more highly differentiated of the two. *Urogale* must have reached Mindanao from Borneo by way of the Sulu Archipelago. At present there are no records of treeshrews from the islands of the Sulu Archipelago, but in view of the occurrence of *Urogale* on Mindanao it seems likely that treeshrews occur on them and they ought to be of a genus or genera the same as or similar to *Urogale* and *Tana*.

The genus *Ptilocercus* with a single species group is found in Borneo, Sumatra, and southern Malay Peninsula and some of the adjacent islands, and parallels the distribution of *Tupaia minor*.

The following natural divisions or areas of the Oriental, based upon the genera and species found in the family Tupaiidæ, may be recognized. They are not of coordinate importance, nor are all of them mutually exclusive. Those divided up by water seem to be sufficiently distinct, however, to indicate that at some not very remote period connections of some sort may have existed between them.

Indian (excluding Ceylon), genus *Anathana*, and absence of other genera.

Philippine (Mindanao only), genus *Urogale*, and absence of other genera.

Indo-Chinese, the *belangeri-chinensis* group of the genus *Tupaia*, absence of other genera and species. (The distribution of *Dendrogale* is so irregular that I have disregarded it.)

Nicobaran, the well-marked species *Tupaia nicobarica*, absence of other genera and species.

Palawan-Calamine, a fairly well-marked species group of the genus *Tupaia*, absence of other species and genera.

Bornean, a well-marked species group in each of the genera *Dendrogale* and *Tana*, and by four well-marked species groups of the genus *Tupaia*.

Belonging to this subdivision but without all the characteristics are Banka, Billiton, and the Natuna and Karimata Islands.

Sumatran-Peninsular, *glis* group of *Tupaia* and *T. minor malaccana*.

Java-Borussan (apparently including high mountain region of southern Sumatra), two species groups of *Tupaia*, absence of other genera and species.

Sumatra-Bornean, genus *Tana*.

Sumatra-Borneo-Peninsular, genus *Ptilocerus* and the *minor* group of *Tupaia*.

So few Tupaiàs are known from the Rhio-Linga Archipelago that little can be said regarding its affinities. It has both Peninsular and Bornean elements. The rather isolated Tambelan Islands have a single species of genus *Tana*, evidently of Bornean origin, and the isolated Anamba Islands, inhabited only by members of the *splendidula* group of *Tupaia*, also appear to be Bornean in their relations.

GEOGRAPHIC INDEX.

The names of the countries and islands are arranged geographically and not alphabetically.

India, south of the Ganges: *Anathana cllioti*, p. 122; *Anathana wroughtoni*, p. 123; *Anathana pallida*, p. 124.

India, north of the Ganges: *Tupaia chinensis*, p. 63.

Burma: *Tupaia chinensis*, p. 63; *Tupaia belangeri*, p. 59.

Tenasserim: *Tupaia belangeri*, p. 59.

China: *Tupaia chinensis*, p. 63.

Hainan: *Tupaia modesta*, p. 69.

Siam (upper): *Tupaia chinensis*, p. 63.

Siam (lower): *Tupaia belangeri*, p. 59; *Tupaia lacernata wilkinsoni*, p. 52.

Anam and Cochin China: *Tupaia concolor*, p. 68; *Dendrogale frenata*, p. 128.

Pulo Condore: *Tupaia dissimilis*, p. 67.

Malay Peninsula: *Tupaia belangeri*, p. 59; *Tupaia lacernata wilkinsoni*, p. 52; *Tupaia glis ferruginea*, p. 41; *Tupaia minor malaccana*, p. 114; *Ptilocercus lowii continentis*, p. 165.

Islands adjacent to Malay Peninsula:
Mergui Archipelago: *Tupaia belangeri*, p. 59.
Lankawi: *Tupaia lacernata lacernata*, p. 53.
Terutau: *Tupaia lacernata lacernata*, p. 53.
Butang Islands: *Tupaia lacernata raviana*, p. 54.
Penang Island: *Tupaia glis glis*, p. 45.
Perhentian Island: *Tupaia lacernata obscura*, p. 55.
Redang Island: *Tupaia lacernata longicauda*, p. 56.
Tioman Island: *Tupaia glis sordida*, p. 48.
Pemangil Island: *Tupaia glis pemangilis*, p. 48.
Aor Island: *Tupaia glis pulonis*, p. 47.
Singapore Island: *Tupaia glis ferruginea*, p. 41
Batam Island: *Tupaia glis batamana*, p. 46.
Bintang Island: *Tupaia castanea*, p. 90.

Sumatra: *Tupaia glis ferruginea*, p. 41; *Tupaia demissa*, p. 58; *Tupaia siaca*, p. 91; *Tupaia minor malaccana*, p. 114; *Tupaia javanica*, p. 106; *Tana tana tana*, p. 139. *Ptilocercus lowii continentis*, p. 165.

Rhio-Linga Archipelago (between Sumatra and Malay Peninsula):
Batam Island: *Tupaia glis batamana*, p. 46.
Bintang Island: *Tupaia castanea*, p. 90.
Linga Island: *Tupaia minor malaccana*, p. 114; *Tana lingæ*, p. 145.
Sinkep Island: *Tupaia phæura*, p. 49; *Tupaia minor sincipis*, p. 115.

Borussan Islands, along southern coast of Sumatra:
Banjak Islands: *Tupaia tephrura*, p. 50; *Tana tana tuancus*, p. 145.
Nias Island: *Tupaia javanica*, p. 106.
Batu Islands:
Pinie: *Ptilocercus lowii continentis*, p. 165.
Tana Bala: *Tana cervicalis cervicalis*, p. 147.
Tana Massa: *Tana cervicalis masae*, p. 148.
Sipora: *Tupaia chrysogaster*, p. 71.
Pagi Islands: *Tupaia chrysogaster*, p. 71.

Java: *Tupaia javanica*, p. 106; *Tupaia hypochrysa*, p. 70.
Borneo: *Tupaia longipes longipes*, p. 76; *Tupaia longipes salatana*, p. 77; *Tupaia montana montana*, p. 94; *Tupaia montana baluensis*, p. 95; *Tupaia picta*, p. 96; *Tupaia gracilis gracilis*, p. 117; *Tupaia minor minor*, p. 110; *Tupaia splendidula*, p. 83; *Dendrogale murina*, p. 129; *Dendrogale melanura melanura*, p. 132; *Dendrogale melanura baluensis*, p. 132; *Tana tana tana*, p. 139; *Tana tana utara*, p. 141; *Tana tana besara*, p. 141; *Tana chrysura*, p. 149; *Tana paitana*, p. 150; *Tana dorsalis*, p. 152; *Ptilocercus lowii lowii*, p. 164.

Islands faunistically related to Borneo:
Laut off southeast corner: *Tupaia minor minor*, p. 110.
Karimata Island, off west coast: *Tupaia carimatæ*, p. 98; *Tupaia gracilis edorata*, p. 118.
Banguey: *Tupaia minor minor*, p. 110; *Tana paitana*, p. 150.
Palawan: *Tupaia palawanensis*, p. 78.
Balabac: *Tupaia palawanensis*, p. 78.
Culion: *Tupaia möllendorffi*, p. 81.
Cuyo: *Tupaia cuyonis*, p. 82.
Natuna Islands:
Sirhassen: *Tana tana sirhassensis*, p. 142; *Ptilocercus lowii lowii*, p. 164.
Bunguran: *Tupaia natunæ*, p. 85.
Laut: *Tupaia splendidula*, p. 83.
Banka: *Tupaia discolor*, p. 73; *Tupaia gracilis inflata*, p. 118.
Billiton: *Tupaia gracilis inflata*, p. 118.

Islands not clearly related to large land masses:

Tambelan Islands: *Tana tana bunoæ*, p. 144.

Anamba Islands:

Siantan Island: *Tupaia chrysomalla*, p. 88.
Jimaja Island: *Tupaia anambæ*, p. 89.
Riabu Island: *Tupaia riabus*, p. 88.

Philippine Islands:

Palawan: *Tupaia palawanensis*, p. 78.
Balabac: *Tupaia palawanensis*, p. 78.
Culion: *Tupaia möllendorffi*, p. 81.
Cuyo: *Tupaia cuyonis*, p. 82.
Mindanao: *Urogale everetti*, p. 157.

MAPS.

On the maps showing the distribution of the various members of the family Tupaiidæ I have endeavored, as far as possible, to indicate the localities mentioned in the text or the tables of measurements and lists of specimens. In a few cases, however, I have been unable to find some of the localities. Most of the maps are somewhat diagrammatic, but that on page 143 is carefully made and shows virtually most of the localities whence specimens of treeshrews have been obtained. In cases where a form is known, but from a single locality the figures indicating the distribution have been limited to the area around that point, where known, from two or three rather separated localities, the distribution figures have been extended to cover the intervening area, the assumption being that the animal will be found there; when known from several scattered areas, or a large land mass, or part of one, the distribution figures have been liberally applied around the whole area. Future explorations will undoubtedly show much wider ranges for many of the forms shown on the maps. On the whole, I have been rather conservative in indicating the distributions, leaving it to the reader to imagine a more extended range. Thus, we know that *Ptilocercus* is found in the Deli-Langkat region, Sumatra, and it has been indicated at that locality only, on the map. There can be but little doubt, however, that it is found elsewhere in Sumatra, but owing to lack of records I have not so indicated it.

FOOD.

Judging by the typically insectivorous nature of the cheek-teeth in Tupaiidæ, the diet of these animals must be largely insects. Many observers say they naturally eat fruit as well. *Ptilocercus* having teeth slightly less insectivorous than the Tupaiinæ, may perhaps have a more varied diet. However, it is a very rare animal and direct observations on living specimens still rarer. The only ones I

recall are those of Schneider,[1] who had a pair alive for some hours. The only food he offered them was bananas, which they did not eat. Of *Tupaia* Cantor [2] says: "The natural food is mixed insectivorous and frugivorous. In confinement, individuals may be fed exclusively on either, though preference is evinced for insects; and eggs, fish, and earthworms are equally relished."

Of the Indian Tupaias Anderson [3] says: "One stomach was full of the imperfectly digested remains of a small yellow ladybird with a sprinkling of the elytra of small beetles. There were also small masses of a jelly-like substance with very fine fibers."

Hardwicke [4] in an introduction to Diard and Duvaucel's account of *Tupaia glis*, says: "A living one was brought to Bengal by a medical gentleman some months ago; it runs about the house tame, but will not allow itself to be caught for close inspection; though at liberty to run out of doors whenever it likes, it shews no disposition to leave its quarters, and evinces some attachment to the family; for whenever strangers enter the house, it shews disquietude by a chattering like noise. It occasions no trouble in feeding, for it is always on the search after insects, and its favorite food seems to be flies, crickets, grasshoppers, and cockroaches."

Jerdon [5] writes of *Tupaia chinensis* at Darjeeling: "It frequents the zone from 3,000 to 6,000 feet, and was said, by the natives, to kill small birds, mice, &c."

Robinson and Kloss,[6] speaking of *Tupaia glis ferruginea*, say: "The diet is very mixed, consisting of ants and other insects, fruits, seeds, and buds."

HABITS.

Cantor [2] writes on the habits of *Tupaia:* "The young of this very numerous species (*T. ferruginea*) in hilly jungle, is easily tamed, and becomes familiar with its feeder, though toward strangers it retains its original mistrust, which in mature age is scarcely reclaimable. In a state of nature it lives singly or in pairs, fiercely attacking intruders of its own species. When several are confined together, they fight each other, or jointly attack and destroy the weakest. A short peculiar tremulous whistling sound, often heard by calls and answers, in the Malayan jungle, marks their pleasurable emotions, as, for instance, on the appearance of food, while the contrary is expressed by shrill protracted cries. Their disposition is very restless, and their great agility enables them to perform the most extraordinary bounds in all directions, in which exercise they spend the

[1] Zool. Jahrb., vol. 23, 1905, p. 84, pl. 1.
[2] Journ. Asiat. Soc. Bengal, vol. 15, 1846, p. 189.
[3] Zool. Res. West. Yunnan, 1879, p, 126.
[4] Asiat. Soc. Bengal, vol. 14, 1822, p. 471.
[5] Mammals of India, 1867, p. 65.
[6] In Thomas and Wroughton, Journ. Fed. Malay States Mus., vol. 4, No. 1, December, 1909, p. 112.

day, till night sends them to sleep in their rudely constructed lairs in the highest branches of trees. At times they will sit on their haunches, holding their food between the forelegs, and after feeding, they smooth the head and face with both forepaws, and lick the lips and palms. They are also fond of water, both to drink and to bathe in."

Raffles says of *Tupaia ferruginea*:[1] "These animals are as tame and sprightly as squirrels. The tame one above mentioned was suffered to go about at perfect liberty, ranged in freedom over the whole house, and never failed to present himself on the breakfast and dinner table, where he partook of fruit and milk." It is also described being diurnal and arboreal. *Tana* is mentioned as being "always found on or near the ground."

Mr. C. Boden Kloss[2] thinks Tupaias are less arboreal than generally accredited. He says: "Of the numerous species of *Tupaia* which I have collected personally *T. longicauda* with *T. nicobarica*, Zelebor, and its subspecies, *T.* (*N.*) *surda* Miller, alone are truly arboreal in habit. As a rule the so-called 'treeshrews' are seen and trapped on the ground, where they live and feed, or, at most, climb occasionally into low bushes; in them the tail is shorter than the head and body length. The above-named animals, which are met with in high trees and have the habits of squirrels, all possess a tail that is considerably longer than the length of head and body."

The collector of *Tupaia chinensis*, reg. Nos. 97.11.2.10, 97.11.2.11, 97.11.2.12, and 97.11.2.13, British Museum, says: "The four were taken from one nest in a hollow bamboo," one of the few observations on their nests that I know of.

Of *Tupaia glis ferruginea*, Robinson and Kloss[3] remark: "The popular name of 'treeshrew' for these animals is hardly descriptive of their habits, as, in the majority of species, at any rate, it is quite exceptional to see one anywhere than on the ground, among the roots of trees or on low bushes. The jungle near Changi, Singapore, was an exceedingly good trapping ground, and out of 70 or 80 traps set every night hardly one was found unsprung or without an occupant next morning. Six or seven of these shrews were usually thus captured and many more were shot every day. The nest is found in holes, often in fallen timber."

Regarding the food and habits of *Tupaia glis ferruginea*, as observed on the Malay Peninsula and Singapore, Mr. H. N. Ridley[4] writes: "The common species is very destructive in gardens, as it is almost if not entirely frugivorous. It bites holes in the chocolate pods to

[1] Trans. Linn. Soc. London, vol. 13, 1822, p. 257, May, 1821.
[2] Journ. Fed. Malay States Mus., vol. 4, p. 191, October, 1911.
[3] In Thomas and Wroughton, Journ. Fed. Malay States Mus., vol. 4, No. 1, p. 111, December, 1909.
[4] Natural Science, vol. 6, 1895, p. 28.

eat the pith which incloses the seeds, strewing the latter all over the ground, and even digs up the seeds planted in flower boxes. * * * *Tupaia ferruginea* is more terrestrial in its habits than a squirrel. When alarmed it darts up a tree, but never very high, and turning its head downward utters a series of little scolding grunts, which sound like some one talking at a considerable distance. When a stone is thrown near it, it usually immediately jumps to the ground. It is evidently as yet only half accustomed to an arboreal life. In confinement it is very nervous, dashing about the cage when approached, and it never lives long in captivity." [1]

BREEDING.

Tupaias are evidently able to bear young at practically all times of the year. An examination of the collector's remarks on the labels of specimens shows that 3 individuals were pregnant in January, 1 in February, 1 in March, 3 in June, 1 in July, 2 in September, and 1 in October. Specimens showing distinct signs of nursing or about which the collector remarks "milk in mammæ" are distributed through the year as follows: February, 2; March, 1; April, 1; May, 1; June, 1; August, 1; September, 2; November, 1. December is the only month without a record of pregnancy or breeding. While the number of records is too small to justify any generalizations it would appear that the beginning and the middle of the calendar year are the periods of greatest productivity. (See table, p. 23.)

NUMBER OF YOUNG.

The number of offspring produced at one time by Tupaias probably varies with the species and directly with the number of mammæ common to that species. Two is apparently the usual number, but it is sometimes one (*Tupaia nicobarica surda*, Cat. No. 111785), or as many as four (*T. chinensis* B. M. 97.11.2.10–13). (See table, p. 23.)

Cantor [2] says: "The female usually produces one young; she has four mammæ, the anterior pair of which is situated on the lower lateral part of the chest, the posterior on the side of the abdomen."

Robinson and Kloss [3] note that two young are produced at a birth in *Tupaia glis ferruginea*.

MAMMÆ.

The number of mammæ in *Tupaia* varies from one pair in certain species to three pairs in others. The number is of some importance as a character for certain species or groups of species. Where the mammæ are six they have been designated by Mr. Oldfield

[1] But see specimen dissected by Garrod, living for two years, in London Zoological Society, page 13.
[2] Journ. Asiat. Soc. Bengal, vol. 15, 1846.
[3] In Thomas and Wroughton, Journ. Fed. Malay States Mus., vol. 4, No. 1, p. 112 December, 1909.

Thomas[1] as postaxillary, lateral, and preinguinal. When there are only two pairs of mammæ, the preinguinal pair seems to have disappeared, and when only one pair is present it would appear to correspond with the lateral pair. The number seems to be very constant. The only exceptions to constancy that I have observed are: *Tupaia pemangilis*, Cat. No. 112499, U.S.N.M., where the mammæ are 2–3 = 5, in a group where 2–2 = 4 is normal; *T. chinensis*, No. 26841, Amer. Mus. Nat. Hist., with 4 mammæ instead of 6. Here the postaxillary pair is wanting; both of the remaining pairs are more posteriorly placed than usual, so that the preinguinal pair is really inguinal and the lateral pair almost preinguinal. An alcoholic specimen of *Tupaia belangeri* in Genoa from Mount Mooleyit, Tenasserim, with only two pairs of mammæ, belongs to a group that normally has three pairs.

Dates of pregnant, and of nursing Tupaias.

Cat. No.	Name.	Date.	Collector's remarks or author's observations.	Number of mammæ.
104976	*T. glis ferruginea*	Oct. 9	"Uterus contained one fetus about 2 inches long."	4
113149	.....do	Sept. 4	"Uterus contained 2 small embryos"	4
115490	.....do	June 4	"Uterus contained 3 well-grown fetuses"	4
115491	.....do	July 16	"Uterus contained 3 embryos"	4
112449	*T. glis pulonis*	June 7	"Uterus contained 2 embryos, each ¾ inch long"	4
113149	*T. phæura*	Sept. 4	"Uterus contained 2 small embryos"	4
121752	*T. iephrura*	Feb. 12	Mammæ evidently nursed	4
124143	*T. belangeri*	Jan. 10	"Uterus contained 2 embryos, size of large peas."	6
104364	.....do	Mar. 10	"Mammæ 6," shows signs of nursing	6
124103	.....do	Jan. 6	"Uterus contained 2 embryos, size of small hazlenuts."	6
104363	.....do	Feb. 26	"Mammæ 6, contained milk"	6
125175	.....do	Jan. 30	"Uterus contained 2 embryos"	4
115608	*T. castaneæ*	Aug. 11	Mammæ evidently nursed	4
144205	*T. siaca*	Nov. 4	.....do	4
104714	*T. natunæ*	June 27	"Contained 2 embryos, about 2 inches long"	4
125122	*T. carimatæ*	Sept. 1	Mammæ evidently nursed	4
125121	.....do	.....do	.....do	4
111785	*T. nicobarica surda*	June 27	Uterus contains 1 fetus, 30 mm. long	2
154593	*T. javanica*	May 29	Mammæ evidently nursed	4
121488	.....do	Apr. —	.....do	4
121490	.....do	June 27	.....do	4
121835	*T. cervicalis*	Feb. 18	"Uterus contained 2 embryos"	4

PELAGE.

There is nothing peculiar in the general characteristics of the pelage of treeshrews.[2] It consists of the usual two sorts of hairs, long straight hairs with their terminal ends having colored rings, and softer, shorter, more wooly hairs, also usually having colored rings distally. The basal portions of both kinds of hairs are uniformly some sort of slate color, except in certain species with more or less ochraceous underparts, where all the hairs of the lower parts are uniformly bright colored throughout. So far as I have been able to ascertain, there is no very distinct seasonal change in pelage, and

[1] Ann. Mus. Civ. Stor. Nat. Genova, ser. 2, vol. 10, p. 920, 1890–91.

[2] For remarks on arrangement and size of hairs, see Meijere, Morph. Jahrb., vol. 21, 1894, p. 398.

the color of the pelage in the two sexes is apparently the same. Change of pelage proceeds from the head downward in a more or less definite line across the body. The dates of specimens which show a distinct changing of the pelage are: February 25, June 4, 7, 29, 30, July 1 (2 specimens), 26, September 4 (2 specimens), 18, 20, 21, 23, October 27, November 5, 12, 14, 21, 26, December 4, 19, 22. The changes accordingly take place mainly during the last half of the calendar year. There is only one specimen undergoing a pelage change during the first five months. The dates of pelage changes are thus not so uniformly distributed throughout the year as are those for the production of young. Marked seasonal changes in color do not appear to exist. There is very little difference in color between the new and the old pelages. Where two pelages exist in the same animal, the newer of them is of course brighter and fresher in color, but, strange to say, nearly always lighter. The lighter color is not due to an excess of light-colored rings on the hairs which may later be worn off, but to a real difference in color or shade between the light rings. One of the most striking examples of this difference in color is seen in the tails of the specimens of *Tupaia inflata* from Billiton. Cat. No. 124985 of that series has a tail with every appearance of an old pelage, and the light areas of the hairs are ochraceous. Cat. No. 124947 of the same series has the light areas of the hairs light buffy in the distal two-thirds, which is in old pelage, and almost whitish in the proximal third, which is distinctly new.

Number of specimens showing changing pelage and evidences of breeding.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
Pelage changes	.....	1	.....	.....	.....	5	3	.....	5	1	5	3
Breeding	3	3	1	1	1	5	1	1	4	1	1	.....

ALBINISM AND MELANISM IN TUPAIA.

These anomalies are evidently rare in *Tupaia*. I have seen but one albinistic specimen, British Museum 60.5.4.72, female, Penang Hills. This is partially albinistic as far down as the rump and hind limbs, which with the tail are quite normal in color. The forefeet are also normal in color, and the top of nose and head is less marked with whitish or gray hairs than are the other albinistic areas. A second specimen, also from Penang Hills, B. M. 79.11.21.307, has an irregular white patch about a square centimeter in area over the right shoulder; otherwise it is entirely normal. It is possible that the cream-colored tails of *Tupaia demissa* and *Tana chrysura* may be a form of partial albinism that has become established in certain areas.

I have seen no specimens of Tupaia that suggest anything like melanism, so that the condition probably occurs very rarely, if at all.

FAMILY OR SUBFAMILY NAMES OF TREESHREWS.

Cladobatæ FITZINGER (Sitz. Akad. Wiss. Math. Nat. Wien, vol. 60, 1869, pt. 1, 263). Genera: *Hylomys*, *Cladobates*, *Dendrogale*, *Ptilocercus*.

Cladobatida HAECKEL, 1895 (Syst. Phylog. Wirbelth., 1895, p. 593). *Cladobates* or *Tupaja* only genus mentioned.

Cladobatidina BONAPARTE, 1838 (Syn. Vert. Syst. in Nuov. Ann. Sci. Nat. Bologna, vol. 2, 1838, p. 111). Used as a division of the Soricidæ, no genera mentioned.

Cladobatina BONAPARTE, 1845 (Cat Met. Mamm. Europ., 1845, p. 5). Used as a subfamily of the Soricidæ, no genera mentioned.

Glisoricina POMEL (Arch. Sci. Phys. Nat. Bibl. Univ. Genève, vol. 9, p. 250, November, 1848).

Glisoricinæ MURRAY (Geog. Hist. Mamm., 1866, p. 319). Under Pomel's arrangement of the insectivora he uses Glisoricinæ as a group name embracing *Hylogale*, *Sorexglis*, and *Oxygomphius* (fossil).

Tupaiadæ BELL. (Todd's Cyclop. Anat. Physiol., vol. 2, 1839, p. 994). Work not seen.

Tupaiidæ MIVART., 1868 (Journ. Anat. Physiol., vol. 2, 1868, p. 145). Comprising *Tupaia*, *Ptilocercus*, *Hylomys*.

Tupaina GRAY, 1825 (Thomson's Ann. Philos., vol. 26, November, 1825, p. 339). Used as a probable fifth group of the Talipidæ, with the one genus *Tupaia*.

Tupajidæ SCHLOSSER (Beitr. Paläort. Oester.-Ungarns, vol. 6, 1887, pp. 91, 114). Work not seen.

Tupayæ PETERS, 1863 (Abhandl. kön. Akad Wissensch. Berlin, 1863, p. 20). As a group name for *Cladobates*, *Ptilocercus*, and *Hylogale* (probably intended for *Hylomys*).

Tupayidæ GILL (Arrang. Fam. Mamm. Smiths. Misc. Coll., No. 230, p. 19, 1872). Another spelling of Tupaiidæ Mivart.

NAMES THAT HAVE BEEN PROPOSED FOR TREESHREWS USED IN A GENERIC SENSE, OR NAMES OF ESTABLISHED GENERA TO WHICH TREESHREWS HAVE BEEN ERRONEOUSLY ASSIGNED.

Chladobates.—A typographical error for *Cladobates*. It occurs in Schinz, Naturgeschichte und Abbildungen der Säugethiere, 1824, p. 87. Included species *javanicus*, *vittatus*, *tana*, *ferrugineus*.

Cladobates.—This term was first proposed by Cuvier (Dents des Mammifères, p. 60, pl. 17) in 1825. It is used synonymously with *Sorex-glis*, and was probably considered by him to be more euphonious or more descriptive of the animals. It contained three species—*tana*, *ferruginea*, *javanica*. It is thus seen to be a pure synonym

of *Tupaia*. The term was adopted by many subsequent writers as the generic designation of the treeshrews, among them Lesson, 1827; Wagner, 1841; Giebel, 1855; Peters, 1864; Zelebor, 1869; Fitzinger, 1870.

Dendrogale.—Proposed by Gray (Proc. Zool. Soc. London, 1848, pl. 16, p. 23) in 1848 as a genus for the species *Hylogalea murina* Schlegel and Müller. Twelve years later Gray apparently repudiated the name when he described another species as *Tupaia frenata*. Until recent years most authors did not consider *Dendrogale* to be generically distinct from *Tupaia*. Fitzinger, however, used it in 1870, and in 1879 it was employed by Anderson as a full genus. Flower and Lydekker in 1891 did not recognize it, and Trouessart in 1898 gave it only subgeneric rank. In the present paper it is employed as the generic term for a small but well defined group of small treeshrews which have gone under the specific names *murina, frenata,* and *melanura*.

Erinaceus.—Blainville (Ostéographie des Mammifères Insectivores, 1839–1864, p. 112, pl. 6, fig. 1) uses the combination *Erinaceus* (*Glisorex*) *tana*. On page 31 he uses *Glisorex* as a full genus in the combination *Glisorex ferrugineus*. This is the third instance that I know of where treeshrews have been referred to a genus that has not been specially set aside for them. The others are Diard and Duvaucel's reference of them to *Sorex* in 1822, and Ellis's *Sciurus* published in Gray. Blainville's error is so evident that one wonders how he made it.

Gladobates.—A typographical error for *Cladobates*. It occurs in Schinz, Naturgeschichte und Abbildungen der Menschen und der Saügethiere, p. 54. Included species *ferrugineus, javanicus*.

Glipora.—This was originally a manuscript name of Diard, and was published by Jentink in 1888 (Cat. Syst. Mus. Hist. Nat. Pays-Bas, vol. 12, Mammifères, p. 118). The species included in it are *G. leucogaster* (= *Tupaia minor?*), *G. rufescens* = (*Tupaia splendidula?*), and *G. murina* = (*Dendrogale murina*). It is not probable Jentink had any intention of establishing the name of the genus or of the included species, *rufescens* or *leucogaster*. It is thus an accidental synonym of *Tupaia*. *Glipora* does not occur in Palmer's Index Generum Mammalium, 1904.

Glirisorex.—Used by Scudder (Nomenclator Zoolgicus, pt. 2, p. 131) in 1882 probably as an etymologic improvement over Desmarest's *Glisorex*. No species are mentioned. It is of course a pure synonym of *Tupaia* used in a broad sense.

Glisorex.—This name was proposed by Desmarest in a footnote on page 536 of his Mammalogie, 1822, as more euphonious than *Sorexglis*, which he and other authors seemed to think was Diard and Duvaucel's generic designation of the treeshrews. Desmarest, however, does

not use the term in preference to *Tupaia*. *Glisorex* was adopted by Blainville and Owen.

Glisosorex.—Used by Giebel in Odontographie, 1855, page 18. He probably intended to copy the term *Glisorex* from Owen's Odontography. On the same page he uses the term *Cladobates*, evidently thinking it a different genus from *Glisorex* and assigning different dental formulas to the two animals. His knowledge of *Cladobates* appears to be based upon Horsfield's account and figures in Zoological Researches in Java. No species are mentioned under *Glisosorex*, and the term is simply a variant of *Glisorex*.

Herpestes.—Anderson (Zool. Res. West. Yunnan, 1879, p. 132) says: "Diard and Duvaucel's figure [of *Sorex glis*] in the Asiatic Researches (Asiatic Researches, vol. 14, 1822, pl. 9) appears to have been copied in a slightly reduced form into the Calcutta Journal of Natural History (Cal. Journ. Nat. Hist., vol. 2, 1842, p. 456, pl. 13½, fig. 1), where it is regarded as a *Herpestes!*" I have been unable to consult the volume of the Calcutta Journal referred to. In his introduction to Diard and Duvaucel's account Major General Hardwicke says: "It bears most resemblance I think to the genus *Viverra*, particularly to *V. Ichneumon*."

Hylogale.—Proposed by Temminck (Monographies de Mammalogie, p. xix) in 1827 as a substitute for *Tupaia*, which being derived from the native name tupai he considered a "*nom très-vicieux.*" He further remarks, "*Ce changement est dans l'intérêt de la science; il sera sans doute adopté.*" According to Temminck the genus contained three species, which, however, are not mentioned by name. The term as originally written by Temminck never seems to have been adopted by other authors.

Hylogalea.—An emendation of *Hylogale* Temminck, used by Schlegel and Müller (Verh. Nat. Gesch. Nederl. Overs, Bezitt, 1839–44, p. 159) as the proper designation of the treeshrews. It is a pure synonym of *Tupaia*, but included two species which were unknown to Raffles. The forms included by Schlegel and Müller are *tana*, *ferruginea*, *javanica*, and *murina*, the last since made the type of the genus *Dendrogale* Gray. Aside from Schlegel and Müller the name does not seem to appear in the literature. In subsequent publications Schlegel adopts the term *Tupaja*.

Ptilocercus.—Proposed by Gray (Proc. Zool. Soc. London, 1848, p. 23) for the very curious animal since then known as *Ptilocercus lowii*. So far as I am aware no other term has ever been proposed for *Ptilocercus*, neither has the animal ever been placed in any other established genus.

Ptilocerus.—A misspelling of *Ptilocercus* found in Wallace's Geographical Distribution of Animals, 1876, vol. 1, p. 337; vol. 2, p. 187; and in Island Life, 1881, p. 345, and in Brehm's Thierleben, 1864, vol. 1, p. 664.

Sciurus.—Used in the manuscript of W. Ellis, 1780, on the third voyage of Captain Cook. Drawing and manuscript in the library of the British Museum, Natural History. This manuscript name was published as *Sciurus dissimilis* in 1860, in the Annals and Magazine of Natural History, third series, vol. 5, p. 71, in an article by Gray.

Sorex.—Employed by Diard in the account of the first described treeshrew, *Sorex glis*, in the Asiatic Journal and Monthly Register, vol. 10, November, 1820, p. 478, also used again by Diard and Duvaucel. (Asiat. Res., vol. 14, 1822, p. 472, pl. 9. This volume was received in London, at the Geological Society, January 10, 1823, and hence was probably published in the third quarter of 1822. Personal communication from C. D. Sherborn.) A careful examination of these works shows that *glis* was described as a new species of the genus *Sorex*. It was not anyone's intention to make a new genus called *Sorexglis*, as certain writers have thought. Palmer in North American Fauna, No. 23, page 636, is of the same opinion that *Sorex glis* was used as a genus and a species, and not as a single name, and so was Horsfield.[1] Desmarest, however, considered it as a generic term and published it as such, *Sorexglis*, and also emended it to *Glisorex*, which was still further emended by Scudder *Glirisorex* and by Giebel as *Glisosorex*.

Sorexglis.—First used by Geoffroy and Cuvier (Hist. Nat. Mamm., vol. 3, liv, 35, December, 1821, p. 1) as a compound word *Sorex-Glis* as a generic designation of treeshrews. No citation of either Raffles or Diard is given, but both are mentioned, and the name is evidently taken from the latter's *Sorex glis*. They discuss the inappropriateness of using barbarous names like *Tupaia*. It is interesting to note that *Tupaia* appeared in May and *Sorexglis* in December of the same year, 1821. Geoffroy and Cuvier included in their genus the species now known as *javanica* and *ferruginea*.

Desmarest was next to use the term, in his Mammalogie, in 1822, in a footnote only, preferring in the text to use the term *Tupaia*.

Sorex-glis is also mentioned by Cuvier in Dents des Mammifères in 1825, although *Cladobates* is adopted as the generic term.

Tapaia.—An accidental renaming of *Tupaia* by J. E. Gray (Ann. Mag. Nat. Hist., ser. 3, vol. 5, 1860, p. 71). The spelling occurs as *Tapaia* in the title, in the body of the article, and in the index. *Tupaia* does not appear in Gray's article, or elsewhere in the volume.

Tupaia.—The earliest generic name for the treeshrews as such proposed by Raffles in May, 1821 (Trans. Linn. Soc. London, vol. 13, 1822, p. 256, May, 1821[2]). It contained two species, *ferruginea* and *tana*. In the present paper *tana* is made the type of a new genus. *Tupaia* is the name adopted by most authors, although it was rejected

[1] Catalogue of the Mammalia in the Museum of the Hon. East-India Company, 1851, p. 130.

[2] See Horsfield, Zool. Res. Java, 1824, p. 2 of text of *Tapirus malayanus*,

by some because of its barbarous origin from tupai the Malay word for any squirrel-like animal, in favor of *Hylogale* or *Hylogalea*, and *Cladobates*.

Tupaia is often written *Tupaja* by German and Dutch authors, and occurs as *Tupaya* in Geoffroy and Cuvier.[1]

Urogale.—Proposed by Mearns (Proc. U. S. Nat. Mus., vol. 28, May 13, 1905, p. 435) for the very peculiar treeshrew from Mindanao, Philippines. The type is *U. cylindrura* Mearns, which in the present paper is considered a synonym of *Tupaia everetti* Thomas. It is one of the most characteristic of all the genera of the Tupaiidæ excepting *Ptilocercus*.

KEY TO GENERA BASED ON EXTERNAL CHARACTERS.

Tail naked for its basal portions, with a distichous tuft of hairs at end.
PTILOCERCINÆ, *Ptilocercus*, p. 159.

Tail haired throughout its whole extent, without a distinct naked basal portion.
TUPAIINÆ.

Tail rounded and close haired for its whole extent.

Hind foot about 30 mm.; snout not unusually long and slender, head usually conspicuously marked ..... *Dendrogale*, p. 126.

Hind foot about 50 mm.; snout long and slender, head without conspicuous markings ..... *Urogale*, p. 154.

Tail clothed with longer hairs, squirrel-like in character.

Snout long and slender, with a naked area on top of nose encroaching backward in middle line into haired area..... *Tana*, p. 134.

Snout not unusually long and slender, with naked area on top of nose not encroaching on haired area, but cut straight across.

Lowerlobe of ear presenting a surface greater than upper half of ear, inner side of ear fairly well haired, reticulations on naked area of nose coarser.
Anathana, p. 120.

Lower lobe of ear presenting a smaller surface than upper portion of ear, inner side of ear scantly haired, reticulations on naked area of nose finer.
Tupaia, p. 30.

KEY TO GENERA BASED ON CRANIAL CHARACTERS.

Supraorbital foramen absent, temporal fossa about equal to orbit in size,
PTILOCERCINÆ, *Ptilocercus*, p. 159.

Supraorbital foramen present, temporal fossa conspicuously smaller than orbit,
TUPAIINÆ.

Fenestra in zygoma small and inconspicuous.

Rostrum much elongated; distance from lachrymal notch to end of premaxilla about equal to distance from notch to occipital condyles..... *Urogale*, p. 154.

Rostrum not conspicuously elongated; distance from lachrymal notch to end of premaxilla much less than distance from notch to occipital condyles.

Distance from lachrymal notch to end of premaxilla equal to distance from notch to auditory meatus; rostrum slender..... *Dendrogale*, p. 126.

Distance from lachrymal notch to end of premaxilla equal to distance from notch to outer pterygoid plate; rostrum heavy..... *Anathana*, p. 120.

[1] Hist. Nat. Mamm., vol. 3, liv, 35, December, 1821, p. 1.

Fenestra in zygoma, conspicuous, elongated, oval in shape.
Rostrum long and slender; premaxillæ elongated; distance from lachrymal notch to end of premaxilla equal to distance from notch to condyles... *Tana*, p. 134.
Rostrum not conspicuously elongated and slender, nor premaxillæ unusually lengthened; distance from lachrymal notch to end of premaxilla equal to distance from notch to auditory meatus ..... *Tupaia*, p. 30.

KEY TO GENERA BASED ON DENTAL CHARACTERS.

Upper molars without mesostyle; upper canine (third tooth in upper jaw) with 2 roots and premolariform in shape; i_2 about twice as large as i_1; middle lower premolar smallest of lower premolar series.....PTILOCERCINÆ, *Ptilocercus*, p. 159.
Upper molars with distinct mesostyle; upper canine (third tooth in upper jaw) usually with a single root, small but somewhat caniniform, i_1 and i_2 almost subequal; first lower premolar smallest of lower premolar series.....TUPAIINÆ.
i^2 much larger than i^1, and caniniform..... *Urogale*, p. 154.
i^2 slightly smaller than i^1, not caniniform.
Hypocones on upper molars much reduced; not present as distinct cusps; lower canines and premolars more trenchant ..... *Dendrogale*, p. 126.
Hypocones on upper molars not conspicuously reduced; present as more or less evident cusps; lower canines and premolars less trenchant.
Hypocones very strongly developed, and pm^4 distinctly wider than long, and c_1 not noticeably higher than adjacent i_3 and pm_2..... *Anathana*, p. 120.
Hypocones moderately developed; pm^4 not conspicuously wider than long; c_1 standing noticeably higher than adjacent i_3 and pm_2.
Lower canine nearer i_3 than to pm_2..... *Tana*, p. 134.
Lower canine equally spaced between i_3 and pm_2..... *Tupaia*, p. 30.

DESCRIPTIONS OF GENERA AND SPECIES.

Genus TUPAIA Raffles.

1820. *Sorex* DIARD, Asiat. Journ. Monthly Register, vol. 10, p. 478, November, 1820. Not of Linnæus 1758.
1821. *Tupaia* RAFFLES, Trans. Linn. Soc. London, vol. 13, 1822, p. 256, May, 1821.
1821. *Sorex-glis* GEOFFROY AND CUVIER, Hist. Nat. Mamm., vol. 3, liv. 35, p. 1, December, 1821, perhaps early in 1822.
1822. *Glisorex* DESMAREST, Mammalogie, footnote, p. 536, 1822.
1825. *Cladobates* CUVIER, Dents des Mammifères, p. 60, pl. 17, 1825.
1827. *Hylogale* TEMMINCK, Monogr. Mamm., p. xix, 1827.
1840. *Erinaceus*, BLAINVILLE, Ostéog. Mamm. Insect., p. 112, pl. 6, fig. 1.
1843. *Hylogalea* SCHLEGEL AND MÜLLER, Verh. Nat. Gesch. Nederl. Overz. Bezitt., p. 159.
1855. *Glisosorex* GIEBEL, Odontographie, p. 18, 1855.
1860. *Sciurus* ELLIS, in Gray, Ann. Mag. Nat. Hist., ser. 3, 1860, vol. 5, p. 71.
1860. *Tapaia* (sic) GRAY. Ann. Mag. Nat. Hist., ser. 3, vol. 5, 1860, p. 71.
1882. *Glirisorex* SCUDDER, Nomenclator Zool., pt. 2, p. 131, 1882.
1888. *Glipora* JENTINK, Cat. Syst. Mus. Hist. Nat. Pays-Bas, vol. 12, Mammifères, p. 118. Publication of manuscript name of Diard.

Type.—*Tupaia ferruginea* Raffles. Two species were included in the genus by Raffles—*T. ferruginea* and *T. tana*. The latter is taken as the type of the new genus *Tana*, page 134, and *T. ferruginea* is selected the type of the genus *Tupaia*.

Diagnostic characters.—The most generalized member of the family Tupaiidæ, mainly characterized by the absence of the specializations of the other members, such as rostrum not excessively elongated, tail not tufted nor close-haired, teeth without unusual development of hypocones or other peculiarities, head without conspicuous markings.

External characters.—The external form of *Tupaia* is exceedingly squirrel-like. The natives make no distinction in name between tupaias and squirrels, calling both *tupai*. Collectors observe it is sometimes impossible to say whether a squirrel or tupaia has been shot until the specimen is picked up. Even experienced workers in museums now and then confuse a tupai skin with a squirrel skin. Aside from the shrew-like snout of *Tupaia*, a character which is not usually obvious in the average skin, the genus is quickly distinguished from *Sciurus* by the absence of the long black whiskers or vibrissæ. From the other members of the family *Tupaia* is distinguished by its relatively small ears, finely reticulated naked area of nose, not encroaching on haired area of nose, well-haired tail, lack of face markings. A more or less distinctly defined oblique shoulder stripe present. Mammæ vary from one to three pairs. For the number and arrangement of the footpads see fig. 3, page 32.

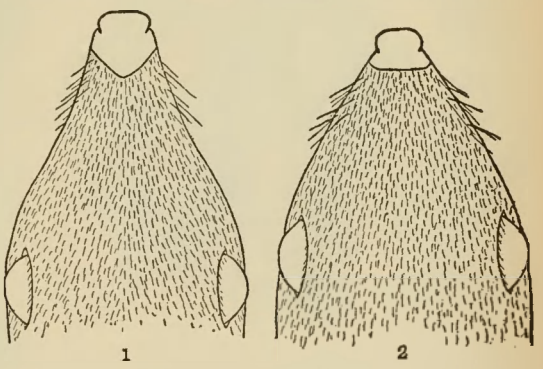


FIG. 2.—DIAGRAM ILLUSTRATING THE RHINARIUM (1) IN THE GENERA TANA AND UROGALE AND (2) IN THE GENERA TUPAIA, ANATHANA, AND DENDROGALE. ABOUT NATURAL SIZE.

Cranial characters.—Rostrum moderately short and heavy; distance from the lachrymal notch to end of premaxilla is about equal to the distance from the notch to the region of the external auditory meatus; in some species the posterior leg of the dividers falling behind the opening, and in others in front of it. In the group containing the species *Tupaia minor* and *gracilis*, the rostrum is particularly short and stubby and the posterior leg of the dividers reaches to about the end of the pterygoid processes. In the species *T. chrysogaster* the rostrum is very slender, but not so much elongated, and the skull as a whole strongly suggests that of the genus *Tana*. The width of the braincase usually approximately equals the length of maxillary toothrow, or exceeds it a trifle in most species; in some of the smaller members of the genus it exceeds it by as much as 3 or 4 mm. Fenestra in zygoma, large and conspicuous, elongated oval in shape; a distinct supraorbital foramen present; temporal fossa distinctly smaller than orbit. (Fig. 4, page 33.)

Dental characters.—The teeth of *Tupaia* are the most generalized of any genus in the family. The two pairs of upper incisors are usually subequal, although the first is nearly always a little the larger. In certain species *T. nicobarica, T. javavica, T. minor, T. gracilis,* however, there is a marked difference in size, but it is always the first pair which is the larger of the two. This difference in size is fairly useful as a group character, but can not be relied upon as a hard and fast one, as specimens showing intermediate degrees of development are found. There are three pairs of lower incisors, all well developed

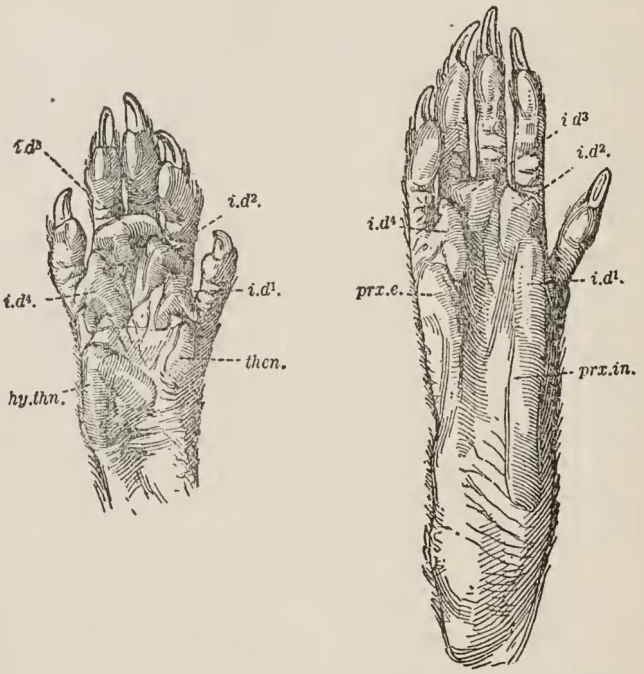


FIG. 3.—PALMAR SURFACE OF RIGHT FOREFOOT AND PLANTAR SURFACE OF RIGHT HINDFOOT OF TUPAIA GLIS FERRUGINEA. CAT. NO. 124319, U. S. N. M., SINGAPORE. ENLARGED ABOUT TWICE. AFTER GREGORY, BULLETIN AMERICAN MUSEUM OF NATURAL HISTORY, VOL. 27, 1910, P. 270. *Hy. thn*, HYPOTHENAR PAD; *i. d*¹, *i. d*², *i. d*³, *i. d*⁴, FIRST, SECOND, THIRD AND FOURTH INTERDIGITAL PADS; *prx. c*, PROXIMAL EXTERNAL PAD; *prx. in*, PROXIMAL INTERNAL PAD; *then*, THENAR PAD.

and functional, but the third pair is much smaller than the others; the second pair is somewhat larger than the first pair. In some cases the third pair is relatively more reduced in size than in others, and in these cases the tooth is barely functional. This is particularly so in those species which have the greatest development of the central upper incisors and is also correlated with a greater development of the lower canine. In this connection it is interesting to note that in the genus *Urogale* where the third lower incisors are quite rudimentary we find a very unusual development of the lower canine, and of the second

pair of upper incisors and not of the first pair, as seems to be the tendency in the genus *Tupaia*. The upper canine in *Tupaia* is moderately well developed, and usually with only one root, except in certain anomalous cases. Its crown always projects distinctly beyond the level of the adjacent premolar. The lower canine is relatively better developed than the upper and always projects conspicuously above the levels of the adjacent premolar and incisor. In the group of species with the enlarged central incisors and reduced third lower incisor, the lower canine is relatively very much enlarged and stands very high above the mandibular toothrow. At first sight this development of the lower canine appears to be a valuable group character, but one encounters specimens or species where it is quite impossible to decide whether the lower canine is of the enormously developed type or not. Its greatest absolute and relative development occurs in *Tupaia nicobarica*. In the case of *T. cuyonis* it is difficult to say whether the canine is unduly enlarged. There are three pairs each of upper and lower premolars. The first of each are small and almost functionless; the others increase in size and complexity from before backward. The last deciduous premolars have the same form as the typical molars. Upper and lower molars, three pairs of each; the first and second upper molars with the hypocones always present, but rather poorly developed. See fig. 5 above.

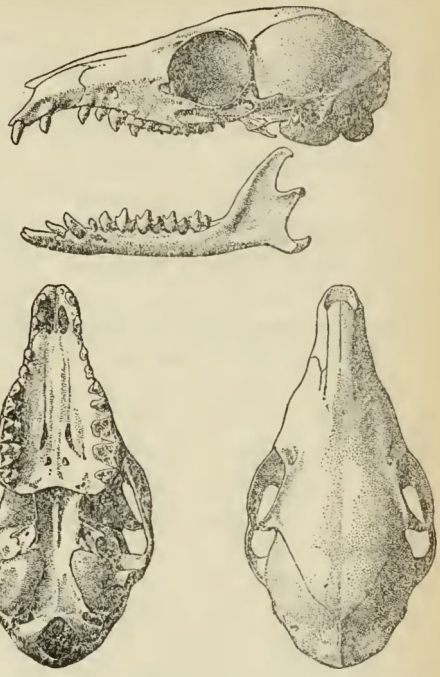


FIG. 4.—TUPAIA GLIS FERRUGINEA, × 1, CAT. NO. 114548. U.S.N.M. TAPANULI BAY, SUMATRA.

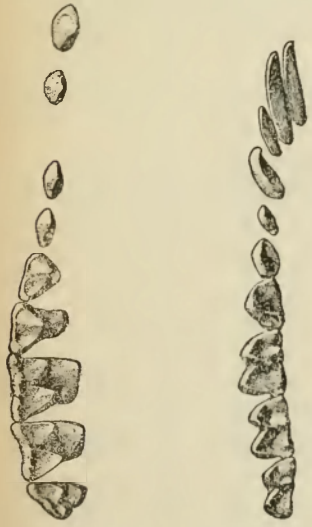


FIG. 5.—TUPAIA GLIS FERRUGINEA UPPER AND LOWER TOOTHROWS × 2½, CAT. NO. 114548, U.S.N.M. TAPANULI BAY, SUMATRA.

A cecum about 10 mm. long is probably one of the generic characters. (See p. 14.)

Geographic distribution.—The genus *Tupaia* has a wider distribution than any of the other genera of the family, ranging on the west from northeastern India, Burma, and Nicobar Islands eastward to members of the Philippine Islands which geographically are extensions of Borneo; on the north from central China south to Sumatra, including islands on the southwest coast, Java, and Borneo. It does not occur on Celebes, nor islands to the east of Java, with the possible exception of Bali, whose fauna is not well known.

Number of forms.—*Tupaia*, the most generalized member of the family contains the largest number of specific and subspecific forms, 48 named forms being recognized in this revision. As a matter of convenience, the genus may be divided into four fairly well-marked sections and each of these into secondary groups and subgroups. I feel sure, however, that the divisions are not natural ones, and it is quite possible in most cases to start with any given subdivision and by means of diverging forms pass into or at least toward some other subdivision. The most strikingly differentiated of the forms are *Tupaia nicobarica* and *T. picta*. The sections, groups, and subgroups, into which the genus may be divided are:

I. Members with the tail longer than head and body, central upper incisors large in comparison with lateral pair, lower canines well developed, and third lower incisor reduced in size, general shape of skull normal. Contains two groups.

1. *Nicobarica* group. Size large, general color brown, black area on lower back; mammæ, 1–1 = 2.

Tupaia nicobarica nicobarica, Great Nicobar Island, page 103.

Tupaia nicobarica surda, Little Nicobar Island, pl. 3, fig. 1; pl. 10, fig. 7, page 104.

2. *Javanica* group, size small, general color olivaceous above and dark below; mammæ 2–2 = 4.

Tupaia javanica, Sumatra, Nias Island, Java, pl. 3, fig. 2; pl. 10, fig. 1, page 106.

II. Members also with the tail longer than head and body, and largely developed central upper incisors and lower canines, but rostrum of skull very short and stubby and brain case relatively inflated, the general shape of the skull being quite atypical. General coloration olivaceous above, light below, mammæ, 2–2 = 4. Contains only one group.

1. *Minor* group. Characters as above.

Tupaia minor minor, Borneo, pl. 3, fig. 3; pl. 10, fig. 3, page 110.

Tupaia minor malaccana, Sumatra, southern Malay Peninsula, and Linga Island, pl. 10, fig. 4, page 114.

Tupaia minor sincipis, Sinkep Island, page 115.

III. Members combining the characters of Section II with those of the next or typical section. The tail is long, the skull has a short stubby rostrum and inflated brain case, like that of Section II, but the teeth do not have unusually developed central upper incisors and lower canines. General coloration olivaceous above, light below. Number of mammæ unknown. Contains but one group.

1. *Gracilis* group. Characters as above.

Tupaia gracilis gracilis, Borneo, page 117.

Tupaia gracilis inflata, Banka Billiton, pl. 10, fig. 2, page 118.

Tupaia gracilis edarata, Karimata Island, page 118.

IV. This section contains the great majority of the members of the genus, the tail is not unusually elongated, the skull has the typical form as in Section I, but the teeth do not show the peculiarity of enlarged central upper incisors and lower canines. Size large or medium, never small. Coloration various. Mammæ, 1–3 pairs. Contains eight fairly well-defined groups.

1. *Chinensis* group. Color generally grayish or olivaceous, without characteristic marks or bright colors; mammæ, 3–3 = 6.

Tupaia chinensis, Southern China, Siam, pl. 8, fig. 1, page 63.

Tupaia concolor, Anam, page 68.

Tupaia modesta, Hainan, page 69.

Tupaia dissimilis, Pulo Condore, pl. 1, page 67.

Tupaia belangeri, Northern Malay Peninsula and southern Burma, pl. 8, fig. 2, page 59.

2. *Möllendorffi* group. General coloration grayish or ochraceous without characteristic marks or bright colors, teeth approaching those of the *javanica* group, section I; mammæ, 2–2 = 4.

Tupaia cuyonis, Cuyo Island, Philippines, pl. 9, fig. 1, page 82.

Tupaia möllendorffi, Culion Island, Philippines, page 81.

Tupaia palawanensis, Palawan Island, Philippines, page 78.

3. *Ferruginea* or *Glis* group. General coloration dark ferruginous, tail various but never clear below except in *T. demissa;* mammæ, 2–2 = 4. For convenience this group may be divided into 2 subgroups, the extremes of which are different enough, but the 2 subgroups practically merge into one another.

a. *Ferruginea* subgroup, typically ferruginous:

Tupaia glis ferruginea, Sumatra, southern Malay Peninsula, pl. 3, fig. 4; pl. 8 fig. 6, page 41.

Tupaia glis glis, Penang Island, pl. 8, fig. 8, page 45.

Tupaia glis batamana, Batam Island, pl. 8, fig. 9, page 46.

Tupaia glis sordida, Tioman Island, pl. 9, fig. 8, page 48.

Tupaia glis pemangilis, Pemangil Island, page 48.

Tupaia glis pulonis, Aor Island, page 47.

Tupaia phæura, Sinkep Island, pl. 9, fig. 7, page 49.

Tupaia tephrura, Batu Islands, pl. 8, fig. 7, page 50.

Tupaia demissa, Sumatra, page 58.

b. Wilkinsoni subgroup, approaching *belangeri* of the *chinensis* group:

Tupaia lacernata wilkinsoni, middle portion of Malay Peninsula, pl. 8, fig. 3, page 52.

Tupaia lacernata lacernata, Lankawi and Terutau Islands, pl. 8, fig. 5, page 53.

Tupaia lacernata raviana, Butang Islands, pl. 8, fig. 4, page 54.

Tupaia lacernata obscura, Great Redang Island, page 55.

Tupaia lacernata longicauda, Perhentian Island, page 56.

4. *Splendidula* group. Color various, usually solid, varying from seal brown to bright ferruginous. Color of underside of tail always clear along the central line at least; mammæ, 2–2 = 4.

Tupaia splendidula, Borneo, pl. 10, fig. 11, page 83.

Tupaia natunæ, Bunguran, Natuna Islands, pl. 10, fig. 12, page 85.

Tupaia lucida, Pulo Laut, Natuna Islands, page 86.

Tupaia chrysomalla, Siantan, Anamba Islands, pl. 10, fig. 10, page 88.

Tupaia riabus, Riabu, Anamba Islands, page 88.

Tupaia anambæ, Jimaja, Anamba Islands, page 89.

Tupaia carimatæ[1], Karimata Island, pl. 10, fig. 6, page 98.

Tupaia castanea[2], Bintang Island, pl. 10, fig. 9, page 90.

Tupaia siaca[2], Sumatra, pl. 10, fig. 8, page 91.

5. *Discolor* group. Underparts rather brightly colored, anterior portion of upper parts ferruginous, posterior olivaceous; mammæ, 3–3 = 6.

Tupaia discolor, Banka Island, pl. 9, fig. 4, page 73.

Tupaia longipes longipes, northern Borneo, page 76.

Tupaia longipes salatana, southern Borneo, pl. 9, fig. 5, page 77.

6. *Hypochrysa* group. Underparts very brightly colored, upper parts darkly olivaceous or brownish; mammæ, 1–1 = 2.

Tupaia hypochrysa, Java, pl. 9, fig. 6, page 70.

Tupaia chrysogaster, Pagi and Nias Islands, pl. 9, fig. 9, page 71.

7. *Montana* group. Entire animal a grizzled dark brownish, often with a well-marked black area on back; mammæ, 2–2 = 4.

Tupaia montana montana, Mount Dulit, Borneo, pl. 9, fig. 2, page 94.

Tupaia montana baluensis, Mount Kina Balu, Borneo, page 95.

8. *Picta* group. Back with a narrow dorsal stripe; mammæ, 2–2 = 4.

Tupaia picta, Borneo, pl. 9, fig. 3, page 96.

Remarks.—*Tupaia* is the most generalized member of the Tupaiidæ and, as would be expected, shows the largest number of distinct forms and the widest geographic distribution. It is easy to see how the other members of the family with the exception of *Ptilocercus* have been derived by relatively slight modifications from *Tupaia*.

[1] Suggests the montana group.

[2] Closer to the ferruginea group than the others.

KEY TO THE SPECIES AND SUBSPECIES OF TUPAIA.

Tail distinctly longer than head and body, lower canine (except in *T. gracilis*) twice the length of the incisor in front of it, and central upper incisors (except *T. gracilis*) very conspiciously larger than lateral pair.

Size large, head and body 180–200 mm., much black on lower back..*T. nicobarica*.

Shoulders and neck bright grizzled ochraceous.

Great Nicobar, *T. n. nicobarica*, p. 103.

Shoulders and neck dull grizzled ochraceous...Little Nicobar, *T. n. surda*, p. 104.

Size small, head and body, 140–150 mm., general color uniformly grizzled olivaceous.

Skull with rostrum of normal shape, not stubby, distance between the two lachrymal notches equals distance from that notch to space between first and second upper incisors, under parts rather dark and grizzled.

Sumatra, Nias, Java, *T. javanica*, p. 106.

Skull with a short stubby rostrum, distance between the two lachrymal notches equals distance from that notch to front of first upper incisor, under parts usually clear whitish or buffy.

Hind foot 30–35 mm., central upper incisors and lower canines well developed, grizzling of upper parts, not unusually fine .....*T. minor*, p. 109.

Tail not conspicuously darker than general coloration of upper parts.

Sumatra, Linga, Malay Peninsula, *T. m. malaccana*, p. 114.

Tail conspicuously darker than general coloration of upper parts.

Rump not distinctly russet in contrast with upper parts.

Borneo, *T. m. minor*, p. 110.

Rump distinctly russet in contrast with upper parts.

Sinkep, *T. m. sincipis*, p. 115.

Hind foot 37–43 mm., central upper incisors and lower canine not unusually developed, grizzling of upper parts very fine .....*T. gracilis*, p. 116.

Hind foot 40 mm. or over, bullæ smaller.....Borneo, *T. g. gracilis*, p. 117.

Hind foot not over 40 mm., bullæ larger.

Upper parts and legs grizzled olivaceous brownish.

Billiton, Banka, *T. g. inflata*, p. 118.

Upper parts and legs grizzled ochraceous brownish.

Karimata, *T. g. edarata*, p. 118.

Tail usually distinctly shorter than head and body, occasionally approximately equal to or slightly longer than head and body, but in that case, lower back without a large black area; central upper incisors not conspicously larger than lateral pair, and lower canine not unusually developed, less than twice the length of the incisor in front of it.

Middle of back with a conspicuous narrow black stripe....Borneo, *T. picta*, p. 96.

Middle of back without a conspicuous narrow black stripe.

Tail not uniformly above and below grizzled blackish and grayish or blackish and ochraceous, if grizzled on upper surface, always showing a clear ungrizzled reddish ochraceous area on either side of central line, when viewed from below.

Tail uniformly above and below, dull cream color..Sumatra, *T. demissa*, p. 58.

Tail various, uniformly tawny above and below, or coarsely grizzled with blackish above, and tawny or ochraceous below, never cream color.

General color of upper parts between seal and walnut brown.

Borneo, *T. splendidula*, p. 83.

General color of upper parts varying from dark hazel or chestnut to bright tawny or ochraceous with or without distinct grizzling.

Upper parts with a fine diffused grizzling of blackish and ochraceous with a tendency toward a dark patch on back.

Karimata Island, *T. carimatæ*, p. 98.

Upper parts without fine diffused grizzling, grizzling absent or else coarse, and without tendency to dark patch on back.

General coloration of head, body, and tail tawny.

Tawny, light and bright.....Laut, Natuna Islands, *T. lucida*, p. 86.

Tawny, dull and darker....Riabu, Anamba Islands, *T. riabus*, p. 88.

General coloration of head and body a mixture of dark ferruginous and blackish.

Under parts ochraceous.....Bintang Island, *T. castanea*, p. 90.

Under parts light or dark buffy, sometimes grizzled.

Under parts bright buffy without grizzling..Sumatra, *T. siaca*, p. 91.

Under parts dull buffy more or less grizzled.

Under side of tail tawny.

Bunguran, Natuna Islands, *T. natunæ*, p. 85.

Under side of tail ochraceous.

Upper parts inclining toward ferruginous.

Siantan, Anamba Islands, *T. chrysomalla*, p. 88.

Upper parts inclining toward ochraceous.

Jimaja, Anamba Islands, *T. anambæ*, p. 89.

Tail uniformly above and below grizzled blackish, and grayish, buffy, or ochraceous, never with a distinct clear area on either side of middle of tail when viewed from below.

First and second upper molars rather quadrate in outline, with distinct hypocones, shoulder stripe obsolete or nearly so, back often marked with with a broad black band.....*T. montana*, p. 93.

Back usually marked with a broad black patch or band.

Mount Dulit, Borneo, *T. m. montana*, p. 94.

Back without a broad black patch.

Mount Kina Balu, Borneo, *T. m. baluensis*, p. 95.

First and second upper molars more triangular in outline and with hypocones poorly developed if at all, shoulder stripe usually fairly well indicated; back never with a broad black band.

Upper parts of body distinctly rusty or ferruginous in color, and if grayish areas are present they are posterior.

Anterior portion of body ferruginous, posterior grayish; mammæ, 3-3=6.

Hind foot less than 50 mm.; difference in color between anterior and posterior portions of back very marked...Banka, *T. discolor*, p. 73.

Hind foot usually 50 mm. or more; difference in color between anterior and posterior portions of back less marked.... *T. longipes*, p. 74.

General effect of lower back and tail bister.

Northern Borneo, *T. l. longipes*, p. 76.

General effect of lower back and tail clove-brown.

Southern Borneo, *T. l. salatana*, p. 77.

Anterior and posterior portions of body of the same ferruginous color.

Under parts dirty white to buffy, never orange rufous; mammæ, 2-2=4. *Ferruginea* group.

Tail brownish, like rest of upper parts in color.

Sinkep Island, *T. phæura*, p. 49.

Tail darker or lighter than rest of upper parts.

Tail black or blackish, seen above.

Palawan Island, *T. palawanensis*, p. 78.

Tail a grizzle of blackish and buffy, seen above.

Hind feet darker than tail, nearly black, a light buffy color predominating at end of tail.. Batu Islands, *T. tephrura*, p. 50.

Hind feet not darker than tail, and a light buffy color not predominating at end of tail.
General color of upper parts brighter, burnt sienna in general effect.
Tail not noticeably grayish, size slightly smaller.
Sumatra southern Malay Peninsula, *T. glis ferruginea*, p. 41.
Tail rather grayish, size slightly larger.
Batam Island, *T. glis batamana*, p. 46.
General color of upper parts duller, a dark mars brown in general effect.
Light colors of under parts inclining toward ochraceous.
Tioman Island, *T. glis sordida*, p. 48.
Light colors of under parts inclining toward buffy or whitish.
Size smaller, hind foot not over 40 mm. and condylobasal length not over 45 mm.
Pemangil Island, *T. glis pemangilis*, p. 48.
Size larger, hind foot over 40 mm. and condylobasal usually over 45 mm.
Color of lower back slightly darker than rest of upper parts ..... Aor Island, *T. glis pulonis*, p. 47.
Color of lower back not noticeably darker than rest of upper parts..... Penang Island, *T. glis glis*, p. 45.
Under parts orange rufous; mammæ, 1–1=2.
Nias and Pagi Islands, *T. chrysogaster*, p. 71.
Upper parts of body not distinctly ferruginous, a grizzle of blackish and various shades of buffy or ochraceous; if ferruginous tints appear they are situated posteriorly.
Under parts orange rufous..... Java, *T. hypochrysa*, p. 70.
Under parts buffy or whitish, or ochraceous.
Mammæ, 3–3=6; ranging from middle of Malay Peninsula northward. *Belangeri-chinensis* group.
Color over lower back more ochraceous or tawny than on upper back.
Northern Malay Peninsula and southern Burma, *T. belangeri*, p. 59.
Color over lower back not essentially different in color from rest of upper parts.
Condylobasal length 50 mm., maxillary, tooth row over 19 mm.
Anam, *T. concolor*, p. 68.
Condylobasal length less than 50 mm. and maxillary tooth row less than 19 mm.
Skull and rostrum narrower, width of brain case 18 mm.
Pulo Condore, *T. dissimilis*, p. 67.
Skull and rostrum not so slender, width of brain case more than 18 mm.
Color darker, especially underparts and legs.
Hainan, *T. modesta*, p. 69.
Color not so dark, underparts whitish and legs often grayish,
Southern China and adjacent territory, *T. chinensis*, p. 63.
Mammæ, 2–2=4; ranging from middle of Malay Peninsula southward, and occurring in Philippine Islands.
Hind foot and condylobasal length usually less than 45 mm. and tail not darker than lower back.

Tail distinctly different in color from lower back.
Tail more grayish than back.
Culion Island, *T. möllendorffi*, p. 81.
Tail more blackish than back.
Palawan Island, *T. palawanensis*, p. 78.
Tail approximately of the same general color as lower back.
Rostrum rather short and heavy with an abrupt origin from rest of skull..... Cuyo Island, *T. cuyonis*, p. 82.
Rostrum not unusually short and heavy nor with an abrupt origin from rest of skull.
Great Redang Island, *T. lacernata obscura*, p. 55.
Hind foot and condylobasal length of skull usually exceeding 45 mm. and tail more or less darker than lower back.
Tail conspicuously darker than rest of upper parts.
Size slightly larger, condylobasal length about 47 mm., maxillary tooth row 19 mm. Middle third of Malay Peninsula,..... *T. lacernata wilkinsoni*, p. 52.
Size slightly larger, condylobasal length short, 45 mm., maxillary tooth row 18 mm.
Lankawi and Terutau Islands, *T. lacernata lacernata*, p. 53.
Tail darker than rest of upper parts, but not conspicuously so.
Skull relatively short and wide, general color more olivaceous.
Butang Islands, *T. lacernata raviana*, p. 54.
Skull relatively not so short and wide, general color more ochraceous,
Perhentian Islands, *T. lacernata longicauda*, p. 56.

TUPAIA GLIS (Diard).

(Synonymy, type specimens, etc., under the subspecies.)

Geographic distribution.—Southern third of the Malay Peninsula, and various adjacent islands, and Sumatra.

Diagnosis.—Upper parts a grizzle of a color between ferruginous and chestnut, and blackish, tail a grizzle of buffy and blackish; mammæ, 2–2 = 4.

Color.—Upper parts of head, neck, and body, and outer side of legs a grizzle of ferruginous or chestnut and blackish, tail both above and below a grizzle of buffy and blackish, the black in excess above and the buff below, especially along the middle line; underparts including inner side of legs various shades of buff, often with dark bases of the hairs showing through; feet a fine grizzle of buffy and blackish, the latter color in excess; shoulder stripe of average development, varying from yellow to buff yellow. Often around base of tail and thighs the ferruginous or chestnut color is replaced by an ochraceous tint.

Skull and teeth.—These show no special distinguishing characteristics. The rostrum is relatively long, and the distance from the front of the premaxilla to the lachrymal pit is generally greater than

the distance from the pit to the posterior edge of the external auditory meatus.

Measurements.—*Tupaia glis* is a relatively large species. The usual measurements are: Head and body, 170–200 mm.; tail, 150–175; hind foot, 45–50; condylobasal length, 45–50; zygomatic width, 25–27; width of brain case, 18–21; maxillary tooth row, 17–20.

Subspecies.—Six geographic forms of *Tupaia glis* may be recognized. They are all insular, except *ferruginea* occurring on the Malay Peninsula and Sumatra, but appear so closely allied to one another that it is often impossible to distinguish them one from the other with certainty.

The forms are:

Tupaia glis ferruginea, southern third of Malay Peninsula, Sumatra, page 41.
Tupaia glis glis, Penang Island, page 45.
Tupaia glis batamana, Batam Island, page 46.
Tupaia glis sordida, Tioman Island, page 48.
Tupaia glis pemangilis, Pemangil Island, page 48.
Tupaia glis pulonis, Aor Island, page 47.

Remarks.—*Tupaia glis* is quite a plastic species, as the number of subspecies shows. The next three species, *T. phaeura*, *T. tephrura*, and *T. demissa*, are all geographic forms of *T. glis*, but differentiation has proceeded so much further that their specific distinctness can not be questioned. It is perhaps a slight misfortune that the earliest name applied to the species was given to one of the insular races and not to the real parent form occurring on the large land masses. As a matter of convenience the mainland subspecies is here treated first and most of the comparisons are made with it. The mainland form is the most common in collections and the most convenient to work with.

TUPAIA GLIS FERRUGINEA Raffles.

1821. *Tupaia ferruginea* Raffles, Trans. Linn. Soc. London, vol. 13, 1822, p. 256, published May, 1821.
1821. *Tupaya press* Geoffroy and Cuvier, Hist. Nat. Mamm., vol. 3, livr. 35, p. 1, and *Sorex-Glis press* on p. 2, December, 1821, perhaps early in 1822.
1842. *Cladobates ferruginea*, Cuvier, Hist. Nat. Mamm., vol. 7, Tab. Gen. Meth., p. 2.
1843. *Hylogalea ferruginea*, Schlegel and Müller, Verh. Nat. Ges. Nederl. Overz. Bezitt., p. 163, pl. 26, fig. 3; pl. 27, figs. 7–10.
1879. *Tupaia ferruginea*, Anderson, Zool. Res. West. Yunnan, p. 130, pl. 7, figs. 4 and 5.

Type-locality.—Bencoolen, Sumatra.

Type-specimen.—British Museum Register No. 79.11.21.573, skin and skull of adult male, marked "Indian Mus. Coll. Sumatra, Sir S. Raffles." It is probably one of the specimens from "the woods near Bencoolen." Raffles says: "First observed tame in the house

of a gentleman at Penang, and afterwards found wild at Singapore and in the woods near Bencoolen." The Penang animal was described several months before *ferruginea* under the specific designation *glis*. No specimens collected at Singapore by Raffles are known, so that it is perfectly justifiable to take the above specimen as the type. It has recently been made into a modern study skin and is in fair condition. Some hair has slipped from about the head, legs, and base of tail. The color seems well preserved. The skull is nearly perfect; the occipital region, zygomata, and bullæ being slightly injured.

Geographic distribution.—Malay Peninsula south of about latitude 7½° N., including the island of Singapore; and most of island of Sumatra. For exact localities from which specimens have been examined, see table, pages 43, 44. See No. 6 on map on page 75.

Diagnostic characters.—A bright-colored member of the group, with upper parts of head and body distinctly ferruginous, tail a grizzle of buffy and blackish, rather distinctly different in color from body.

Color.—Upper parts of head, neck, and body, and outerside of legs a grizzle of ferruginous or chestnut and blackish, tail both above and below a grizzle of buffy and blackish, the black in excess above and the buff below, especially along the middle line; underparts including inner side of legs various shades of buff, often with dark bases of the hairs showing through; feet a fine grizzle of buffy and blackish, the latter color in excess; shoulder stripe moderately conspicuous, buffy in color.

Skull and teeth.—These show no special distinguishing characteristics. See plate 8, fig. 6, and figures 4 and 5 on page 33.

Measurements.—Type: Hindfoot, 45 mm; condylobasal length, 51; zygomatic width, 25±; width of braincase, 20; maxillary toothrow, 20. Usual measurements of adults: Head and body, 175–200; tail, 150–175; hindfoot, 42–47; condylobasal length, 47–49; zygomatic width 25–27; width of brain case, 19–20; maxillary toothrow, 18–20. For measurements of all specimens examined, see table, pages 43, 44.

Remarks.—*Tupaia glis ferruginea* has one of the largest areas of distribution of any of the forms in the family, and appears very constant in its characters. I have been able to find no essential differences between specimens from the Malay Peninsula and the island of Sumatra. This case is exactly paralleled by *Tragulus napu*.[1]

An old specimen, British Museum, Register No. 79.6.28.15, collected at Pajo, Sumatra, by Carl Bock, approaches very closely *Tupaia phœura*.

Specimens examined.—Sixty in the United States National Museum, 37 in the British Museum, 1 in the Genoa Museum, 3 in the Berlin Museum.

[1] Miller, The Mouse Deer of the Rhio-Linga Archipelago: A Study of Specific Differentiation Under Uniform Environment, Proc. U. S. Nat. Mus., vol. 37, pp. 1–9, Sept. 1, 1909.

Measurements of Tupaia glis ferruginea.

Locality.	Number.	Sex.	Molar teeth worn.	Head and body.	Tail.	Hind foot.	Condylo-basal length.	Zygomatic width.	Width of brain case.	Maxillary tooth row.	Number of mammæ.
				mm.	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	
Sumatra, Loh Sidoh Bay.	114152.....	Female .	Moderately .	190	175	43	48±	25	19±	18.5	2–2
Do.....	114153.....	Male....	....do.....	190	.....	45	48	24.5	19	18.5	.....
Sumatra, Tarussan Bay.	141074.....	...do....	.....do.....	200	175	47	49.5	26.5	20	19	.....
Do.....	141075.....	...do....	None[1].....	186	175	47	.....	.....	20	19	.....
Sumatra, Tapanuli Bay.	114548.....	Female .	Slightly.....	195	170	44	47.5	25.5	20	18.5	2–2
Do.....	114549.....	Male....	Moderately .	200	190	47	.....	25	19.5	19	.....
Do.....	114553[14].....	(?).....	Slightly.....	.....	.....	.....	49	26	19.5	18.5	.....
Sumatra, Aru Bay..	143328[2].....	Male....	(3).....	205±	155	44	.....	.....	.....	.....	.....
Do.....	143329.....	...do....	Moderately .	197	178	47	48.5	26	20	18.5	.....
Do.....	143330.....	...do....	Slightly [4]....	200	170	46	.....	24±	.....	19	.....
Do.....	143331.....	...do....	.....do.[5].....	.....	.....	.....	47	24±	.....	18	.....
Do.....	143332.....	...do....	None[1].....	200	162	45	46.5	23	19.5	17.5	.....
Do.....	143333.....	...do....	Moderately .	190	165	44	48	25	20	19	.....
Do.....	143334.....	Female .	Slightly.....	185	175	43	47	25	19	18.5	2–2
Do.....	143335.....	...do....	.....do.....	.....	.....	.....	49.5	25	19.5	19.5	.....
Do.....	143336.....	...do....	None[6].....	195	160	46	45.5	23±	19.5	18.5	.....
Do.....	143337.....	...do....	.....do.[1].....	170	145	43	.....	23.5	19.5	17.5	.....
Sumatra, Ranau, 3,300 feet.	82.7.28.5.....	Male....	Adult[2].....	210	155	46	.....	.....	.....	.....	.....
Sumatra, Pajo.....	79.6.28.15.....	.....	.....	.....	.....	45	.....	.....	.....	.....	.....
Sumatra, Bencoolen	79.11.21.573[7].	Male....	Moderately .	.....	.....	45	51	25±	20	20	.....
Sumatra, Si Rambi.	Genoa[2].....	Female .	None[8].....	150±	125±	45	.....	.....	.....	.....	.....
Sumatra.....	Berlin, 4059[9]	...do....	Adult.....	.....	.....	40	.....	.....	.....	.....	2–2
Johore, Tanjong Peniabong.	112658.....	...do....	Much.....	192	163	45	48	25.5	18.5	19	2–2
Johore, Endau River.	112577.....	...do....	Slightly[10]...	183	157	44	47	23.5	19	19	2–2
Do.....	112580.....	...do....	Moderately .	191	151	45	47	25.5	20	18.5	2–2
Do.....	112582.....	...do....	Slightly[10]...	190	143	44	49.5	23	20	19.5	.....
Do.....	112578.....	Male....	Much.....	195	155	43	47.5	26	20	19	.....
Do.....	112579.....	...do....	Slightly[10]...	200	165	44	49	25	19.5	19	.....
Do.....	112581.....	...do....	.....do.....	197	173	45	49.5	25.5	20	19.5	.....
Do.....	112601.....	...do....	Much.....	189	151	44	47	27.5	20	19	.....
Johore, Sembrong River.	112616.....	Female .	.....do.....	203	157	44	50	25.5	19	18.5	2–2
Do.....	112617.....	Male....	None[11].....	185	160	46	.....	24.5	20	19	.....
Johore, Tanjong Silantei.	112662.....	...do....	...do.[12].....	155	.....	43	48	24	19.5	18	.....
Johore, Endau River.	112576.....	Female .	None[13].....	.....	.....	.....	41	22	19.5	17±	.....
Johore, Pelepak....	143268.....	Male....	Slightly.....	190	165	47±	49±	26	20	19.5	.....
Do.....	143269.....	...do....	.....do.....	185	155	47±	49	25.5	20	19	.....
Johore, Pulai.....	143270.....	Female .	None[11].....	180	170	47	.....	25	19	18	.....
Johore, Endau River.	112575[14].....	(?).....	Moderately .	200	173	.....	48	25.5	20.5	19	.....
Do.....	112660[2].....	Female[15]	.....	170±	130	42	.....	.....	.....	.....	.....
Johore, Tanjong Peniabong.	112659[2].....	Male[16]..	.....	200±	160	44	.....	.....	.....	.....	.....
Tringanu, Tanjong Dungun.	105024.....	Female .	Slightly.....	184	165	42	48.5	24.5	19	19	.....
Do.....	105026.....	...do....	.....do.....	191	152	43	48	24	20	19	.....
Do.....	105027.....	...do....	.....do.....	178	165	43	46.5	24	19.5	18.5	.....
Do.....	105030.....	...do....	.....do.....	191	159	43	47	24.5	19.5	18	.....
Do.....	105031.....	...do....	Moderately .	190	160	44	47.5	24	19.5	19	.....
Do.....	105033.....	...do....	Much.....	187	152	44	47.5	25	20	18.5	2–2
Do.....	105034.....	...do....	Slightly.....	178	146	42	47	23	19	18	.....
Do.....	105025.....	Male....	Moderately .	178	159	44	48.5	24.5	19.5	19	.....
Do.....	105032.....	...do....	.....do.....	185	154	43	47	24.5	19.5	19	.....

[1] *dpm*,[3] *dpm*[4] still in place.
[2] Preserved in alcohol.
[3] Genitalia well developed.
[4] *dpm*[3] still in place.
[5] *dpm*,[3] *dpm*[4] still in place, permanent *c'* just appearing.
[6] *m*[3] half way up.
[7] Type.
[8] *m'* last tooth in place.
[9] v. Faber, collector.
[10] *pm*[4] in place, *pm*[3] half way up.
[11] *dpm*[3], *dpm*[4] not yet shed.
[12] *pm*[4] nearly in place, *dpm*[3] still in place.
[13] *m*[4] just appearing.
[14] Skull only.
[15] About two-thirds grown.
[16] Adult, genitalia well developed.

Measurements of Tupaia glis ferruginea—Continued.

Locality.	Number.	Sex.	Molar teeth worn.	Head and body.	Tail.	Hind foot.	Condylo-basal length.	Zygomatic width.	Width of brain case.	Maxillary tooth row.	Number of mammæ.
				mm.	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	
Tringanu, Tanjong Dungun.	105012[1]	Male	[2]	210±	170	46					
Do	105013[1]	do	[3]	190±	165	44					
Pahang, Rumpin River.	115490	Female	Slightly[4]	196	164	46	48.5	25.5	20	18.5	2-2
Do	115491	do	Moderately	205	163	47	49.5	25.5	19.5	18.5	2-2
Do	115492	do	None[5]				42	22	20		
Selangor, Kuala Lumpur.	152184	Male	Moderately	175	181	46		25±		18.5	
Do	152185	do		190	159	47±					
Singapore, Botanic Gardens.	111977, skin only.	Female		171	146	41					
Do	111979, skin only.	do		178	146	42					2-2
Do	105077	do	None[6]				44.5	23.5	19	18	
Do	105078[7]	do	Slightly				46±	25.5	19.5	19.5	
Do	105079[7]	do	Moderately				45.5	24.5	19	18.5	
Do	105080[7]	Male	Slightly				47.5	25	19	18.5	
Do	124316[1]	Female	[8]	210±		44					2-2
Do	124317, skeleton.	do	Moderately			46	49	25	19	19	
Do	124318[1]	do	[8]	200±		41					2-2
Singapore, Island of Changi.	9.4.1.106	Male	Moderately	174	157	45	48	26	19	19	
Do	9.4.1.108	do	do	192	163	45	49.5	27	19.5	19.5	
Do	9.4.1.109	Female	do	195	160	46	50	26	19	19.5	2-2
Do	9.4.1.107	Male	do	184	162	44	48	25.5	19	19.5	
Do	9.4.1.111	Female	do	184	158	43	49	25	20	19.5	2-2
Do	9.4.1.110	do	Slightly	169	154	42	47	24	19.5	18.5	2-2
Do	9.4.1.105	Male	do	178	156	43	47	25	19.5	19	
Singapore, Woodlands.	5.12.7.7	Female	None	179	155	41		25	20	19	2-2
W. Singapore Is.	94.11.28.1[1]	Male		165	140	44					
Singapore	5475, Berlin.	(?)	Moderately			41	47±	25	20	19	
Gunong Tahan, Pahang, 3,300 feet.	6.10.4.10	Male	Slightly	167	172	45		26	20	19	
Do	6.10.4.11	Female		180	153	44					2-2
Pahang River, Kuala Temelong.	6.10.4.12	Male	Much	151	139	42	49	26.5	19	19	
Selangor, Ginting Bidai.	10.10.1.15	Female	Moderately	172	164	45	48	25.5	19.5	19	2-2
Do	10.10.1.14	Male	None[9]	145	106	45			19.5		
Do	10.10.1.12	do	Moderately	168	160	44	48	26.5	19	19	
Do	10.10.1.13	do	do	185	171	47	49.5	27	19.5	19.5	
Do	10.10.1.16	Female	do	195	166	45		26	20	19.5	2-2
Selangor, Telang	85.8.1.93	Male									
Johore, Pulai	5.12.7.6	Female	Slightly	177	178	44	49		20	19.5	
Johore, Pelepak	5.12.7.3	Male	do	180	170	45	49	24.5	19.5	19.5	
Do	5.12.7.1	do	do	180	160	42	48	23.5	19.5	19	
Do	5.12.7.2	do	None[10]	180	150	44	49	24.5	20	19.5	
Do	5.12.7.5	Female	Moderately	187	158	43	49.5	25	20	20	2-2
Johore, Boru	5.12.7.4	do	Slightly			45		25.5	20.5	20	
Johore, Si Karang	9.4.1.112	Male	None[11]	171	164	44	47.5		19.5	18.5	
Do	9.4.1.113	Female	Slightly	175	161	45	50	25	19.5	20	2-2
Malacca	79.11.21.310	do				46					2-2
Do	79.11.21.572		None[11]			44				19.5	
Do	79.11.21.571		None			44		24		17	
Do	79.11.21.689	Female	Much			43				19	2-2
Do	85.8.1.92		None[12]			44				18	
Do	85.8.1.91					44					
Wellesley Province	79.11.21.688										
Biserat	3.2.6.22	Male	Much	160	164			27	19.5	19.5	
Kelantan	9.5.9.1	do	Moderately	189	152	43	49	26	19.5	19	

[1] Preserved in alcohol.
[2] Adult, genitalia moderately developed.
[3] Adult, genitalia well developed.
[4] dpm^3 dpm^4 still in place.
[5] m^1 last tooth in place.
[6] dpm^3 dpm^3 still in place, pm^2 just appearing.
[7] Skull only.
[8] Adult.
[9] I^1 just appearing.
[10] Permanent incisors not in place.
[11] dpm^4 still in place.
[12] di^1 and di^2 still in place.

TUPAIA GLIS GLIS (Diard).

1820. *Sorex glis* DIARD, Asiat. Journ. Month. Reg., vol. 10, p. 478, November, 1820.

1821. *Tupaia ferruginea* RAFFLES, Trans. Linn. Soc. London, vol. 13, 1822, p. 256, published May, 1821.

1822. *Sorex glis*, DIARD and DUVAUCEL, Asiat. Res., vol. 14, p. 472, pl. 9.

1911. *Tupaia ferruginea penangensis* ROBINSON and KLOSS, Journ. Fed. Malay States Mus., vol. 4, p. 242, November, 1911. (Type No. 1445/11, Selangor Museum, collected at Telok Behang, Penang Island, Apr. 2, 1911.)

Type-locality.—Penang Island, off west coast of Malay Peninsula.

There is no type-specimen of *Tupaia glis glis*. Penang is the only exact locality mentioned in the original description, and consequently is regarded here as the type-locality. No mention of its occurring on the Malay Peninsula is made. Of course Diard and Raffles had the same animal in mind in describing their respective species, but the practical results are that *glis* is the name for the Penang animal and *ferruginea* for the Sumatran and peninsular one.

Geographic distribution.—Penang Island. See No. 21 on map on page 75.

Diagnosis.—A slightly differentiated geographic form of *Tupaia glis*, differing in smaller size and a duller paler coloration of the upper parts.

Color.—The general style of coloration of *Tupaia glis glis* is very similar to that of wide ranging *T. glis ferruginea*, but the upper parts of body instead of being a fine grizzle of ferruginous or chestnut and blackish, is a grizzle of rather dark tawny or tawny ochraceous and blackish, while the head and neck are a grizzle of ochraceous buff and blackish. The tail is generally duller in *T. glis glis*. In other respects the two animals are essentially the same.

Skull and teeth.—The skull and teeth of *Tupaia glis glis* are distinctly smaller than those of *T. glis ferruginea*, especially seen in the brain case. (Plate 8, fig. 8.)

Measurements.—The usual measurements of adults: Head and body, 165 mm.; tail, 155; hindfoot, 42–43; condylo-basal length, 47; zygomatic width, 25; width of braincase, 19; maxillary tooth row, 18.5; most of them agreeing with the minimum measurements of *Tupaia glis ferruginea*. For measurements of all specimens examined see table, page 46.

Remarks.—*Tupaia glis glis* is closely related to *T. glis ferruginea* of the neighboring mainland of which it is zoologically a geographic form. Robinson and Kloss were entirely right in describing it as a subspecies of the mainland animal, and it is perhaps a misfortune that *glis* was not originally used for the mainland form, or rather that *ferruginea* was not proposed first, as the latter name has been so long in use that it seems a pity to have it rank as a subspecies.

Specimens examined.—Seven in the British Museum, and two loaned by the Selangor Museum. See table, page 46.

Measurements of Tupaia glis glis.

Locality.	Number.	Sex.	Molar teeth worn.	Head and body.	Tail.	Hind foot.	Condylo-basal length.	Zygomatic width.	Width of brain case.	Maxillary toothrow.	Number of mammæ.
				mm.	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	
Penang Island..	79.11.21.309....	Male....	None [1].....	.....	.....	41	.....	.....	18.5	18	.....
Do.....	79.11.21.307....	...do....	.....do.[2]...	.....	.....	41	45	23	18.5	18	.....
Do.....	60.5.4.72.....	Female..	Moderately..	.....	.....	43	46	25.5	19.5	17.5	.....
Do.....	79.11.21.333....	Male....	None [3].....	.....	.....	42	45	.....	18.5	17	.....
Do.....	60.5.4.71.....	...do....	.....do.....	.....	.....	43	46.5	25	20	18.5	.....
Do.....	79.11.21.308....	...do....	.....do.[4]...	.....	.....	42	43	22	19.5	17.5	.....
Do.....	79.11.21.687....	Female..	Much.....	.....	.....	43	48	25	20	19	2–2
Do.....	S. M. 1442/11[5] .	...do....	Moderately..	165	155	42	46	24.5	19	19	2–2
Do.....	S. M. 1444/11..	Male....	.....do.....	163	156	43	47.5	25.5	19	18	.....

[1] i^1 and i^2 just appearing.
[2] i^1 just appearing.
[3] di^1 and di^2 still in place.
[4] m^3 just appearing.
[5] S. M.—Selanger Museum, Federated Malay States.

TUPAIA GLIS BATAMANA Lyon.

1907. *Tupaia ferruginea batamana* Lyon, Proc. U. S. Nat. Mus., vol. 31, p.656, Jan. 16, 1907.

Type-locality.—Senimba Bay, Batam Island, Rhio Archipelago.

Type-specimen.—In United States National Museum, Cat. No. 142151, Senimba Bay, Batam Island, September 15, 1905; collected by Mr. C. Boden Kloss; original number, 2; in good condition.

Geographic distribution.—Batam Island. See No. 18 on map on page 75.

Diagnosis.—A geographic form of *Tupaia glis* having a somewhat grayer tail than has the mainland form *ferruginea* and rather heavier skull and teeth.

Color.—With the exception of its slightly grayer tail and a brighter and more rufescent shade of the upper parts of body, *Tupaia glis batamana* does not differ from typical *T. glis ferruginea.*

Skull and teeth.—The skull and teeth of *Tupaia glis batamana* differ only in their slightly greater size from those of *T. glis ferruginea,* the majority of specimens showing a condylo-basal length of over 49 mm., and a zygomatic width of more than 26, while in the mainland animal only a relatively small number exceed these measurements; the tooth row is 19 mm. or over, and in *T. glis ferruginea* is 19 or under. (Plate 8, fig. 9.)

Measurements.—Type: Head and body, 200 mm.; tail 160; hind foot, 45; condylo-basal length, 50.5; zygomatic width, 27.5; width of brain case, 20; maxillary tooth row, 20. Extreme measurements: Head and body, 180–200; tail, 141–161; hind foot, 43–47; condylo-basal length, 47–51.5; zygomatic width, 26–28.5; width of brain case, 19–20; maxillary tooth row, 19–20.5. See table, page 47.

Specimens examined.—Fifteen, 6 of them preserved in alcohol.

Measurements of Tupaia glis batamana.

Locality.	Number.	Sex.	Molar teeth worn.	Head and body.	Tail.	Hind foot.	Condylo-basal length.	Zygomatic width.	Width of brain case.	Maxillary tooth row.	Number of mammæ.
				mm.	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	
Batam Island, Senimba Bay.	142151 [1]	Female	Slightly	200	160	45	50.5	27.5	20	20	.....
Do	142152	do	Moderately	180	154	43	48.5	26	19	19	.....
Do	143255 [2]	do	do	190	155	44	49.5	27	19.5	19.5	2-2
Do	143256 [2]	do	do	185	150	45	50	26.5	20	20	2-2
Do	143257 [2]	do	do	185	150	43	47	26	19	19	2-2
Do	143252 [2]	Male	Slightly	185	150	47	49.5	27	19.5	19.5	.....
Do	143253 [2]	do	Moderately	190	150	46	49.5	27	19.5	19.5	.....
Do	143254 [2]	do	Much	195	145	44	49.5	27	19	19	.....
Batam Island, Tanjong Turut.	9.4.1.115	do	Moderately	197	158	44	50	28	19.5	19.5	.....
Do	9.4.1.119	Female	Slightly	192	145	44	48.5	27	19	19.5	2-2
Do	9.4.1.116	Male	do	197	161	43	49	26.5	19	19.5	.....
Do	9.4.1.118	Female	Much	194	160	45	50	28.5	20	19.5	2-2
Do	9.4.1.117	Male	Moderately	199	158	45	50	27	19	20	.....
Do	9.4.1.120	Female	Slightly	192	153	47	51.5	26.5	19.5	20.5	2-2
Do	9.4.1.114	Male	do	192	141	47	48.5	27	19.5	19	.....

[1] Type. [2] Preserved in alcohol.

TUPAIA GLIS PULONIS Miller.

1903. *Tupaia pulonis* Miller, Smiths. Misc. Coll., vol. 45, p. 56, Nov. 6, 1903.

Type-locality.—Pulo Aor, off east coast of Malay Peninsula.

Type-specimen.—In United States National Museum, Cat. No. 112449, skin and skull, adult female, Pulo Aor, June 7, 1901; collected by Dr. W. L. Abbott; original number, 1023; in good condition.

Geographic distribution.—Known only from Pulo Aor, the type-locality. See No. 30 on map on page 75.

Diagnosis.—A geographic race of *Tupaia glis* differing from the mainland animal in being rather duller in color, and tail lighter and more buffy.

Color.—The ferruginous-chestnut color of *Tupaia glis ferruginea* is replaced in *T. glis pulonis* by a color approaching tawny, and in the mixture of buffy and blackish in the tail, the buff is in excess; the under parts and inner side of legs are lighter and nearly cream color. The shoulder stripes are lighter and more conspicuous than they are in *T. glis ferruginea.* The general coloration of the Aor animal is not unlike that of *Tupaia glis glis,* but the under parts and tail are lighter and the general color above more ferruginous.

Skull and teeth.—These do not show any tangible characters by which *Tupaia glis pulonis* can be separated with certainty from related forms.

Measurements.—Type: Head and body, 197 mm.; tail, 175; hind foot, 42; condylo-basal length, 47.5; zygomatic width, 26; width of brain case, 19; maxillary tooth row, 18.5. For measurements of a second specimen, see table, page 51.

Specimens examined.—Two in the United States National Museum.

TUPAIA GLIS SORDIDA Miller.

1900. *Tupaia sordida* MILLER, Proc. Wash. Acad. Sci., vol. 2, p. 231, Aug. 20, 1900.

Type-locality.—Pulo Tioman, off east coast of Malay Peninsula.

Type-specimen.—In United States National Museum, Cat. No. 101747, Pulo Tioman, October 2, 1899; collected by Dr. W. L. Abbott; in good condition.

Geographic distribution.—Pulo Tioman. See No. 28 on map on page 75.

Diagnosis.—Essentially the same in color as *Tupaia glis pulonis*, but under parts darker and more buffy; condylo-basal length slightly less.

Color.—Color of upper parts of head, neck, and body and outer side of legs is not distinguishable from that of *Tupaia glis pulonis;* shoulder stripe less prominent; under parts and inner side of legs dull buff to dull ochraceous buff with considerable of the dark bases of the hairs showing through; underside of tail grayer and less buffy than in the case of *T. glis pulonis*.

Skull and teeth.—These do not show any very tangible differences from those of *T. glis pulonis*, but the condylo-basal length averages about 2 mm. less, and the skull as a whole appears narrower and slenderer, especially when compared with *T. glis ferruginea*. (Plate 9, fig. 8.)

Measurements.—Type: Head and body, 171 mm; tail, 165; hind foot, 40; condylo-basal length, 45.5; zygomatic width, 25.5; width of brain case, 19; maxillary tooth row, 18. For measurements of all the specimens examined see table, page 51.

Specimens examined.—Six in United States National Museum and two in British Museum.

TUPAIA GLIS PEMANGILIS Lyon.

1911. *Tupaia pemangilis* LYON, Proc. Biol. Soc. Wash., vol. 24, p. 168, June 16, 1911.

Type-locality.—Pulo Pemangil, off east coast of Malay Peninsula.

Type-specimen.—In United States National Museum, Cat. No. 112499, Pulo Pemangil, June 12, 1901; collected by Dr. W. L. Abbott; original number, 1064; in good condition.

Geographic distribution.—Pulo Pemangil. See No. 29 on map on page 75.

Diagnosis.—Essentially the same color as *Tupaia glis pulonis*, but hind foot smaller and skull smaller and slenderer.

Color.—The color of *Tupaia glis pemangilis* does not differ from that of *T. glis pulonis*.

Skull and teeth.—The skull and teeth are very similar to those of *Tupaia glis pulonis* and *T. glis sordida*, but the skull is slenderer, slightly shorter; m^3 is smaller; bullæ are slightly smaller.

Measurements.—*Tupaia glis pemangilis* is slightly smaller than the closely related *T. glis pulonis*. External and cranial measurements

of the type: Head and body, 185 mm.; tail, 150; hind foot, 40; condylobasal length, 45; zygomatic width, 23.5; width of brain case, 19; maxillary tooth row, 17.

Specimen examined.—One, the type.

Remarks.—The three forms just enumerated, *Tupaia glis pulonis*, *T. g. sordida*, and *T. g. pemangilis*, are very closely related to one another. These three insular forms are not based on large series and it does not appear improbable that larger numbers might even show that but a single form inhabited the three geographically associated islands of Tioman, Pemangil, and Aor, as the differences separating the three are not greater than are often found in the same form having a greater area of distribution.

TUPAIA PHÆURA Miller.

1902. *Tupaia phæura* MILLER, Proc. Acad. Nat. Sci. Phila., 1902, p. 157, June 11, 1902.

Type-locality.—Sinkep Island, Rhio-Linga Archipelago.

Type-specimen.—In United States National Museum, Cat. No. 113148, skin and skull, adult male, Sinkep Island, September 4, 1901; collected by Dr. W. L. Abbott; original number, 1275; in good condition.

Geographic distribution.—Sinkep Island. See No. 19 on map on page 75.

Diagnosis.—Related to *Tupaia glis ferruginea*, but rather dark and reddish, and with the tail not essentially different in color from rest of the animal. Mammæ, 2–2 = 4.

Color.—*Tupaia phæura* differs in color from *T. glis ferruginea* in having less black mixed in with the ferruginous-chestnut in the region of the neck and shoulders and more black and less grizzling on the lower back and rump. The tail both above and below is a coarse grizzle of black and tawny ochraceous, the black predominating on the upper surface and the tawny ochraceous slightly in excess in the middle line below. When viewed from above the tail is concolor with the rest of the upper parts. The under parts, legs, feet, shoulder stripe, etc., do not differ in color from the corresponding parts of *T. glis ferruginea*.

Skull and teeth.—There are no characters by which the skulls and teeth of *Tupaia phæura* can be distinguished from those of *T. glis erruginea*. (Plate 9, fig. 7.)

Measurements.—Type: Head and body, 195 mm.; tail, 140; hind foot, 44; condylobasal length, 47.5; zygomatic width, 26.5; width of brain case, 19.5; maxillary tooth row, 19. For measurements of 2 other specimens see table, page 51.

Remarks.—*Tupaia phæura* is a very strongly characterized geographic form of *T. glis* and has no close relatives. It is at once dis-

tinguished from *T. glis* and its subspecies by the characters of its tail. It seems curious that with all the large collections made in the Rhio-Linga Archipelago by Dr. W. L. Abbott that on only four islands—Batam, Bintang, Linga, Sinkep—have treeshrews been collected by him: a slightly differentiated form of *T. glis* on Batam, the very distinct *Tupaia phœura* or Sinkep, and on Bintang a member of the *splendidula* group. On Linga and Sinkep occur treeshrews of a very different group (*Tupaia minor*) and genus (*Tana*).

Specimens examined.—Three. See table, page 51.

TUPAIA TEPHRURA Miller.

1903. *Tupaia tephrura* MILLER, Smiths. Misc. Coll., vol. 45, p. 57, Nov. 6, 1903.
1909. *Tupaia tephura* (sic), LYON AND OSGOOD, Bull. U. S. Nat. Mus., 62, p. 250.

Type-locality.—Tana Bala, Batu Islands, off west coast of Sumatra.

Type-specimen.—In United States National Museum, Cat. No. 121752, skin and skull of adult female, Tana Bala Island, February 12, 1903; collected by Dr. W. L. Abbott; original number, 2276; in good condition.

Geographic distribution.—Known only on Tana Bala Island, but probably occurring on other islands of the Batu group. See No. 20 on map on page 75.

Diagnosis.—A dark-colored member of the *Tupaia glis* group of treeshrews, darker than *T. phœura*, but with a distinctly lighter tail. Mammæ 2–2 = 4.

Color.—Compared with *Tupaia glis ferruginea*, *T. tephrura* has a generally darker color effect, the ferruginous tones being deeper and richer, and on the posterior half of the body there is a greater admixture of black; the ferruginous extends further forward, distinctly coloring the top and sides of head. The legs are darker in color than they are in *T. glis ferruginea;* the feet are almost black. The underparts are slightly darker than is usual in *T. glis ferruginea.* The tail is a mixture of black or blackish and buff or buffy; above at the base the black predominates, but for the posterior half the two colors are about equally mixed; on the underside the buffy color in excess, and on either side of the middle line is almost unmixed with blackish, and rather closely approaches the style of tail of the *T. splendidula* group.

Skull and teeth.—The skull and teeth of *Tupaia tephrura* are not essentially different from those of *T. glis ferruginea.* (Plate 8, fig. 7.)

Measurements.—Type: Head and body, 193 mm.; tail, 130 hind foot, 43; condylo-basal length, 48.5; zygomatic width, 25.5; width of brain case, 19.5; maxillary tooth row, 19. See table, page 51.

Remarks.—*Tupaia tephrura* is a well-marked geographic form of *T. glis.* Curiously enough it has many external resemblances to *T. phœura* of Sinkep on the opposite side of Sumatra, but it is distinctly darker and more ferruginous anteriorly, and its tail is buffy

where that of *T. phæura* is tawny ochraceous, and is distinctly different in color from the rest of the upper parts.

Specimens examined.—Two, from Tana Bala.

Measurements of five insular forms of the Tupaia glis group of treeshrews.

Name.	Locality.	Number.	Sex.	Molar teeth worn.	Head and body.	Tail.	Hind foot.	Condylo-basal length.	Zygomatic width.	Width of brain case.	Maxillary tooth row.	Number of mammæ.
					mm	*mm*	*mm*	*mm*	*mm*	*mm*	*mm*	
T. glis pulonis....	Pulo Aor.....	112449 [1]...	Female	Moderately	197	175	42	47.5	26	19	18.5	2-2
Do.....	.....do.....	112448....	Male...	None [2].....	195	190	43	48	26	19.5	19.5	....
T. glis pemangilis.	Pulo Pemangil.	112499 [1]...	Female	Moderately	185	150	40	45	23.5	19	17	2-2
Tupaia glis sordida.	Pulo Tioman...	101746....	...do...	Slightly....	178	140	39	45	24	19	17.5	....
Do.....	.....do.....	101747 [1]...	Male...	Moderately	171	165	40	45.5	25.5	19	18	....
Do.....	.....do.....	104973....	Female	.....do.....	172	152	39	46.5	25	19	17.5	....
Do.....	.....do.....	104974....	...do...	Slightly....	178	146	41	45	24	19	17.5	....
Do.....	.....do.....	104975....	Male...	Moderately	178	152	41	46.5	25	19	18	....
Do.....	.....do.....	104976....	Female	Much.....	189	152	42	46	25	19	18	2-2
Do.....	.....do.....	10.10.1.11.	Male...	Slightly....	187	....	39	46.5	25	19.5	18.5	....
Do.....	.....do.....	8.1.25.4...	Female	Much.....	176	140	40	46.5	25	19.5	18.5	....
T. phæura.....	Pulo Sinkep...	113148 [1]...	Male...	Moderately	195	140	44	47.5	26.5	19.5	19	....
Do.....	.....do.....	113147....	Female	Much.....	185	140	42	46.5	25.5	19.5	18.5	2-2
Do.....	.....do.....	113149....	...do...	.....do.....	195	140	43	47.5	25	19.5	18.5	2-2
T. tephrura.....	Batu Ids.; Tana Bala.	121752 [1]...	...do...	Moderately	193	130	43	48.5	25.5	19.5	19	2-2
Do.....	.....do.....	121751....	Male...	None [2].....	180	150	44	47.5	25	19.5	19.5	....

[1] Type.

[2] Permanent pm^4 half way up.

TUPAIA LACERNATA Thomas and Wroughton.

(Synonymy, type-specimens, etc., under the subspecies.)

Geographic distribution.—The middle third of the Malay Peninsula, and some of the adjacent islands. See Nos. 5, 23, 24, 38, and 39 on map on page 75.

Diagnosis.—Size, skull, and teeth about as in *Tupaia glis*, intermediate in color between *T. belangeri* and *T. glis;* upper parts of head and anterior half of body a grizzle of ochraceous buff and black, of posterior half of body a grizzle of tawny and black, tail generally darker than rest of upper parts; mammæ 2–2 = 4, as in *T. glis*, and not 3–3 = 6, as in *T. belangeri.*

Color.—Upper parts of head, neck, and anterior half of body, including outerside of forelegs, a fine grizzle of ochraceous or ochraceous buff and black, the darker color rather in excess, the general color effect being similar to light raw umber, in certain lights, with an olivaceous cast; upper parts of posterior half of body, including outerside of hind legs, a grizzle of tawny and black, both colors about equally mixed, producing a general color effect of russet, tail above, a coarse grizzle of black and buff, the former color in excess, and the tail as a whole distinctly darker and more blackish than rest of upper parts; underside of tail with the same colors, but the buffy predominating especially in the middle line; under parts of head, neck

and body cream color to dull orange buff, with more or less of the dark bases of the hairs showing through, inner side of legs colored similarly to under parts, but hairs scantier and colors duller; shoulder stripe moderately pronounced, buffy in color.

Skull and teeth.—These do not differ materially from those of *Tupaia glis;* the rostrum is if anything slightly relatively shorter in the more northern animal.

Measurements.—The usual measurements are: Head and body, 175–200 mm.; tail, 150–185; hind foot, 41–46 (less than in *T. glis*); zygomatic width, 24–26; width of brain case, 18.5–20; maxillary tooth row, 17.5–19.5.

Subspecies.—In addition to the mainland form, four insular forms are recognized:

Tupaia lacernata wilkinsoni, middle third of Malay Peninsula, page 52.

Tupaia lacernata lacernata, islands of Lankawi and Terutau, page 53.

Tupaia lacernata raviana, Butang Islands, page 54.

Tupaia lacernata obscura, Great Redang Island, page 55.

Tupaia lacernata longicauda, Perhentian Island, page 56.

Remarks.—As a matter of practical convenience the mainland subspecies is first described, and comparison of the insular races made with it. *Tupaia lacernata* is almost a perfect intermediate so far as color is concerned between *T. glis* and *T. belangeri.* *Tupaia belangeri* is lighter in color and the contrast of its rather tawny rump with the lighter anterior parts of the body more marked; its tail is not so dark. The point of most perfect differentiation, however, is the number of mammæ. Twenty-four females of *T. lacernata* showing developed mammæ have the number 2–2=4, while 21 females of *T. belangeri* have the number 3–3=6.

TUPAIA LACERNATA WILKINSONI Robinson and Kloss.

1911. *Tupaia ferruginea wilkinsoni* Robinson and Kloss, Journ. Fed. Malay States Mus., vol. 4, No. 2, p. 173, April, 1911.

Type-locality.—Ko-khau, Tarang (also spelled Trang and Trong), Lower Siam.

Type-specimen.—In the Selangor Museum, No. 1138/10, skin and skull of adult male. Ko-khau, Tarang, January 12, 1910. I have not seen this type.

Geographic distribution.—Tarang and extending northward toward southern Tenasserim. See No. 5 on map on page 75.

Diagnosis.—The brightest colored member of the species; rump more tawny, larger than the insular forms except *T. lacernata longicauda;* tail not so blackish as in the forms on the west coast islands, but darker than those on the east coast islands.

Color.—As described above under the species, brighter than any of the subspecies, tail moderately blackish, rump rather tawny; shoulder stripe rather well developed.

Skull and teeth.—Aside from their relatively larger size, the skull and teeth of *T. lacernata wilkinsoni* do not differ essentially from those of the related subspecies. (Plate 2 and plate 8, fig. 3.)

Measurements.—Collector's external measurements taken in the flesh (probably the type but not stated in the description): Head and body, 180 mm.; tail, 175; hind foot, 42; ear, 16. Cranial measurements: Probably the type; greatest length, 51.8; basal length, 44.9; zygomatic breadth, 25.9; cranial breadth, 20.9. Usual measurements of adults: Head and body, 180–195; tail, 150–170; hind foot, 43–45; condylo-basal length, 47–49; zygomatic width, 24–26; width of brain case, 19–20; maxillary tooth row, 18–19. See table below.

Specimens examined.—Nineteen, in the collections of the United States National, British, and Selangor Museums. See table below.

Measurements of Tupaia lacernata wilkinsoni, longicanda, obscura.

Name.	Locality.	Number.	Sex.	Molar teeth worn.	Head and body.	Tail.	Hind foot.	Condylo-basal length.	Zygomatic width.	Width of brain case.	Maxillary tooth row.	Number of mammæ.
					mm	*mm*	*mm*	*mm*	*mm*	*mm*	*mm*	
T. lacernata wilkinsoni.	Tarang, Telibon Island.	S3256	Female.	Moderately	.....	....	42	45.5	25	19	17.5	2-2
Do	Tarang	S3477	Male	...do	191	159	43	49	25	18.5	18.5	....
Do	...do	S3254	...do	Much	178	152	43	47.5	26	18.5	18	....
Do	...do	S3257	...do	Moderately	178	165	42	45	26	19	16.5	....
Do	...do	86727 [1]	Female.	Adult	215±	165	42	....	....	....	....	2-2
Do	Chong, Tarang.	10.10.1.21	...do	Slightly	168	181	42	44	24	19	17	2-2
Do	...do	10.10.1.20	Male	Moderately	188	172	44	47	24.5	19	19	....
Do	...do	10.10.1.24	Female.	None	166	170	44	47	24	19.5	19	....
Do	...do	10.10.1.22	...do	...do.[3]	161	160	40	....	....	18	....	....
Do	...do	10.10.1.17	Male	Moderately	181	144	42	47.5	26	20	18.5	....
Do	...do	10.10.1.18	...do	Slightly	179	141	43	46.5	24	19.5	19	....
Do	...do	10.10.1.19	Female.	Moderately	181	162	41	48	25	19	19	2-2
Do	...do	10.10.1.23	...do	...do	192	173	45	49	26	19.5	19.5	2-2
Do	Lamra, Tarang.	10.10.1.28	...do	...do	196	170	43	48.5	25	19.5	19.5	2-2
Do	...do	10.10.1.27	...do	...do	185	156	45	48	25	20	19	2-2
Do	...do	10.10.1.25	Male	...do	201	171	45	48	....	19	19	....
Do	...do	10.10.1.26	Female.	Slightly	186	160	43	47	25	19	18.5	2-2
Do	Chong, Tarang.	SM.[2] 36/10	Male	Moderately	191	167	45	48	25	19.5	18	....
Do	...do	SM.34/10	Female.	Slightly [4]	176	173	43	48	24.5	19.5	18.5	2-2
T. lacernata longicanda.	E. Perhentian Island.	S.M.2303/10.	Male	Moderately	171	189	45	47.5	25.5	18	19	....
Do	...do	S.M.2315/10.	Female.	...do	190	184	46	48.5	26.5	20	18.5	2-2
T. lacernata obscura.	Gt. Redang Island.	S.M.2287/10.	...do	...do	174	179	42	44	24	18.5	17.5	2-2
Do	...do	S.M.2282/10.	Male	...do	167	163	40	43	25	19	18.5	....

[1] Preserved in alcoholic. [2] Selangor Museum. [3] *pm*[3] not in place. [4] Permanent i_1 and *c* not in place.

TUPAIA LACERNATA LACERNATA Thomas and Wroughton.

1909. *Tupaia lacernata* Thomas and Wroughton, Ann. Mag. Nat. Hist., ser. 8, vol. 4, p. 535, December, 1909.

Type-locality.—Island of Lankavi off the west coast of the Malay Peninsula.

Type-specimen.—In British Museum, Reg. No. 9.11.1.30, skin and skull of adult female, Pulo Lankavi (Kubong Bodak Island, an adjacent islet); collected March 18, 1909, by Mr. H. C. Robinson; original number, 2673; in good condition.

Geographic distribution.—Islands of Lankavi and Terutau, including adjacent islets, west coast of Malay Peninsula. See No. 23 on map on page 75.

Diagnosis.—Differs from *Tupaia lacernata wilkinsoni* of the opposite mainland in its slightly smaller size and less tawny rump, darker tail, and less conspicuous shoulder stripe, and slightly smaller skull and teeth.

Color.—As described above under the species, the tawny element of the rump less pronounced than in the mainland form, and with the dark elements of the tail when viewed from above more conspicuous and contrasted with the color of the back.

Skull and teeth.—These are nearly identical in appearance with those of the mainland animal, but on the whole appear slightly smaller. (Plate 8, fig. 5.)

Measurements.—Type: Head and body, 180 mm.; tail, 155; hind foot, 44; condylo-basal length, 47.5; zygomatic width, 25; width of brain case, 20; maxillary tooth row, 19. Usual measurements: Head and body, 170–185; tail, 140–150; hind foot, 42–44; condylobasal, 45–47, zygomatic width, 24–25; width of brain case, 19; maxillary tooth row, 18. For details of measurements see table, page 57.

Specimens examined.—Seventeen from Pulo Terutau and 14 from Pulo Lankavi.

TUPAIA LACERNATA RAVIANA Lyon.

1911. *Tupaia raviana* LYON, Proc. Biol. Soc. Wash., vol. 24, p. 167, June 16, 1911.

Type-locality.—Pulo Rawi, Butang Islands, off west coast of Malay Peninsula.

Type-specimen.—In United States National Museum, Cat. No. 104355, Pulo Rawi, December 18, 1899; collected by Dr. W. L. Abbott; original number, 172; in good condition.

Geographic distribution.—Butang Islands, west coast of Malay Peninsula. See No. 24 on map on page 75.

Diagnosis.—Similar to *Tupaia lacernata lacernata* and *T. lacernata wilkinsoni*, but skull generally wider, and rostrum especially thicker and wider, but somewhat lighter in color, and not so tawny on the rump.

Color.—*Tupaia lacernata raviana* differs in color from *T. l. lacernata* in having the light annulations of the hairs less ochraceous and more buffy, and with only a trace of tawny on the rump; the black element of tail is less in evidence, so that the tail as a whole is somewhat lighter; the feet are grayer and less ochraceous than they are in *T. l. lacernata;* the underparts and shoulder stripe are not different in the two forms.

Skull and teeth.—In general, the skull and teeth of *Tupaia lacernata raviana* resemble those of *T. l. wilkinsoni* and *T. l. lacernata,* but the skull is noticeably wider, with a thicker and wider rostrum, and more spreading zygomata. The skull differences while not appearing considerable in a description, are quite marked when skulls of the two

forms are viewed together, and are greater than the differences seen in the skins. (Plate 8, fig. 4.)

Measurements.—Type: Head and body, 184 mm.; tail, 165; hind foot, 46; condylo-basal length, 46.5; zygomatic width, 25.5; width of brain case, 19; maxillary tooth row, 17.5; width of rostrum back of incisors, 7. For measurements of a second specimen from Pulo Adang, Butang Islands, see table, page 57.

Specimens examined.—Two from the Butang Islands, the type from Pulo Rawi, and one from Pulo Adang.

TUPAIA LACERNATA OBSCURA Kloss.

1911. *Tupaia obscura* Kloss, Ann. Mag. Nat. Hist., ser. 8, vol. 7, p. 116, January, 1911.

Type-locality.—Great Redang Island, off east coast of Malay Peninsula, near Tringanu.

Type-specimen.—In Selangor Museum, No. 2279/10. Skin and skull, adult male, Great Redang Island, September 2, 1910; collected by Mr. C. Boden Kloss, original number, 3708. I have not seen the type-specimen.

Geographic distribution.—Great Redang Island. See No. 39 on map on page 75.

Diagnosis.—Differs from the mainland *Tupaia lacernata wilkinsoni* in possessing a generally distinctly lighter coloration and smaller size.

Color.—Based on two topotypes kindly loaned by the Selangor Museum, Reg. Nos. 2282/10, and 2287/10. Neither of the two specimens are in uniformly the same pelage, both having a newer and darker pelage anteriorly, and an older and lighter posteriorly. General color of the upper part of head, neck, and body and outer side of legs a fine grizzle of blackish and tawny ochraceous (darker pelage areas) and of blackish and ochraceous (lighter pelage areas), the ochraceous or tawny ochraceous always in excess; tail, above, a uniform grizzle of blackish and cream buff, the darker color slightly in excess; tail, below, similar but the lighter color predominating, particularly in the middle line; under parts cream color to almost buff yellow; shoulder stripe well defined, whitish or cream color.

Skull and teeth.—The skull and teeth of *Tupaia lacernata obscura* differ from those of the related forms only in their generally smaller size and somewhat relatively larger bullæ.

Measurements.—"Collector's external measurements of type: Head and body, 173; tail, 167; hind foot, 40; ear, 15. Cranial measurements: Greatest length, 48; * * * basal length, 42; * * * greatest cranial breadth, 19.1; zygomatic breath, 25.8." For measurements of two topotypes, see table page 53, and see also Kloss., Jour. Fed. Malay States Museum, vol. 4, p. 192, October, 1911.

Specimen examined.—Two loaned by the Selangor Museum.

TUPAIA LACERNATA LONGICAUDA Kloss.

1911. *Tupaia ferruginea longicauda*, Kloss, Ann. Mag. Nat. Hist., ser. 8, vol. 7, p. 117, January, 1911.

1911. *Tupaia longicauda*, Kloss, Journ. Fed. Malay States Mus., vol. 4, p. 190, October, 1911.

Type-locality.—East Perhentian Island, off Tringanu, east coast of Malay Peninsula.

Type-specimen.—In Selangor Museum No. 2295/10, skin and skull adult female, East Perhentian Island, September 8, 1910. Collected by C. Boden Kloss; original number, 3517. I have not seen the type-specimen.

Geographic distribution.—East and West Perhentian Islands off east coast of Malay Peninsula. See No. 38 on map on page 75.

Diagnosis.—Differs from the other subspecies in its longer tail and lighter color.

Color.—Based on two specimens loaned by the Selangor Museum, Nos. 2303/10 and 2315/10. The general color of *Tupaia lacernata longicauda* is essentially the same as it is in the mainland *T. lacernata wilkinsoni*, but the ochraceous and tawny ochraceous bands on the hairs are wider and more conspicuous, and the lighter color is slightly in excess of the black; the grizzling is coarser, and there is less concentration of the tawny color on the rump, and the anterior parts have no indication of the slight olivaceous tint seen in *T. lacernata wilkinsoni;* essentially the same colors are found in the tails of *T. lacernata longicauda* and *wilkinsoni*, but the black is not in excess in *T. lacernata longicauda;* the under parts of the two forms are essentially alike; the hands and feet of *T. l. longicauda* are more ochraceous than they are in *T. l. wilkinsoni.*

Skull and teeth.—No appreciable differences exist between the skull and teeth of *Tupaia lacernata longicauda* and *T. lacernata wilkinsoni.*

Measurements.—"Collector's external measurements of the type: Head and body, 178; tail, 192; hind foot, 44; ear, 16. Cranial measurements: Greatest length, 51.7; basal length, 44.7; * * * greatest cranial breadth, 19.5; zygomatic breadth, 26.2." For measurements of two topotypes see table, page 53, and for measurements of additional specimens see Kloss, Journ. Fed. Malay States Mus., vol. 4, p. 193, October, 1911. The average external measurements of 24 adults given by Mr. Kloss is: Head and body, 177. 5; tail, 185.6; and hind foot, 43.5. A few specimens have the tail actually shorter than the head and body, 2304/10, 179, 176; 2315/10, 190, 184, and in one case equal 2214/10, 178, 178.

Specimens examined.—Two loaned by the Selangor Museum.

Remarks.—The two treeshrews just described are closely related to one another as well as to the mainland form from the middle of the Malay Peninsula from which they have evidently been derived. Although somewhat more like *Tupaia belangeri* in point of coloration than the other subspecies, yet the mammæ are 2-2=4. Typical

Tupaia glis ferruginea is found on the nearby mainland of Tringanu. *T. l. obscura* and *longicauda* are quite different from the tupaias found on Tioman, Pemangil, and Aor, which are distinctly of the *ferruginea* type.

Mr. Kloss [1] makes the following interesting observations on the habits of this treeshrew: "Of the numerous species of *Tupaia* which I collected personally, *T. longicauda* with *T. nicobarica*, Zelebor and its subspecies *T.* (*N.*) *surda*, Miller, alone are truly arboreal in habit. As a rule the so-called 'treeshrews' are seen and trapped on the ground where they live and feed, or, at most, climb occasionally into low bushes. In them the tail is shorter than the head and body length. The above-named animals, which are met with in high trees and have the habits of squirrels, all possess a tail that is considerably longer than the length of head and body."

Measurements of Tupaia lacernata lacernata and T. lacernata raviana.

Name.	Locality.	Number.	Sex.	Molar teeth worn.	Head and body.	Tail.	Hind foot.	Condylo-basal length.	Zygomatic width.	Width of brain case.	Maxillary toothrow.	Number of mammæ.
					mm	*mm*	*mm*	*mm*	*mm*	*mm*	*mm*	
T. lacernata lacernata.	Pulo Terutau	123981	Male	Moderately	170	150	41	45	24.5	19	18	....
Do	do	123984	do	Much	180	145	43	46	25.5	19	18.5	....
Do	do	123985	do	do	180	145	43	46	25	19	18.5	....
Do	do	123986	do	None [2]	170	145	41	....	....	....	18	....
Do	do	123982	Female	Much	180	143	43	47	24	18.5	18	2-2
Do	do	123983	do	Slightly [2]	170	140	42	43	22.5	19	17.5	....
Do	do	123987	do	Moderately	185	150	42	46.5	23.5	18	18	2-2
Do	do	123988 [3]	do	do	....	....	....	45	....	18.5	17.5	....
Do	do	123989 [4]	do	(5)	195±	145	43	....	....	....	....	2-2
Do	South Udang, Terutau.	9.11.1.17	Male	....	180	140	43	....	....	....	....	....
Do	do	9.11.1.20	Female	Moderately	160	155	42	45.5	24.5	18	17.5	2-2
Do	do	9.11.1.19	do	Much	170	140	42	46	25	18.5	19	2-2
Do	do	9.11.1.16	Male	Moderately	170	145	41	45	25	19	18	....
Do	do	9.11.1.15	do	do	180	150	43	46	25	19	18	....
Do	do	8.2.25.10	Female	None	158	151	42	47.5	24	19	18	2-2
Do	Terutau	9.11.1.14	Male	Much	175	135	42	....	....	....	18	....
Do	do	9.11.1.18	Female	do	185	144	42	45	24	19	18	2-2
Do	Pulo Lankawi	104353	Male	Slightly	171	152	42	46	25	20	18	....
Do	do	123901	do	Moderately	180	145	44	47	25	19	18.5	....
Do	do	104352	Female	None [6]	165	140	41	44	23	18.5	17	....
Do	do	123900	do	do [7]	175	155	42	46	24	19	18.5	....
Do	do	9.11.1.27	do	Moderately	157	133	42	46.5	24	18.5	18.5	2-2
Do	do	9.11.1.28	do	Much	165	134	43	46	25	18	18	2-2
Do	do	9.11.1.26	do	Moderately	160	133	41	47	24.5	19	18.5	2-2
Do	do	9.11.1.25	do	Slightly	190	140	41	46.5	24	19.5	18	2-2
Do	do	9.11.1.29	do	Moderately	172	154	44	47.5	....	18.5	19	2-2
Do	do	9.11.1.21	Male	Much	180	140	41	43.5	23	18.5	18	....
Do	do	9.11.1.22	do	Moderately	172	152	43	47.5	25	18.5	18	....
Do	do	9.11.1.23	do	do	185	129	44	47.5	26	19	19	....
Do	Pulo Lankawi, Kubong Bodak Island.	9.11.1.30 [8]	Female	do	180	155	44	47.5	25	20	19	2-2
Do	Pulo Lankawi, South Kilin Island.	9.11.1.24	Male	Much	160	150	43	....	25	....	18	....
T. lacernata raviana.	Butang Islands, Pulo Rawi.	104355 [8]	do	do	184	165	46	46	26	18.5	18	....
Do	Butang Islands, Pulo Adang.	104354	do	Moderately	178	171	45	46±	25	18.5	18.5	....

[1] Journ. Fed. Malay States Mus., vol. 4, p. 191.
[2] *dpm*^{3}, *dpm*^{4} still in place.
[3] Skull only.
[4] Preserved in alcohol.
[5] Adult.
[6] *dpm*^{4} nearly displaced, c^1 just appearing but *dc* still in place.
[7] *pm*^{4} just appearing, *dpm*^{3} still in place.
[8] Type.

TUPAIA DEMISSA Thomas.

1888. *Tupaja ferruginea* var. *chrysura* JENTINK (not of Günther), Notes Leyden Museum, vol. 11, p. 29, 1889. Type-locality, Deli, Sumatra.

1904. *Tupaia ferruginea demissa* THOMAS, Zool. Anz., vol. 27, p. 723, July 12, 1904.

1905. *Tupaia ferruginea demissa*, SCHNEIDER, Zool. Jahrb., vol. 20, p. 86, 1905.

Type-locality.—Tanjong Bringin, lower Langkat, northeastern Sumatra.

Type-specimen.—In British Museum, Reg. No. 4.6.9.1, skin and skull of adult female, collected at Tanjong Bringin, lower Langkat, Sumatra, February 8, 1898, by Gustav Schneider. Originally preserved in alcohol, but made into a skin probably about 1904. The colors do not appear to have been affected by the alcohol. Type specimen in good condition.

Geographic distribution.—Deli-Langkat region, northeastern Sumatra. It was not found by Dr. W. L. Abbott immediately north of lower Langkat, in the vicinity of Aru Bay, nor in the region of the Siak River a short distance to the southeast. See No. 7, on map on page 75.

Diagnosis.—In all respects like *T. glis ferruginea* except that the color of the tail is cream buff; mammæ, 2–2=4.

Color.—The color of *Tupaia demissa*, with the exception of the tail, is so like that of *T. g. ferruginea* that no detailed description is necessary. The tail, except its base, which is like adjacent parts of body, is cream buff in color throughout its whole extent on both surfaces, although a few brownish hairs may mar the clearness of the upper view.

Skull and teeth.—As in *Tupaia glis ferruginea.*

Measurements.—Type: Hind foot, 44 mm.; condylo-basal length, 49.5; zygomatic width, 27; width of brain case, 20.5; maxillary toothrow, 19. For individual measurements, see table, page 59.

Remarks.—*Tupaia demissa* is a very distinct member of the "*ferruginea*" group. Although described as a subspecies, and occurring on the same land mass with *T. g. ferruginea*, I have here called it a full species because so far as I am aware there is no evidence of it intergrading with the usual form. It appears to be a well-established color anomaly of *T. g. ferruginea* quite parallel with the case of *Tana chrysura* of Borneo. Because the tail has a uniform color and is not a decided mixture of blackish and some buffy or rufescent color, *Tupaia demissa* might with a certain degree of propriety be classed with the *splendidula* group, but I am much more inclined to consider it a perpetuated case of partial albinism in the *ferruginea* group.

Specimens examined.—Six, all from Deli or Langkat. In addition to these I have seen a specimen of this species on exhibition in the Natural History Museum at Strassburg, collected in "Sumatra" in 1903. A specimen of this species is recorded by Jentink in the Ley-

den Museum as *Tupaia ferruginea chrysura* in 1888, collected at Deli by Doctor Hagen. Doctor Jentink considered it a mere color freak, and tentatively applied the name *chrysura* in analogy with *Tupaia tana* var. *chrysura* Günther of Borneo.

Measurements of Tupaia demissa.

Locality.	Number.	Sex.	Molar teeth worn.	Head and body.	Tail.	Hind foot.	Condylo-basal length.	Zygomatic width.	Width of brain case.	Maxillary tooth row.	Number of mammæ.
				mm.	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	
Sumatra, upper Langkat.	4.4.1.4	Male	Moderately			43	50.5	25	20	20	....
Sumatra, lower Langkat.	4.6.9.1[1]	Female	do			44	49.5	27	20.5	19	2-2
Sumatra, Deli	174608	do	Slightly[2]	200±	140±	43	45	23.5	19.5	17	2-2
Do	174609	do	do	200±	155±	45	48.5	25.5	20	19.5	....
Sumatra, lower Langkat.	11461 Berlin[3]		Moderately				49	26.5	20	19.5	....
Sumatra, Langkat	Berlin, Rolle collection, 64.[4]	Female	Adult								2-2

[1] Type. [2] Permanent i^1 half way up. [3] Skull only. [4] Skin only.

TUPAIA BELANGERI (Wagner).

1835. *Tupaia du Pegou* Isadore Geoffroy, in Belanger, Zool, Voyage aux Indes Orientales, pp. 103–107, pl. 4.

1841. *Cl[adobates] belangeri* Wagner, Schreber's Säugthiere, Supplementband, vol. 2, p. 42.

1842. *Tupaia peguanus* Lesson, Nouv. Tabl. Reg. Anim. Mamm., p. 93. Based on precisely the same animal as *Cl. belangeri* of one year earlier.

1879. *Tupaia belangeri*, Anderson Zool. Res. West. Yunnan, p. 126, pl. 7, figs. 6 and 7.

Type-locality.—Siriam, near Rangoon, Pegu, Burma, southeastern Asia.

Type-specimen.—A specimen that might be considered the type is in the Paris Museum of Natural History. It bears the numbers 2 and 1023; it is labeled "Indes orientales," and was probably collected by Belanger, December, 1828. It is an old mounted and much bleached specimen with the skull inside. Aside from historical association, this specimen has little value.

Geographic distribution.—Along the west coast of the Malay Peninsula, from Victoria Point (lat. 10° N.), northward and westward into Pegu and Arakan,[1] and probably extending northward along the river valleys, and on the following islands: Preparis between the Andamans and Pegu; and Bentink, Domel, Kissering, Sullivan,

[1] See Cat. Mamm. Indian Mus., pl. 1, pp. 154–155, 1881.

Clara, James, St. Luke, and St. Matthew of the Mergui Archipelago, and probably other islands of the same group. See No. 2 on map on page 75.

Diagnosis.—Differs from *T. glis ferruginea* in generally lighter and more grayish coloration and from *T. chinensis* in having a distinct ochraceous wash over the rump and lower back; mammæ, 3–3 = 6.

Color.—Upper parts of head, neck, anterior half of back and outer side of forelegs a fine distinct grizzle of cream buff and blackish, the buffy color slightly in excess; lower back, rump, base of tail, outer side of hind legs a fine grizzle of ochraceous and blackish, the ochraceous in excess; lower back distinctly different in color from upper back, but the one imperceptibly merging into the other; tail above usually intermediate in color between anterior and posterior back, but the grizzling less distinct and with an excess of the darker color; underside of tail similar to upper, but lighter and more buffy, and the grizzling less distinct; underparts, including inner sides of legs, cream color to buff yellow.

Skull and teeth.—The skull and teeth of *Tupaia belangeri* show no pecularities to distinguish them with certainty from those of related species; the rostrum is relatively shorter than it is in *T. glis ferruginea*, and the skull as a whole slightly smaller than it is in *T. glis ferruginea*, and slightly larger than in *T. chinensis*. (Plate 8, fig. 2.)

Measurements.—Usual measurements of adults: Head and body, 175 to 190 mm.; tail, 150 to 160; hind foot, 42 to 45; condylo-basal length, 46 to 48; zygomatic width, 24 to 25; width of braincase, 18 to 19; maxillary tooth row, 18 to 19. For details of measurements, see table, pages 62 and 63.

Specimens examined.—Tenasserim and Pegu, 30, Mergui Archipelago, 26, from the following islands: Bentink, 2; Domel, 4; Kissering, 3; Sullivan, 2; Clara, 1; James, 8; St. Luke, 1; St. Matthew, 5.

Remarks.—*Tupaia belangeri* as represented by specimens from the Mergui Archipelago and the mainland opposite is a well marked form. From the type-locality, however, specimens are less differentiated. In the British Museum are two skins from Rangoon, one of which, Reg. No. 6.4.5.3, is quite typical of the species as here described; the other, Reg. No. 7.7.20.7, is scarcely ochraceous posteriorly and bears considerable resemblance to *T. chinensis*. Both these skins were collected in February of different years, and both are adult. It would appear that *T. belangeri* is not as differentiated at the type-locality as it is further southward along the coast. As originally described *Tupaia belangeri* does not appear to be different from *T. chinensis*. In the old accounts mention is not made of the distinct ochraceous wash over lower back, but as the species at that time was being separated from *T. ferruginea*, this is not surprising. The old specimen,

that may be taken as the type of the species, has been exposed to the light too long to be of value in determining whether it was a typical *T. belangeri* or approached *T. chinensis*. The facts appear to be that *belangeri* is the oldest name for the continental Tupaias that are not *ferruginea*. From the description and supposed type-specimen, the name *belangeri* might be applied to what I call in this paper *belangeri* or *chinensis*, but at the type-locality of *belangeri* occur treeshrews certainly belonging to what is here called *belangeri;* and *chinensis* has been proposed by Anderson for uniformly grizzled grayish treeshrews farther northward, thus leaving *belangeri* perfectly available for the Tenasserim animal.

The relationship between *Tupaia belangeri* and *T. chinensis* seems intimate, and it would not be surprising if the two forms were found to intergrade, *belangeri* being confined to the coastal region and *chinensis* to the higher region of the interior. As it is, many of the specimens examined are not typical of *belangeri*, among them British Museum, Reg. No. 7.7.20.7 Rangoon; Reg. No. 85.8.1.82 Meetan; Reg. Nos. 82.11.18.1, 85.8.1.86 Thaungyeen Valley, and Reg. No. 85.8.1.90 Bankasun, and the two Kokareet specimens in Genoa. Before determining this point it would be desirable to obtain good series of skins from the mouths of the Irawadi and Salwen Rivers and at various points from along the river until the upper courses in or near Yunnan are reached.

The specimens in the United States National Museum from the various islands of the Mergui Archipelago are fairly uniform in most of their characters. A few differences in size or color are indicated in some of them, but it does not appear possible to divide them into geographic races, or to separate the island forms as a whole from those of the adjacent mainland. On the mainland, Bentink, St. Luke, St. Matthew, the skins appear brighter on the lower back, and on Domel, Sullivan, Clara, James, and Kissering, the skins are slightly duller on the lower back, and perhaps darker anteriorly. A few slight differences in size are revealed by examining the table of measurements. All the St. Matthew specimens have a maxillary toothrow of 19 mm. or over, while on James Island it is 18.5 or under, and in a single specimen from St. Luke Island it is only 17.5. But these extremes are all bridged over by intermediate specimens from other islands or from the mainland.

A treeshrew probably related to *Tupaia belangeri* occurs on Preparis Island, between the Andamans and Pegu. A specimen from there is recorded by Anderson in the Catalogue of Mammals of the Indian Museum, Calcutta, part 1, page 155, listed as "hh." It is said to be darker than the mainland specimens, and undoubtedly represents an undescribed form.

Measurements of Tupaia belangeri.

Locality.	Number.	Sex.	Molar teeth worn.	Head and body.	Tail.	Hind foot.	Condylo-basal length.	Zygomatic width.	Width of brain case.	Maxillary tooth row.	Number of mammæ.
				mm.	*mm.*	*mm*	*mm*	*mm*	*mm*	*mm*	
"Pegu or Upper Burma" from Blanford.	63.5.9.11	.....	Moderately	.....	.....	42	46	26	19	18	....
Rangoon, Burma	7.7.20.7[1]	Female	....do....	.....	.....	45	47	25	20	18.5	3-3
Do	6.4.5.3	Male...	Slightly....	180	180	43	47	22	19	18	....
South of Moulmein	85.8.1.80	...do...	Moderately	.....	.....	42	....	25	18	17.5	....
45 miles east of Moulmein	85.8.1.83	...do...	.....do.....	.....	.....	44	....	25	19	18	....
Tichera, Amherst district, Burma.	6.7.5.2	Female	.....do.....	159	151	41	....	24	18	17.5	....
Tavoy, Tenasserim	85.8.1.84	.....	Slightly....	.....	.....	41	....	24	19.5	18	....
Matan, B. Burma	85.8.1.82[1]	.....	.....do.....	.....	.....	42	....	24.5	19	18	....
Mutan, Tenasserim	85.8.1.81	Male...	.....do.....	.....	.....	44	....	....	19.5	18.5	....
Tenasserim, from Davidson.	85.8.1.78	...do...	Moderately	.....	.....	43	....	24.5	19	18	....
Do	85.8.1.79	.....	Much.....	.....	.....	43	....	27	20	17.5	....
Tenasserim, Thaton	85.8.1.85	Male...	Moderately	.....	.....	45	....	....	19	18	....
Tenasserim, Thaungyeen Valley.	82.11.18.1[1]	...do...	Slightly[2]	.....	.....	45	....	....	18.5	17	....
Tenasserim, Thaungyeen River.	85.8.1.86[1]	Female	None.....	6.6	7	42	....	....	19	16	....
Tenasserim, Bankasun	85.8.1.90[1]	.....	.....	.....	.....	44	....	....	....	....	....
B. Burma, road to Myanadee.	8.3.9.1	.....	.....	.....	.....	44	....	....	....	....	....
Cheonkhon	85.8.1.87	.....	Slightly....	7.5	80	44	....	24.5	19	18	....
Kokareet,[5] Tenasserim	Genoa, Fea[3]	Female	Much.....	190±	145±	45±	46	25	18.5	18	....
Tenasserim	88.6.18.1[4]	Male...	Moderately	180	185	43	44	26	19.5	17	....
Do	88.6.18.2[4]	Female	Adult.....	185	175	43	....	....	....	....	3-3
Kokareet,[6] Tenasserim	88.12.1.32[4]	Male...	.....do.....	180	170	44	....	....	....	....	....
Do	88.12.1.33[4]	Female	Adult.....	185	170	44	....	....	....	....	3-3
Kaukargit, Burma	5509, Berlin	.....	Slightly....	190±	155±	45	....	23	19.5	17	....
Do	5508, Berlin	.....	Moderately	200±	165±	45	47	....	19.5	18	....
Thagata,[6] Burma	Genoa, Fea collection.[4]	Female	.....	185	190	45	....	....	....	....	3-3
Mount Mooleyit,[5] Burma	.....do.[4]	Male...	([6])	190	180	45	....	....	....	....	....
Do	.....do.[4]	Female	.....	180	175	45	....	....	....	....	2-2
Do	.....do.[4]	Male...	([7])	140	135	41	....	....	....	....	....
Kokareet [5]	.....do.....	...do...	([6])	190	180	46	....	....	....	....	....
Do	.....do.....	Female	.....	180	175	46	....	....	....	....	....
Moulmein	Genoa [8]	Male...	.....	185	175	46	....	....	....	....	....
Pegu	1023, Paris [9]	.....	([10])	.....	.....	42	....	....	....	....	....
Tavoy, Tenasserim	2143, A. M. N. H.[11]	Female	.....	.....	.....	42	....	....	....	....	3-3
Tenasserim, Telok Besar [12]	124284	Male...	Moderately	190	163	43	48.5	25	18.5	18.5	....
Do	124283	Female	.....do.....	190	160	43	48	24.5	18.5	19	3-3
Tenasserim, Bok Pyin	104358	Male...	.....do.....	171	152	43	46	25	19	18	....
Tenasserim, Sungei Balik[12]	111996	...do...	Slightly....	175	165	44	46.5	23.5	19.5	18.5	....
Tenasserim, Tanjong Badak [12]	104357	...do...	Moderately	178	152	44	47	24.5	19.5	18.5	....
Tenasserim, Victoria Point	124003	...do...	.....do.....	197	168	44	48	24.5	18.5	18.5	....
Tenasserim, Telok Besar[12]	124282[4]	Female	([13])	190±	155	42	....	....	....	....	3-3
Mergui Archipelago, Bentinck.	104364	...do...	Moderately	178	159	42	47	24.5	19	18.5	3-3
Do	104365	...do...	None [14]	152	140	41	39	20	18	....	....
Mergui Archipelago, Clara	124143	...do...	Much.....	190	175	44	48±	26.5	19.5	19	3-3
Mergui Archipelago, James	124076	Male...	Moderately	190	155	41	47	25	19	18	....
Do	124078	...do...	.....do.....	180	152	42	46.5	23.5	19	18	....
Do	124079	...do...	.....do.....	175	135	41	45	24	19	18	....
Do	124077	Female	.....do.....	185	145	41	47	24.5	19	18.5	3-3
Do	124080	...do...	.....do.....	185	150	42	47	24.5	18.5	18.5	3-3
Do	124081	...do...	Slightly....	168	150	43	46	23	18.5	18	....
Do	124082[4]	...do...	([13])	185±	150	42	....	....	....	....	3-3
Do	124083[4]	...do...	([13])	195±	155	42	....	....	....	....	....

[1] Not typical, resembling *T. chinensis*.
[2] c. and *pm*[1] not in place.
[3] Mounted.
[4] Preserved in alcohol.
[5] East of Moulmein.
[6] Adult, genitalia well developed.
[7] About one-third grown.
[8] Received from Calcutta Museum.
[9] Type.
[10] Skull inside.
[11] American Museum of Natural History, New York.
[12] Just north of Victoria Point.
[13] Adult.
[14] *m* [1] not quite in place.

Measurements of Tupaia belangeri—Continued.

Locality.	Number.	Sex.	Molar teeth worn.	Head and body.	Tail.	Hind foot.	Condylo-basal length.	Zygomatic width.	Width of brain case.	Maxillary tooth row.	Number of mammæ.
				mm.	*mm.*	*mm*	*mm*	*mm*	*mm*	*mm*	
Mergui Archipelago, Kisseraing.	124203	Male	Moderately	180	150	43	46	25.5	19	17	....
Do	124202	Female	do	190	150	41	46	25	19	18	3-3
Do	124204	do	do	180	160	43	47.5	25	19	18	3-3
Mergui Archipelago, Sullivan.	124102	Male	do	183	152	43	47.5	24.5	19	17.5	....
Do	124103	Female	do	185	160	43	47.5	24.5	19.5	18.5	3-3
Mergui Archipelago, St. Matthew.	104359	Male	do	184	159	43	49	26.5	19.5	19	....
Do	104361	do	do	171	152	45	48.5	26.5	19	19	....
Do	111911	do	Much	180	150	43	47.5	25.5	18.5	19.5	....
Do	104360	Female	Moderately	184	152	43	48.5	25.5	18.5	19	3-3
Do	104400, skull.	do	Slightly	165	152	....	47.5	25.5	19	19.5	....
Mergui Archipelago, Domel.	124173	Male	Moderately	180	138	45	48	25	19±	19.5	....
Do	124174	do	do	175	135	43	47±	26.5	19.5	18.5	....
Do	104363	Female	Much	165	152	41	45.5	24	18.5	19	3-3
Do	124175	do	Moderately	175	155	42	46.5	24	18.5	18	3-3
Mergui Archipelago, St. Luke.	104362	Male	Slightly	178	152	42	47	24	19	17.5	....

TUPAIA CHINENSIS Anderson.

1879. *Tupaia chinensis* ANDERSON, Zool. Res. West. Yunnan, p. 129, pl. 7, figs. 8 and 9.

Type-locality.—Ponsee, Kakhyen Hills, 3,185 feet, and Muangla, Sanda Valley, 2,400 feet, western Yunnan, China.

Type-specimens.—Two specimens of this species were evidently secured by Dr. Anderson, No. 204*a*, adolescent male in alcohol, and its skull, Ponsee, and No. 204*b* and *c*, skin of an adult and its skull, Muangla, in the Catalogue of Mammalia in the Indian Museum, Calcutta, Part I, 1881, page 155. So far as I am aware these specimens are still in Calcutta. They are not in London at the British Museum, and I have not seen them. Cranial measurements of both are given in the original account, external measurements of one of them, and illustrations of the skull, probably of the specimen of which the external measurements are given (determined by comparing some of the figures given with the actual measurements of the illustration). The specimen whose skull is illustrated and whose external measurements are given should be considered the type. As to whether it is the Ponsee or the Muangla specimen it is impossible to say, though if both specimens are still intact a careful examination of them and the measurements and illustrations would probably disclose which specimen is the type and which of the two localities is the exact type-locality.

Geographic distribution.—*Tupaia chinensis*, as here understood, ranges from northern Tenasserim and Burma northward into China as far as Mitschi (or Meechee) (?) and from Nepal, on the west, as far east as Mongtsze and Tonkin, China. See No. 1 on map on page 75.

Diagnosis.—*Tupaia chinensis* is characterized by a unifrom grizzled olivaceous gray color without ferruginous on upper parts, or ochraceous colors on rump; skull slightly smaller than in *T. glis ferruginea*, with relatively shorter rostrum; mammæ, 3–3=6.

Color.—Upper parts of head, neck, and body and outer side of legs a fine uniform grizzle of blackish and a color that varies from buff to ochraceous in certain individuals, the lighter colors predominating anteriorly; both colors are about equally mixed, in some individuals the lighter colors are in excess, and in others, especially in the middle line posteriorly the black admixture is sometimes in excess; the tail above is a coarse grizzle, sometimes showing indistinct annulations of the same colors as have the upper parts of body, below the tail is lighter, especially in the middle line; the underparts of head, neck, and body, including the inner sides of the legs, vary from distinct whitish, sometimes with the dark bases of the hairs showing through, to buffy; hands and feet similar to outer sides of legs but often lighter and grayer; shoulder stripe poorly developed and sometimes practically obsolete. Three skins from Meechee, China, are quite light and grayish, but are almost exactly matched by a British Museum skin from Manipur, Reg. No. 85.8.1.89. The Darjiling and two of the Tura skins are rather dark, as are also the Siamese skins, none, however, are so generally dark as are *Tupaia concolor* and *T. modesta*.

Skull and teeth.—These are of the same general style as they are in *T. glis ferruginea*, but average slightly smaller and have a relatively shorter rostrum, so that the distance from the end of the premaxillary to the lachrymal notch is generally distinctly less than the distance from the notch to the external auditory meatus. Although *T. chinensis* was originally separated from *T. belangeri* mainly on skull characters, I have been able to find no satisfactory constant characters to distinguish skulls of the two forms. The individual variation in skulls of *Tupaia* is quite considerable, and with a relatively small number of specimens such as Anderson seems to have had it would be comparatively easy to find distinguishing features. I regret that I have not seen his type or cotypes. (Plate 8, fig. 1.)

Measurements.—Anderson's measurements of the cotypes converted to millimeters: Head and body, ——, 165 mm.; tail, ——, 156; hind foot, ——, 40; inferior margin of foramen magnum to tip of premaxillaries, 39, 40 (making a condylobasal length of approximately 42, 43); zygomatic width, 22, 23. The usual measurements of adults corresponds very closely with those of the cotypes, the head and body measurement is often 5 mm. longer, but the tail in most of the specimens which have collectors' measurements is nearly always from 5 to 15 mm. longer than head and body, but the skins and alcoholics of which I have taken approximate head and body, and tail measurements show the tail to be shorter than head and body. The maxillary tooth row is about 17.5. For details of measurements, see table, page 66.

Specimens examined.—Forty-three, mostly in the collections of the British Museum, only one in the United States National Museum. For list of specimens, see table, page 66.

Remarks.—The specimens which I have included under *Tupaia chinensis* constitute a somewhat heterogeneous collection. With the *T. glis ferruginea* group I have recognized many slightly differentiated geographic forms, mostly insular, but with *Tupaia chinensis* I have been extremely conservative and have not ventured to describe some color variations that are as pronounced as some of the color variations in the *ferruginea* group. This is largely from lack of adequate material and to the fact I have not seen the cotypes or even topotypes of *T. chinensis*. Many of the localities are represented by only single specimens instead of adequate series and are unaccompanied by notes as to altitude. The specimens that one might be inclined to recognize as races of *T. chinensis* are the three Meechee[1] specimens very light in color, though showing degrees of lightness among themselves and the rather full-pelaged olivaceous specimen from Jerkalo on the Thibet boundary. Light as are the Meechee specimens compared with the majority of the others, yet they are not more different from them than two specimens from Tura, Assam (American Museum of Natural History, Cat. Nos. 26843 and 26841), showing there may be considerable individual variation. Until more material is at hand, with carefully worked out localities it seems best for the present to refer all the northern uniformly grizzled grayish continental treeshrews to the single species *Tupaia chinensis*. The relationship of *Tupaia chinensis* to *T. belangeri* is not perfectly clear. What I have called *T. belangeri* is typical in the Mergui Archipelago and adjacent mainland, and is certainly a very different animal from *T. chinensis* as found away from the seacoast, back in the interior. I am free to admit that I have seen certain specimens from Tenasserim, particularly some to the east of Moulmein that could with considerable propriety be placed in either species, and I strongly suspect that future collections, with carefully identified localities and altitudes, will show that *Tupaia chinensis* is a subspecies of *T. belangeri*. If that should prove to be the case, the relation of them to *Tupaia glis ferruginea* will be interesting. At present *T. chinensis* and *T. belangeri* appear to be sharply separated from *T. g. ferruginea* and *T. lacernata wilkinsoni* by the presence of six instead of four mammæ as was pointed out by Thomas[2] in 1891. In spite of that marked

[1] The only Meechee that I have been able to find on modern maps is Mitschi (see p. 75). The three Meechee specimens were collected by Styan and are labeled Meechee, Yunnan. No Meechee appears on the numerous maps of Yunnan that I have examined. As to the exact locality of the Meechee specimens I can not say. It is very doubtful if treeshrews occur as far north in China as Mitschi. Perhaps Meechee is only a small village in Yunnan and the three specimens may be virtual topotypes.

[2] Ann. Mus. Civ. Stor. Nat. Genova, ser. 2, vol. 10, p. 920, 1890–91.

difference, however, *T. lacernata wilkinsoni* in point of color appears as an almost perfect intermediate between *Tupaia glis ferruginea* and *T. belangeri*. With the certain rather doubtful specimens from Tenasserim it may ultimately develop that but a single species of *Tupaia* occurs on continental Asia ranging from Singapore to Meechee and from Nepal to Tonkin, but wherever there are sufficient climatic or physiographic differences subspecies have been produced, of which five continental forms have been described—*T. glis ferruginea, lacernata wilkinsoni, belangeri, chinensis, concolor.*

Measurements of Tupaia chinensis.

[A. M. N. H.=American Museum of Natural History, New York. B. M.=British Museum.]

Locality.	Number.	Sex.	Molar teeth worn.	Head and body.	Tail.	Hind foot.	Condylo-basal length.	Zygomatic width.	Width of brain case.	Maxillary tooth row.	Number of mammæ
				mm.	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	
Meechee, China	8.8.11.14	Female	None [1]			45				16.5	
Do	8.8.11.13	do				41					3-3
Do	8.8.14.14		Slightly			42		23	19	16.5	
Jerkalo, China	Paris, 173		No skull	180±	140±	41±					
Nepal, from Hodgson	79.11.21.306		do								
Sikhim	86.11.15.1		Moderately			43				17.5	
Darjiling	87.2.9.1					44					
Tura, Assam	A.M.N.H.26841	Female		215±	160±	45					2-2
Do	A.M.N.H.26843	do	Moderately	205±	155±	42	44	24.5	18.5	16.5	3-3
Do	A.M.N.H.26844	Male		200±	190±	43					
Cachar	82.2.6.3		Slightly			44		24	19	17.5	
Amoli, Manipur	85.8.1.88		Moderately			42			18±	16.5	
Machi, Manipur	85.8.1.89		do			41		23.5	18	16.5	
Myitkyina	9.7.20.1	Male	Slightly			40	42	22.5	18.5	16	
Bhamo	Genoa, Fea [2]	do	About half grown.	160	160	41					
Zibugaung Lower Chindwin.	6.7.5.1	do	Slightly	173		40	44±	25.5	18	17.5	
Carin Hills	20888	do	Moderately			43	46	25.5	19	17.5	
Chengmai, Siam	98.10.5.6	Female	Much	168	175	42	45	24	19	17.5	3-3
Do	98.10.5.4	Male	do	179	195	45	47	27	19.5	18.5	
Do	98.10.5.3	do	Moderately	171	181	44	47	26	19	18.5	
Do	98.10.5.5	do	Slightly	173	186	42	46	25.5	19	18	
Mung Pai, Siam	9.10.11.11	Female	Moderately	165	169	41	45		19.5	17	
Do	9.10.11.10	do	Much	143	174	43	46	25	18.5	17.5	
Nan, Siam	98.2.8.12	do	Moderately	170	177	43	47.5	25	19	18	3-3
Do	97.11.2.14	do	None [3]	170	184	43	46	23.5	20	18	3-3
Do	97.11.2.8	Male		173	185	45					
Do	97.11.2.10	do	None [4 5]	130	135	40					
Do	97.11.2.11	do	do [4 5]	132	142	40					
Do	97.11.2.12	Female	do [4 5]	122	130	38					
Do	97.11.2.13	do	do [4 5]	124	132	39					
Do	97.11.2.9	Male	do [4]	112	125	38					
Me Ping River, north of Raheng, Siam.	7.11.13.2	do	do [6]	159	178	41	43		18.5	17	
Do	7.11.13.3	Female	Slightly	171	184	42	45	24	19	17.5	3-3
"Siam"	78.6.17.15		None			40	40		19		
"Camboja" [7]	78.6.17.26		No skull			43					
"Burma" from Blyth	62.7.16.12		Moderately			44		25.5	19	17.5	
Lao Mountains, Siam	B.M.1452 [8]		None [9]			39	37		19		
Do	B.M.1452 [8]		do			40	44	24.5	19	17	
Pexaburg, Siam	Paris, 1244	Female	Moderately	195±	160±	42±		25	19	18	2-2
Mongtsze, China	Brit. Mus.	do	do	179	160	42	45	24	19	17	3-3
Do	do	Male	Slightly	185	164	44	44	24	20	16	
Tonkin, China	Berlin [2]	do	Very young	130	110	41					
Do	do [2]	do	do	110	90	35					
Southern China [10]	A 1706, Berlin		Slightly	(11)			48	20	19.5	19	

[1] *pm* 4 half through alveolus.
[2] Preserved in alcohol.
[3] *pm* 2 halfway through.
[4] *m* 1 last tooth in place.
[5] Nest of four young ones in hollow bamboo.
[6] *dc* 1 still in place.
[7] Not typical; may be *T. concolor.*
[8] Skeleton, British Museum.
[9] *m* 2 just appearing.
[10] Not typical, rostrum short and heavy, teeth large and heavy.
[11] Skull only; no skin.

TUPAIA DISSIMILIS (Ellis).

1860. *Sciurus dissimilis* ELLIS, in Gray, Ann. Mag. Nat. Hist., ser. 3, vol. 5, p. 71.

Type-locality.—Pulo Condore, off south coast of Siam.

Type-specimen.—No type-specimen ever existed so far as known. This species was thought to be a peculiar squirrel by W. Ellis, a surgeon on Captain Cook's third voyage. The expedition stopped at Pulo Condore, 1780, in the latter part of January. Ellis wrote a description in Latin, published by Gray in 1860, and made an excellent drawing of the entire animal and of its anterior teeth. Through the kindness of the authorities of the British Museum, Natural History, in whose library Ellis's manuscript and drawings are now kept, a photographic reproduction of this picture appears as plate 1.

Geographic distribution.—Pulo Condore. See No. 27 on map on page 75.

Diagnosis.—A geographic form of *Tupaia chinensis* distinguished by its smaller size; hind foot, 38–40; *T. chinensis* usually over 40 mm.; mammæ unknown.

Color.—Based on Cat. No. 3745, Berlin Museum, originally received from the Paris Museum, an old mounted specimen with skull removed. Upper parts of head, neck, and body, a grizzle of ochraceous and blackish, the two colors about equally mixed, tail similar but grizzle coarser; ochraceous color on head slightly lighter than on body; outer side of legs similar to adjacent parts of body, underparts and inner side of legs with much hair gone and soiled, apparently dull buffy; underside of tail in middle line similar to rest of underparts; margins of tail underneath a coarse mixture of buffy and blackish.

Skull and teeth.—Of similar form to those of *Tupaia belangeri* (comparison made with Berlin Burma specimen), but smaller, rostrum narrower, and brain case decidedly narrower; teeth similar to those of *T. belangeri*, but m^1 and m^2 shorter.

Measurements.—Hind foot, 38–40 mm.; condylo-basal length about 45; zygomatic width, 23–24; width of brain case, 18–19; maxillary toothrow 17. In mounted specimens the head and body is 180–200, and the tail 140–165 mm. See table, page 70.

Specimens examined.—Three, two in Paris, and one in Berlin, all probably collected by Germain, in 1882.

Remarks.—There can be little doubt as to the distinctness of *T. dissimilis* from *T. chinensis*, the rather limited material showing it to be distinctly smaller. Probably these are good color characters as well, but at present there is not sufficiently good material of either species to point them out. Although this was the first species of a treeshrew to come under the observation of Europeans, this is the first time it has been given recognition as a species.

TUPAIA CONCOLOR Bonhote.

1907. *Tupaia concolor* BONHOTE, Abstr. Proc. Zool. Soc. London, p. 2, January 22, 1907 (also see Proc. Zool. Soc. London, 1907, p. 7, June, 1907).

Type-locality.—Nhatrang, on the coast of Annam.

Type-specimen.—In British Museum, Reg. No. 6.11.6.3, skin and skull of an adult male, collected by Dr. J. Vassal, at Nhatrang, Annam, March 22, 1906; original number, 59; in good condition.

Geographic distribution.—Southern Annam and northern Cochin China, probably along the coast. See No. 3 on map on page 75.

Diagnosis.—Similar to *Tupaia chinensis* but larger, more bushy tail, and larger, longer skull; mammæ probably 2–2 = 4.

Color.—Type: Upper parts of head, neck, body, outer side of legs, and feet a grizzle of ochraceous buff and blackish, the two colors about equally mixed, but mid-dorsal area slightly darker; anteriorly the light color is more buffy, and posteriorly more ochraceous, but the differences not at all conspicuous; tail above similar to adjacent parts of body, but the grizzle much coarser; tail below with outer half similar to upper surface, central portion dull pale buffy, mixed with blackish, hairs of tail very conspicuously annulated and when artificially spread out, five distinct light bands may be seen, alternating with as many blackish ones; under parts generally dull buffy.

Skull and teeth.—Large and heavy when compared with *Tupaia chinensis*, with a narrowed rostrum, distance from lachrymal pit to premaxilla equal to distance from pit to center of external auditory meatus.

Measurements.—Type: Head and body, 230 mm.; tail, 140; hind foot, 43; condylo-basal length, 50; zygomatic width, 29; width of brain case, 21; maxillary toothrow, 20. For measurements of a paratype and four specimens from Cochin China, see table, page 70.

Remarks.—*Tupaia concolor* is at once distinguished from *T. chinensis* by its much larger size, especially seen in its skull measurements. At the time it was described it was known only from the type-locality. There is one specimen in the Paris Museum, No. 1149, marked "Cochin China," which evidently belongs to this same species. Its external measurements are large, and its skull measurements agree very closely with those of *T. concolor*. While I have not had the opportunity of comparing the two specimens directly, my notes show that the Cochin China skull differed from the usual Siam skulls of *T. chinensis* in nearly the same manner that *T. concolor* does. The Cochin China skull, however, is rather narrower and has less spreading zygomata. Three other specimens marked Cochin China in the Paris Museum represented by skins only, I have assigned to *T. concolor* mainly on geographic grounds. One of them, collected by Germain,

may have come from Pulo Condore, and one of the others has a distinctly small hind foot like that of the Cordore animal. See table, page 70.

Specimens examined.—Six. See table, page 70.

TUPAIA MODESTA Allen.

1906. *Tupaia modesta* ALLEN, Bull. Amer. Mus. Nat. Hist., vol. 22, p. 481, Dec. 17, 1906.

Type-locality.—Island of Hainan, off the south coast of China.

Type-specimen.—In American Museum of Natural History, New York, Cat. No. 26654, collected at Lei-Mui-Mon, Hainan, January 5, 1903, through agents of Mr. Alan Owston; skin well preserved, but skull damaged posteriorly.

Geographic distribution.—Island of Hainan. See No. 4 on map, on page 75.

Diagnosis.—A geographic form of *Tupaia chinensis* distinguished by its generally darker coloration, externally not unlike *T. concolor*, but distinctly smaller; mammæ, 2–2 = 4.

Color.—In general coloration *Tupaia modesta* is essentially like *T. concolor*, but the underparts are more whitish, and when the hairs of the tail are artificially spread only three distinct buffy annulations are seen instead of five.

Skull and teeth.—The skulls of *Tupaia modesta* available for examination are considerably damaged. Apparently they are not essentially different from those of *T. chinensis*.

Measurements.—Type: Hind foot, 46 mm.; zygomatic width, 25.5; width of brain case, 19.5; maxillary tooth row, 18. The type has the largest hind foot in the series, most of the other specimens measuring only 43 mm. See table, page 70.

Remarks.—*Tupaia modesta* is quite distinct in its generally darker color from most specimens of *T. chinensis*, if not appearing distinctly darker with reference to the upperparts, the tail and underparts appear so. As to how different it is from tree shrews on the mainland adjacent to Hainan it is impossible to say. The nearest specimens geographically that I have seen are two from Tonkin in alcohol, young, and so useless for comparison. The two Mongtsze specimens are very dark above, but are distinctly whitish underneath. It is to be observed that *Tupaia concolor* of the southeast coast region of Asia is also a dark-colored animal, but distinctly larger than *T. modesta*.

The number of mammæ, 2–2 = 4, in this species and the preceding is interesting as in all the other continental treeshrews north of the Malay Peninsula, the number is 3–3 = 6. As only one specimen in each species is available for determining the number of mammæ, too much weight can not be attached to this peculiarity.

Specimens examined.—Seven, from various localities in Hainan. See table, page 70.

Measurements of Tupaia concolor, dissimilis, and modesta.

Name.	Locality.	Number.	Sex.	Molar teeth worn.	Head and body.	Tail.	Hind foot.	Condylo-basal length.	Zygomatic width.	Width of brain case.	Maxillary tooth row.	Number of mammæ.
					mm	*mm*	*mm*	*mm*	*mm*	*mm*	*mm*	
T. concolor..	Nhatrang, Annam.	6.11.6.4.....	.....	Slightly....	215±	160±	46	50	28	20	19.5	....
Do.....	.....do.....	6.11.6.3 [1]....	Male...	Moderately.	230±	140±	43	50	29	21	20	....
Do.....	Cochin China....	1149, Paris.....	.....	Slightly....	220±	145±	46±	49±	26.5	19.5	20	....
Do.....	.....do.....	303, Paris..	Female	.....	210±	145±	40±	....	....	....	....	2–2
Do.....	Cochin China, Saigon.	678, Paris...	...do....	.....	210±	150±	44±	....	....	....	....	....
Do.....	Cochin China [2]..	9, Paris [3]...	Male...	.....	180±	160±	40±	....	....	....	....	....
T. dissimilis.	Pulo Condore...	3745, Berlin	Female	Moderately.	200±	165±	40	45±	25±	18	17	....
Do.....	.....do.....	(9) Paris [3]..	.....	None [4].....	190±	160±	39±	....	23	19	17	....
Do.....	.....do.....	1096, Paris.	.....	.....	180±	140±	38±	....	....	....	....	....
T. modesta...	Hainan, Lei Mui Mon.	A. M. N. H. 26654.[1]	Male...	Moderately.	.....	.....	46	....	25.5	19.5	18	....
Do.....	Hainan, Hoihow.	26658 [5 6]	...do....	.....	.....	.....	43	....	....	....	....	....
Do.....	Hainan, Lei Mui Mon.	26657 [6].....	...do....	Slightly....	.....	.....	45	....	25	19.5	18	....
Do.....	.....do.....	26655 [6].....	...do....	.....do.....	185±	155±	43	....	....	19.5	18	....
Do.....	Hainan.....	26660 [6].....	Female	Moderately.	200±	160±	44	....	....	....	18.5	2–2
Do.....	Hainan, Lei Mui Mon.	26656 [6].....	Male?..	.....do.....	.....	.....	43	....	....	....	18	....
Do.....	Hainan, Utoshi.	26659 [6].....	Female?	Slightly....	.....	.....	43	....	25.5	20±	18	....

[1] Type.
[2] Though labeled "Cochinchina." I strongly suspect it came from Pulo Condore, being collected by Germain, 1882. See No. 9, Paris, *T. dissimilis*.
[3] Germain, 1882.
[4] *dpm* [4] still in place.
[5] The skeleton of this specimen is figured by Gregory, Bull. Amer. Mus. Nat. Hist., vol. 27, p. 276, 1901.
[6] All these specimens are in the American Museum of Natural History, New York.

TUPAIA HYPOCHRYSA Thomas.

1895. *Tupaia ferruginea hypochrysa* THOMAS, Ann. Mus. Civ. Stor. Nat. Genova, ser. 2, vol. 14, p. 6, footnote, January 7, 1895.

Type-locality.—Java.

Type-specimen.—In British Museum, Reg. No. 86.7.2.12, skin and skull of adult male, collected in Java, in 1856, by Henry Blyth. The skin is in good condition, but skull damaged in the occipital region after the manner of bird collectors.

Geographic distribution.—Java. See No. 11 on map on page 75.

Diagnosis.—Above blackish finely grizzled with buffy or ochraceous, tail blackish, underparts ochraceous rufous; mammæ unknown.

Color.—Upper parts of head, neck, body, and outerside of legs a fine uniform grizzle of blackish and dull ochraceous rufous anteriorly gradually passing into pale raw sienna, the blackish color rather in excess; tail, above blackish finely and sparingly lined with cream buff; tail below, a rather coarse mixture of cream color and blackish, the lighter color predominating in the middle line, and the black color predominating on the margins and tip; underparts of head, neck, and body ochraceous rufous, extending to inner side of legs but there considerably admixed with blackish brown, hands and feet blackish brown; shoulder stripe barely indicated, ochraceous rufous.

Skull and teeth.—The skull and teeth of *Tupaia hypochrysa* are not fundamentally different from those of *T. g. ferruginea*. The skull averages larger as a whole, the rostrum is relatively long and heavy, the distance from the lachrymal notch to tip of premaxillary is equal to distance from notch to posterior edge of external auditory meatus; the bullæ are smaller than they are in *T. g. ferruginea;* zygomatic arch wide and heavy and strongly marked anteriorly for insertion of muscles; the teeth are larger and heavier and the tooth-row as a whole distinctly longer. (Plate 9, fig. 6.)

Measurements.—Type and a specimen from Mount Salak, Cat. No. 154599, U.S.N.M. Head and body, ——, 145 mm.; tail, ——, 145; hind foot, 48, 49; condylo-basal length, 51.5, 51; zygomatic width, 26, 28; width of brain case, 19.5, 21.5; maxillary tooth row, 21, 20.5.

Remarks.—While *Tupaia hypochrysa* is probably the Javan representative of *T. glis ferruginea*, yet it is a very distinct species. When first described specimens in alcohol from Sipora, Mentawei Islands, were regarded as being the same species. While they seem to belong to the same group as *T. hypochrysa*, I have identified them with *Tupaia chrysogaster* from the geographically nearer Pagi Islands, and with which they seem to agree more closely with respect to measurements. *Tupaia hypochrysa* has many resemblances to *Tupaia longipes* and *discolor* of Borneo and Banka. *Tupaia hypochrysa* is one of the few species of treeshrews whose number of mammæ is unknown, and in this particular instance knowledge on that point is of much importance to show probable affinities. *T. chrysogaster* of the Mentawei Islands has the mammæ 1–1 = 2, while in *T. longipes* and *T. discolor* they are 3–3 = 6.

Specimens examined.—Three, the type from "Java" and a second specimen from "Java" and a third from 3,500 feet on Mount Salak, western Java. See table, page 72.

TUPAIA CHRYSOGASTER Miller.

1903. *Tupaia chrysogaster* MILLER, Smiths. Misc. Coll., vol. 45, p. 58, November 6, 1903.

Type-locality.—North Pagi Island, off southwest coast of Sumatra.

Type-specimen.—In United States National Museum, Cat. No. 121752, skin and skull of adult female collected on North Pagi Island, November 21, 1902, by Dr. W. L. Abbott; original number, 2078; in good condition.

Geographic distribution.—North and South Pagi, and Sipora of the Mentawei Islands, off the southwest coast of Sumatra. See No. 16 on map on page 75.

Diagnosis.—Above, including tail, finely grizzled, blackish and ochraceous rufous; below, clear ochraceous rufous; mammæ, 1–1 = 2.

Color.—Upper parts of head, neck, body, tail, and outerside of legs a fine grizzle of blackish and ochraceous rufous, both colors about in equal proportions; on nose the ochraceous rufous lightens to raw sienna; underside of tail similar to upper but orange ochraceous

lighter and duller, and in greater proportion than the black element; entire underparts, including inner side of legs, ochraceous rufous, much clearer than in *Tupaia hypochrysa;* hands and feet blackish brown, slightly and finely grizzled with an ochraceous color; shoulder-stripe barely indicated, sometimes practically obsolete, ochraceous rufous.

Skull and teeth.—The skull and teeth of *Tupaia chrysogaster* are essentially like those of *T. hypochrysa,* but the rostrum is distinctly slenderer, and the teeth not so large and heavy and the bullæ not so reduced; in other respects the two skulls are similar. The slenderness of the rostrum suggests the genus *Tana.* (Plate 9, fig. 9.)

Measurements.—Type: Head and body, 205 mm.; tail, 140; hind foot, 46; condylo-basal length, 51.5; zygomatic width, 27; width of brain-case, 19.5; maxillary toothrow, 20. These measurements are quite characteristic of the series, which show little individual variation. The tail is seen to be much shorter than the head and body. For individual measurements, see table below.

Specimens examined.—Thirteen; six from North Pagi, four from South Pagi, one marked simply Pagi Islands, and two from Sipora Island.

Remarks.—*Tupaia chrysogaster* is a very distinct species and needs no close comparison with any other member of the genus. It has few affinities with the treeshrews of Sumatra, the nearest land mass, but is clearly related by the size and form of its skull and color of the underparts to *Tupaia hypochrysa* of Java.

Measurements of Tupaia chrysogaster and T. hypochrysa.

Name.	Locality.	Number.	Sex.	Molar teeth worn.	Head and body.	Tail.	Hind foot.	Condylo-basal length.	Zygomatic width.	Width of brain case.	Maxillary tooth row.	Number of mammæ.
					mm.	*mm*	*mm*	*mm.*	*mm.*	*mm.*	*mm.*	
T. chrysogaster	Pagi Islands...	121580...	Male...	None[1].....	195	125	45	48	26	20.5	18.5	....
Do.....	North Pagi Island.	121571...	...do....	Much.....	197	138	44	51±	26.5	19	20	....
Do.....	.....do.....	121572[2]..	Female	.....do.....	205	140	46	51.5	27	19.5	20	1-1
Do.....	.....do.....	121573...	...do....	.....do.....	220	140	47	52±	.....	19.5	20	1-1
Do.....	.....do.....	121574...	...do....	Slightly....	179	146	45	49.5	25.5	20.5	20	....
Do.....	.....do.....	121575...	...do....	Much.....	188	147	44	49.5	26.5	20	20	1-1
Do.....	.....do.....	121576...	...do....	Slightly....	188	145	45	51	26	20	20	1-1
Do.....	South Pagi Island.	121577...	...do....	Moderately	210	150	46	51	26.5	19.5	20	....
Do.....	.....do.....	121578...	Male?..	None[3].....	205	160	46	50.5	25.5	19.5	19.5	....
Do.....	.....do.....	121579...	Female	Slightly....	195	95	45	50	26	19.5	19.5	1-1
Do.....	.....do.....	121892[4]...	...do....	(5).....	160±	130	43	.....	.....	.....	.....	1-1
Do.....	Sipora, Mentawei Islands.	95.1.9.2[4].	...do....	.....	190	140	45	.....	.....	.....	.....	....
Do.....	.....do.....	Genoa[4]...	...do....	.....	210	145	45	.....	.....	.....	.....	1-1
T. hypochrysa	Java, Mount Salak, 3,500 feet.	154599...	Male...	Moderately	145	145	49	51.5	26	19.5	21	....
Do.....	Java.....	86.7.2.12[2]	...do....	Much.....	.....	....	48	51	28	21.5	20.5	....
Do.....	.....do.....	633, Berlin.	.....	Moderately	.....	....	46	.....	27	20.5	19.5	....

[1] m^3 just level with alveolus.
[2] Type.
[3] Permanent pm^3 and pm^4 not in place.
[4] Preserved in alcohol.
[5] About three-fourths grown.

TUPAIA DISCOLOR Lyon.

1906. *Tupaia discolor* LYON, Proc. U. S. Nat. Mus., vol. 31, p. 602, December 18, 1906.

Type-locality.—Island of Banka, east of Sumatra.

Type-specimen.—In United States National Museum, Cat. No. 124703, skin and skull of adult female, collected at Tanjong Rengsam, Banka, May 24, 1904, by Dr. W. L. Abbott; original number, 3262; in good condition.

Geographic distribution.—Island of Banka. See No. 12 on map on page 75.

Diagnosis.—A treeshrew of the *T. glis ferruginea* build with the general color effect of the anterior parts rather ferruginous, and the posterior parts rather tawny olive, underparts ochraceous; mammæ, 3–3 = 6.

Color.—Upper parts of head, neck, anterior half of body, and outer side of forelegs a fine grizzle of black, and ferruginous, the latter color in excess; posterior half of upper parts, with base of tail, and outer side of hind legs a fine grizzled mixture of ochraceous buff and blackish, both colors in about equal proportions; upper surface of tail a grizzle of blackish and cream color or buff; the black being much in excess; underparts of head, neck, and body, including inner side of legs, varying from ochraceous buff to dull orange ochraceous; underside of tail similar to upper, but the lighter color in excess along its center; hands and feet blackish brown, with a very fine ochraceous grizzle; shoulder stripe well developed, orange rufous.

Skull and teeth.—These are distinctly of the *ferruginea* type, but the teeth are noticeably smaller, the bullæ larger, and brain case more rounded and inflated. (Plate 9, fig. 4.)

Measurements.—Type: Head and body, 220 mm.; tail, 175; hind foot, 48; condylobasal length, 48.5; zygomatic width, 26; width of brain case, 19; maxillary tooth row, 18.5. Except in length of tooth row and width of brain case the type has measurements slightly in excess of the majority of specimens. For individual measurements, see table, page 78.

Remarks.—*Tupaia discolor* is a very distinct form, and along with *T. longipes* of Borneo constitutes a distinct section of the genus. Although clearly of the *ferruginea* type it is very different in coloration and in number of mammæ from that form. It is clearly a derivative of the Bornean *T. longipes* and has no close affinities with *T. glis ferruginea* of Sumatra. It is described here before *T. longipes* because it is a more extreme development of the same type of animal. Although externally showing many affinities to *T. hypochrysa* of Java, yet its skull shows none of the peculiarities of that species and is distinctly of the wide ranging *ferruginea* type.

Specimens examined.—Fifteen, all from Banka—three from Klabat Bay, on the northern end, and twelve from Tanjong Rengsam, upper part of Banka Strait.

EXPLANATION OF NUMBERS ON MAP FACING.

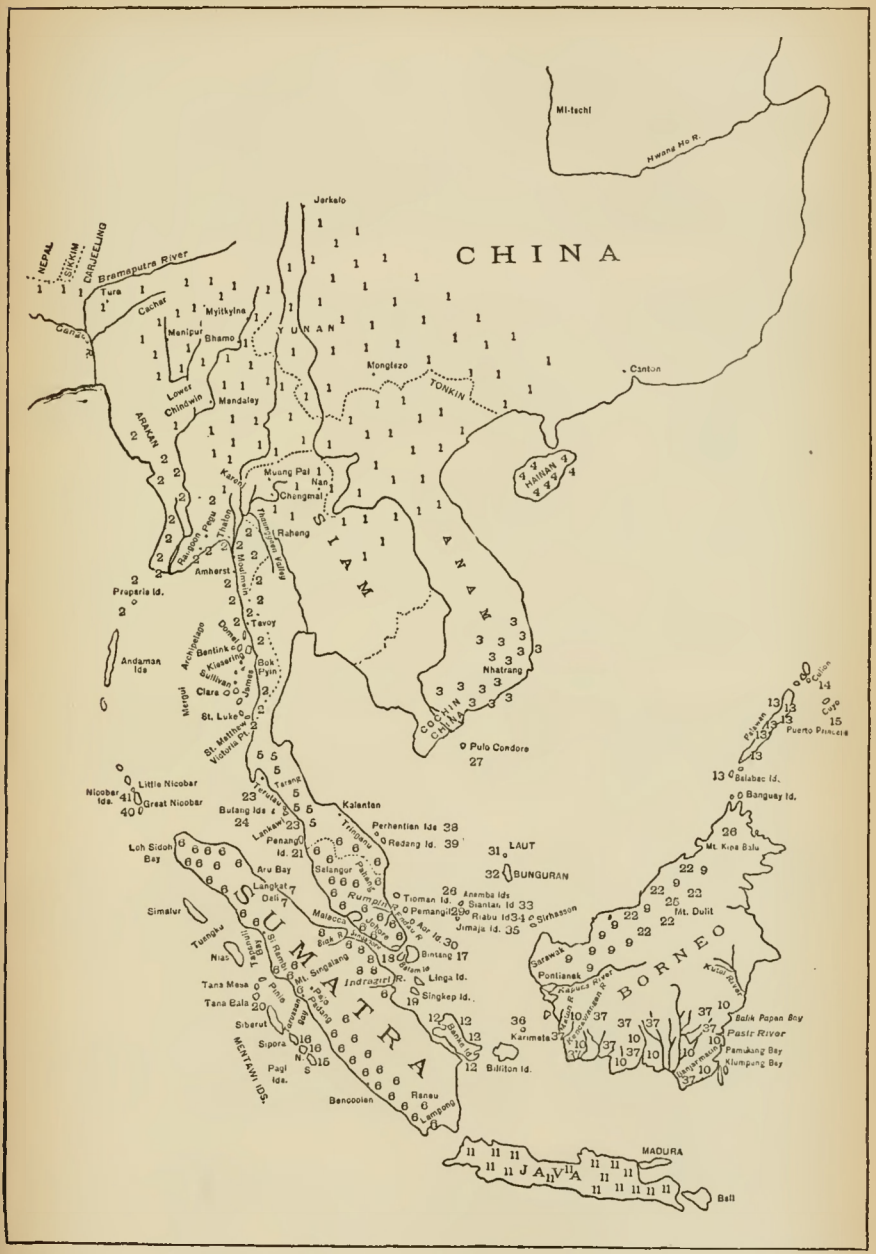
1 *T. chinensis:* China, northern Burma.
2 *T. belangeri:* Tenasserim.
3 *T. concolor:* Anam.
4 *T. modesta:* Island of Hainan.
5 *T. laccrnata wilkinsoni:* Middle of Malay Peninsula.
6 *T. glis ferruginea:* Southern Malay Peninsula, Sumatra.
7 *T. demissa:* Northern Sumatra.
8 *T. siaca:* Eastern Sumatra.
9 *T. longipes longipes:* Northern Borneo.
10 *T. longipes salatana:* Southern Borneo.
11 *T. hypochrysa:* Java.
12 *T. discolor:* Banka, east of Sumatra.
13 *T. palawanensis:* Palawan, Balabac, northeast of Borneo.
14 *T. möllendorffi:* Culion, northeast of Borneo.
15 *T. cuyonis:* Cuyo, northeast of Borneo.
16 *T. chrysogaster:* Mentawi Islands, south of Sumatra.
17 *T. castanea:* Bintang Island, south of Malay Peninsula.
18 *T. glis batamana:* Batam Island, south of Malay Peninsula.
19 *T. phœura:* Sinkep Island, between Malay Peninsula and Sumatra.
20 *T. tephrura:* Tana Bala, southwest coast of Sumatra.
21 *T. glis glis:* Penang Island, west coast, southern Malay Peninsula.
22 *T. picta:* Northern Borneo.
23 *T. laccrnata laccrnata:* Lankawi, Terutau, west coast Malay Peninsula.
24 *T. laccrnata raviana:* Butang Islands, west coast, Malay Peninsula.
25 *T. montana montana:* Mount Dulit, Northern Borneo.
26 *T. montana baluensis:* Mount Kina Balu, northeastern Borneo.
27 *T. dissimilis:* Condore Island, off Cochin China.
28 *T. glis sordida:* Tioman Island, east of southern Malay Peninsula.
29 *T. glis pemangilis:* Pemangil Island, east of southern Malay Peninsula.
30 *T. glis pulonis:* Aor Island, east of southern Malay Peninsula.
31 *T. lucida:* Pulo Laut, north of west end of Borneo.
32 *T. natunæ:* Bunguran Island, north of west end of Borneo.
33 *T. chrysomalla:* Siantan Island, between southern Malay Peninsula and Borneo.
34 *T. riabus:* Riabu Island, between southern Malay Peninsula and Borneo.
35 *T. anambæ:* Jimaja Island, between southern Malay Peninsula and Borneo.
36 *T. carimatæ:* Karimata Island, southwest coast of Borneo.
37 *T. splendidula:* Southern Borneo.
38 *T. lacernata longicauda:* Perhentian Island, east coast of Malay Peninsula.
39 *T. lacernata obscura:* Redang Island, east coast of Malay Peninsula.
40 *T. nicobarica nicobarica:* Great Nicobar Island, northwest of Sumatra.
41 *T. nicobarica surda:* Little Nicobar, northwest of Sumatra.

TUPAIA LONGIPES Thomas.

(Synonymy under subspecies.)

Geographic distribution.—Borneo. See Nos. 9 and 10 on map on page 75.

Diagnosis.—Similar to *Tupaia discolor* of Banka, but larger and with less contrast in color between anterior and lower portions of back; mammæ, 3–3 = 6.



MAP OF THE MALAY REGION, SHOWING THE DISTRIBUTION OF THE FORMS OF THE GENUS TUPAIA, EXCEPTING THE MEMBERS OF THE GRACILIS, JAVANICA, AND MINOR GROUPS.

Color.—Upper parts of head, neck, and anterior half of body and outer side of forelegs a fine grizzle of black and tawny, the latter color in excess; posterior portions of upper parts including base of tail, and outer side of hind legs a fine grizzly mixture of ochraceous buff and blackish, both colors in about equal proportions; upper surface of tail blackish brown faintly grizzled with a buff-like color; undersurface of tail similar, but the buffy color predominating in the middle line; anterior half of underparts light orange ochraceous, posterior portions dull buffy, inner side of legs similar to adjacent portion of underparts, but colors duller; feet blackish brown with a very few light specks.

Skull and teeth.—Of the same general form as in *Tupaia glis ferruginea*, but slightly larger throughout and very similar to the skull of *T. discolor*, with a similar inflation of the brain case and rather enlarged ballæ, but the skull and teeth as a whole decidedly larger than in *discolor*.

Measurements.—Head and body, 200 mm., or slightly more; tail, 190; hind foot, 50–53; condylobasal length, 48–52; zygomatic width, 26–28; width of brain case, 20–21; maxillary tooth row, 19–21.

Forms.—*Tupaia longipes* is separable into two fairly well marked forms, *T. longipes longipes* from northern Borneo, and a form from southern Borneo described below as new.

TUPAIA LONGIPES LONGIPES Thomas.

1893. *Tupaia ferruginea longipes* THOMAS, Ann. Mag. Nat. Hist., ser. 6, vol. 11, p. 343, May, 1893.

1911. *Tupaia longipes*, LYON, Proc. U. S. Nat. Mus., vol. 40, p. 122, April 25, 1911.

Type-locality.—Northwestern Borneo.

Type-specimen.—In British Museum, Reg. No. 76.9.20.5, collected in 1876, by H. Low.; a fairly well made skin in good condition; skull with the occipital portion cut away after the manner of bird collectors.

Geographic distribution.—Northern Borneo, specimens from Sarawak to Mount Kalulong. See No. 9 on map on page 75.

Diagnosis.—Tail and lower back more brownish, and less gray than in the southern subspecies, and less contrast in color between anterior and posterior portions of body; maxillary tooth row usually over 20 mm. in length.

Measurements.—Type: Hind foot, 51 mm.; zygomatic width, 27; width of brain case, 20.5; maxillary tooth row, 21. For measurements of other specimens, see table, page 77.

Specimens examined.—Twelve, from northern Borneo. For exact localities, see table, page 77.

TUPAIA LONGIPES SALATANA, new subspecies.

Type-locality.—Pangkallahan River, S. E. Borneo, 15 miles from mouth.

Type-specimen.—In U. S. National Museum, Cat. No. 151882, collected along Pangkallahan River February 11, 1908, by Dr. W. L. Abbott; original number, 5785; skin in good condition; skull damaged by shot in basal occipital region.

Geographic distribution.—Southern Borneo, specimens from Kendawangen River region and Pangkallahan River. See No. 10 on map on page 75.

Diagnosis.—Differs from the northern race in having more contrast in color between anterior and posterior portions of back, more rufescent on the shoulders than is *T. l. longipes* and less than *T. discolor;* general effect of lower back and tail is much like clove brown, while in the northern race it is more like bistre; not so light on the lower back as is *T. discolor;* maxillary tooth row less than 20 mm. in length. (Plate 9, fig. 5.)

Measurements.—Type: Head and body, 213 mm.; tail, 185; hind foot, 50; condylobasal length, 45; zygomatic width, 25.5; width of brain case, 20.5; maxillary tooth row, 19.5. For measurements of four other individuals, see table below.

Specimens examined.—Five; four from southwestern and one from southeastern Borneo. An old mounted specimen is in the Paris Museum, numbered 21, and marked simply "Borneo," collected by Temminck in October, 1842, hind foot measuring about 45 mm. It may possibly belong to the present subspecies.

Measurements of Tupaia longipes and Tupaia discolor.

Name.	Locality.	No.	Sex.	Molar teeth worn.	Head and body.	Tail.	Hind foot.	Condylo-basal length.	Zygomatic width.	Width of brain case.	Maxillary tooth row.	Number of mammæ.
					mm.	*mm.*	*mm*	*mm*	*mm*	*mm*	*mm*	
T. longipes salatana.	Borneo, Batu Jurong.	153852	Male	Slightly	205	195	49	48	25.5	21.5	19	
Do	do	153853	do	None [1]	192	205	51	45.5	25	20	18	
Do	Borneo, Kendawangan River.	153854	Female	do [1]	190	180	50	46.5	25	21	19	
Do	do	153855	Male	Slightly [2]	213	190	53	49	26	21	19	
Do	Borneo, Pangkallahan River.	151882 [3]	do	Moderately	213	185	50	49±	25.5	20.5	19.5	
Do	Borneo [4]	Paris, 21					45±					
T. longipes longipes.	Baram River, Sarawak.	92.2.7.20	Male	Much			51	50			19.5	
Do	Baram, Sarawak.	0.S.4.7	do	do			53	52	28	21	20.5	
Do	Kalulong, Sarawak.	S.1.27.2	do	Moderately			53	49.5		20	21	
Do	Spitang, North Borneo.	92.9.6.1	do	do			49	49	27	21	20	

[1] Permanent *pm* [3] and *pm* [4] not yet in place.
[2] *i* [1] and *i* [2] not fully in place.
[3] Type.
[4] Collected by Temminck, October, 1842.

Measurements of Tupaia longipes and Tupaia discolor—Continued.

Name.	Locality.	No.	Sex.	Molar teeth worn.	Head and body.	Tail.	Hind foot.	Condylo-basal length.	Zygomatic width.	Width of brain case.	Maxillary tooth row.	Number of mammæ.
					mm.	*mm.*	*mm*	*mm*	*mm*	*mm*	*mm*	
T. longipes longipes.	North west Borneo.	76.9.20.5 [1]	.....	Moderately	.....	.....	51	....	27	20.5	21	....
Do	Sarawak	93.4.1.37	Male	Adult	215	205	54	....	....	....	....	....
Do	Baram River	Berlin	Female	Skull inside	.....	.....	53	....	....	....	....	....
Do	Sarawak [2]	Genoa [3]	Male	.....	195	195	53	....	....	....	....	....
Do	do [2]	Genoa [3]	do	.....	160	165	51	43	24	20.5	....	....
Do	do [2]	Genoa 3b [4]	Female	Moderately	190±	165±	50±	51.5	27	21	21	3-3
Do	do [2]	Genoa 3a [4]	Male	.....	190±	155±	50±	....	....	....	....	....
Do	do [2]	Genoa 3d [5]	.....	None [6]	200±	155±	52	47.5	26	21	20	....
T. discolor	Banka, Klabat Bay.	124903	Female	None [7]	170	155	48±	41.5	23.5	19.5	18±	....
Do	do	124904	do	Moderately	210	162	46	48	25.5	19	18.5	3-3
Do	Banka, Tanjong Rengsam.	124700	Male	Slightly	203	177	48	47	25.5	19.5	19	....
Do	do	124701	do	Moderately	205	187	48	47	25.5	19.5	18.5	....
Do	do	124702	do	do	200	.....	48	46.5	25	20	18	....
Do	do	124705	do	do	203	187	48	46	25	19.5	18	....
Do	do	124706	do	do	200	180	48	47	25.5	20	19	....
Do	do	124704	Female	Much	203	180	49	47	25	19.5	19	3-3
Do	do	124707	do	Slightly	192	170	46	45.5	24	19.5	19	3-3
Do	do	124703 [1]	do	Moderately	220	175	48	48.5	26	19	18.5	3-3
Do	do	124708	do	do	.....	.....	....	47.5	25	19.5	18.5	....
Do	do	124697 [3]	Male	(8)	195±	170	47	....	....	....	....	....
Do	do	124698 [3]	Female	(9)	225±	170	47	....	....	....	....	3-3
Do	Banka, Klabat Bay.	124905 [3]	Male	(8)	200±	160	48	....	....	....	....	....
Do	Banka, Tanjong, Rengsam.	9.8.16.1	Female	Moderately	210	175	49	47	25.5	20	19	2-2

[1] Type.
[2] Collected by Doria and Beccari.
[3] Preserved in alcohol.
[4] Mounted.
[5] Skeleton.
[6] *dpm*[4] still in place.
[7] m^2 last tooth through.
[8] Nearly adult.
[9] Adult.

TUPAIA PALAWANENSIS Thomas.

1894. *Tupaia ferruginea palawanensis* THOMAS, Ann. Mag. Nat. Hist., ser. 6, vol. 13, April, 1894.

Type-locality.—Palawan, Philippine Islands.

Type-specimen.—In British Museum, Reg. No. 94.2.1.3; skin and skull of adult male, collected on Palawan by A. Everett; skin in good condition, but skull slightly damaged in occipital and palatal regions.

Geographic distribution.—Islands of Palawan and Balabac, and probably other near-by islands. See No. 13 on map on page 75.

Diagnosis.—Generally similar in color to *T. glis ferruginea*, but tail when viewed from above clear black or nearly so; mammæ, 2–2 = 4.

Color.—Type: Upper parts of head, neck, and body a rather coarse grizzle of blackish and ochraceous or ochraceous rufous, the ochraceous being more conspicuous anteriorly and the ochraceous rufous posteriorly, the black element of the grizzle being somewhat in excess, especially along the middle line; underparts dull buff or

ochraceous buff; outer and inner side of legs similar to adjacent parts of body; feet similar to legs, but toes distinctly blackish; upper side of tail clear blackish; underside similar except for tawny ochraceous annulations on either side of the middle line and toward the base.

Not all specimens are as strongly characterized as the type; in most of them the tail is not clear black above, in some cases being blackish brown and nearly always with some fine ochraceous dots or annulations showing on the upper surface. Two specimens, Reg. No. 94.2.1.4 and 97.9.12.1, are very similar to the type in color, but the specimens from Puerto Princessa in the Paris Museum are similar to *Tupaia chinensis*, but are darker above, and with distinctly darker tails.

Skull and teeth.—These do not show any distinguishing characteristics, being generally like those of *Tupaia glis ferruginea*.

Measurements.—Type: Head and body (from dried skin), 210 mm.; tail (from dried skin), 185; hind foot, 45; condylo-basal length, 50; zygomatic width, 26.5; width of brain case, 18.5; maxillary tooth row, 18. Measurements of other specimens fully as old as the type are essentially the same except that the condylo-basal length is much shorter in some, as small as 43 mm., and the hind foot is seldom as long. For individual measurements see table, page 80.

Remarks.—As represented by the type-specimen *Tupaia palawanensis* is a very distinct form, and quite different from its geographic neighbor, *T. longipes*, of Borneo. *T. longipes* is finely grizzled on the upper parts, and its tail is essentially like the back in color, while *T. palawanensis* is coarsely grizzled, and its black tail is very different in appearance from the back. While I have not been able to compare the Puerto Princessa specimens directly with the type of *T. palawanensis*, yet as far as can be told from memory they seem very different in general style of coloration from the type. Although the tails are darker than the upper parts they do not appear black, and the difference in condylo-basal length 50 in the type and 43 mm. in a Puerto Princessa specimen with moderately worn teeth is considerable. It is barely possible that more than one form of *Tupaia* may occur on Palawan. It is to be noted also that the exact locality of the type does not appear to be known, the specimen being labeled simply "Palawan." This species or a related one occurs on Balabac, represented by British Museum, Reg. No. 94.7.2.55, a nearly adult female preserved in alcohol. Owing to its immaturity and manner of preservation it is not possible to say whether it is *T. palawanensis* or some other form. Another specimen in the British Museum, not numbered, collected by W. Doherty, is marked "Palawan or Basilan," is not particularly different from *T. palawanensis*, and for the time

being at least it seems best to regard it as having come from Palawan. In the Berlin Museum is a specimen collected by Möllendorf, agreeing very well with *T. palawanensis*. It is labeled "Calamianes Gruppe." If not coming from northern Palawan itself, it probably came from some of the nearer islands at the northern end of Palawan. This specimen was called by Nehring,[1] in 1894, *T. ferruginea*. The specimen appears to be an old one and to have been mounted at one time. The same name was applied to the British Museum specimens in 1889 by Everett.[2]

Specimens examined.—Eighteen; 6 including the type from "Palawan"; 6 from Puerto Princessa, Palawan; 3 from Iwahig, Palawan; 1 from the "Calamianes Gruppe"; 1 from Balabac; and 1 from "Palawan or Basilan." See table below.

Measurements of Tupaia palawanensis.

[B. M.=British Museum, London; P. M.=Philippine Museum, Manila; A. M. N. H.=American Museum of Natural History, New York.]

Locality.	Number.	Sex.	Molar teeth worn.	Head and body.	Tail.	Hind foot.	Condylo-basal length.	Zygomatic width.	Width of brain case.	Maxillary tooth row.	Mammæ.
				mm.	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	
Palawan	94.2.1.3 [3]	Male	Slightly	210±	185±	45	50	26.5	18.5	18	....
Do	94.2.1.5	.....	None [4]	180±	150±	45	37.5	21	18.5	.....	....
Do	91.11.28.1	.....	.....do.[5]	.....	.....	43	44	.....	.....	17	....
Do	76.10.4.6	.....	.....do.[6]	160±	135±	40	.....	.....	20	.....	....
Do	7.99.12.1 [7]	.....	Moderately	.....	.....	42	47.5	.....	19	18	....
Do	94.2.1.4	Female	Slightly	210±	185	45	46	.....	19	17.5	2-2
Palawan or Basilan	B. M. no no.; W. Doherty, collector.	.....	None	190	150	40	.....	.....	.....	19.5	....
Balabac	94.7.2.55	Female	([8])	180	150	43	.....	.....	.....	.....	....
Palawan, Puerto Princesa.	79.5.3.10	Male	([9])	165	145	44	.....	.....	.....	.....	....
Do	98 P. M.	Female	Slightly [10]	148±	148±	43	44.3	22.5	19	16.7	2-2
Palawan, Iwahig	A. M. N. H. 29725.	.....	Moderately	.....	.....	.....	.....	25	18.5	17.5	....
Do	29726	.....	None [11]	.....	.....	.....	.....	.....	20±	17±	....
Do	29724	.....	Much	.....	.....	.....	.....	.....	.....	17.5	....
Palawan, Puerto Princesa.	Paris, 234	.....	Moderately	190±	175±	41±	.....	25	21	17	....
Do	Paris, 1282	.....	.....do.....	200±	160±	40±	.....	24	18.5	17	....
Do	Paris, 22	.....	None	210±	170±	42±	43	.....	18.5	18	....
Do	Paris, 1281	Female	Moderately	205±	155±	42±	43	23	18	17	2-2
"Calamianes Gruppe."	13908, Berlin [12]	.....	Skull in skin.	.....	.....	42	.....	.....	.....	.....	....

[1] Sitz.-Ber. Ges. nat. Freunde, Berlin, 1894, No. 8, p. 184.
[2] Proc. Zool. Soc. London, 1889, p. 223.
[3] Type.
[4] pm^2 just appearing.
[5] m^3 half way up.
[6] pm^2 half way up.
[7] Mounted specimen.
[8] Nearly adult preserved in alcohol.
[9] Deciduous incisors still in place, preserved in alcohol.
[10] Deciduous incisors still in place, permanent *i* appearing.
[11] m^3 just appearing.
[12] Obtained by Möllendorf probably from natives, mentioned by Nehring as *T. ferruginea*. Specimen rather old and once mounted.

TUPAIA MÖLLENDORFFI Matschie.

1898. *T[upaja] möllendorffi* MATSCHIE, Sitz.-Ber. Ges. nat. Freunde, Berlin, 1898, p. 39.

Type-locality.—Culion (also called Calimian), a small island north of Palawan, Philippine Islands.

Type-specimen.—In the Royal Zoological Museum, Berlin, No. 9858, skin and skull of adult male, collected on Culion, Philippine Islands, by Dr. von Möllendorff; skin in good condition, but posterior parts of the skull are lacking.

Geographic distribution.—Island of Culion and possibly some of the immediately adjacent islands. See No. 14 on map on page 75.

Diagnosis.—Upper parts finely grizzled ochraceous and blackish, tail coarsely black and buff, different, that is grayer, in color from rest of upper parts. Mammæ, 2–2 = 4.

Color.—Upper parts and sides of head, neck, and body a fine grizzle of ochraceous (or ochraceous buff), and blackish, the lighter color being slightly in excess, expecially along the sides and rump; underparts, including throat and inner side of legs, usually dirty buff, or ochraceous buff; in the type the chin and throat, cream buff, distinctly lighter than rest of underparts; outer side of legs essentially like upper parts of body; feet similar, but the grizzle very fine, and the dull ochraceous buff color predominating; shoulder stripe fairly well defined, buffy; tail a coarse grizzle of buff and blackish, both above and below, the blackish color slightly in excess above, and the buff below; tail from above with a distinctly grayer look than rest of upper parts, and noticeably different in color.

Skull and teeth.—The skull of *Tupaia möllendorffi* is smaller than that of *T. glis ferruginea*, relatively shorter, wider, with a relatively thicker rostrum which arises more abruptly from rest of skull. Aside from their slightly smaller size and relatively greater development of the central upper incisors the teeth of *T. möllendorffi* are not essentially different from those of *T. glis ferruginea*.

Measurements.—Type: Head and body (dried skin), 200 mm.; tail, (dried skin), 160; hind foot, 43; zygomatic width, 24; width of brain case, 18; maxillary tooth row, 16.5. For measurements of three other specimens see table, page 83.

Remarks.—*Tupaia möllendorffi* is quite different and apparently very distinct from its geographic neighbor, *T. palawanensis*. It is smaller and its external appearance quite different from the typical Palawan form. When compared with the Puerto Princesa (Palawan) specimens it is not so distinct, but its lighter colored tail serves to distinguish it easily. It was identified by Nehring[1] in 1894 as *Tupaia ferruginea*.

Specimens examined.—Four. See table, page 83.

[1] Sitz. Ber. Ges. naturf. Freunde, Berlin, 1894, p. 184.

TUPAIA CUYONIS Miller.

1910. *Tupaia cuyonis* MILLER, Proc. U. S. Nat. Mus., vol. 38, p. 393, August 19, 1910.

Type-locality.—Cuyo Island northeast of Palawan, Philippine Islands.

Type-specimen.—In the collection of the Philippine Museum, Manila, Philippine Islands, No. 26, skin and skull of adult male, collected on Cuyo Island January 15, 1903, by R. C. McGregor and A. Celestino; in good condition.

Geographic distribution.—Known only from the Cuyo Island. See No. 15 on map on page 75.

Diagnosis.—Similar to *Tupaia möllendorffi;* head and body of a uniformly grizzled ochraceous and black coloration, but tail not different in color from lower back. Mammæ, 2–2=4.

Color.—Type: Upper parts and sides of head, neck, and body a fine grizzle of ochraceous and black, the lighter color being slightly in excess, especially along the sides and rump; under parts, including throat and inner side of legs, generally ochraceous, darker anteriorly and approaching buff posteriorly, the dark bases of the hairs showing through, giving an ill-defined grizzled appearance; outer side of legs essentially like the body, the feet similar, but grizzling finer; shoulder stripe ill defined, buff in color; tail above and below a coarse grizzle of ochraceous and blackish, the darker color slightly in excess above and the lighter color below.

Skull and teeth.—These are without special peculiarities, distinctly smaller than those of *T. glis ferruginea;* brain case relatively wide, rostrum rather short and heavy, arising rather abruptly from rest of skull. The hypocones of the first and second molars are very poorly developed. (Plate 9, fig. 1.)

Measurements.—Type: Head and body, 154 mm.; tail, 166; hind foot, 41; condylo-basal length, 43; zygomatic width, 24.4; width of brain case, 18; maxillary tooth row, 16.5. The external measurements of the type are somewhat less than those of the majority of specimens, but the cranial measurements are characteristic. For individual measurements see page 83.

Remarks.—The two species just described, *T. möllendorffi* and *T. cuyonis,* are closely related forms but easily distinguished by the tail being grayer than rest of upper parts in the one case and by its being of generally the same color as the lower back in the other case. They appear more closely related to one another than either of them does to *T. palawanensis.* The skulls of the two forms are essentially alike. There are many things about *Tupaia cuyonis* to suggest *T. javanica.* The two are not so very different in size, especially when the skulls are compared. The skulls have the same general shape in the two species. The development of the central upper incisors and lower canines is distinctly greater than in most members of the genus, but on the whole rather less than what one finds in good

specimens of *Tupaia javanica*. *T. cuyonis* also resembles *T. javanica* in having dark under parts. *T. cuyonis* might with much propriety be described as a large brown and not olivaceous *T. javanica*. The difference between the length of tooth row and the width of brain case is greater in *Tupaia cuyonis* than it is in *T. chinensis* or *T. belangeri*, and still greater than in *T. glis ferruginea*, where the maxillary tooth row is sometimes as long as the brain case is wide. In *T. javanica* the difference in length of maxillary tooth row and width of brain case is even greater than in *T. cuyonis*. *Tupaia cuyonis* and *T. möllendorffi* are very distinct from each other and from other members of the genus, but at the same time they have no sharply separating characters. They have characters which on the one hand ally them with *T. javanica* and on the other with *T. chinensis*.

Specimens examined.—Nine, all from Cuyo Island, and in the collection of the Philippine Museum. See table below.

Measurements of Tupaia möllendorffi and T. cuyonis.

Name.	Locality.	Number.	Sex.	Molar teeth worn.	Head and body.	Tail.	Hind foot.	Condylo-basal length.	Zygomatic width.	Width of brain case.	Maxillary tooth row.	Number of mammæ.
					mm	*mm*	*mm*	*mm*	*mm*	*mm*	*mm*	
T. möllendorffi.	Culion Island, Philippine Islands.	2 P. M.[1]	Male	Slightly	164	166	46	43.0	23.0	18.5	16.7	....
Do	do	3 do.[1]	Female.	None [2]	147	147	40	40.7	22.2	18.0	15.4	2-2
Do	do	9858, Berlin[3]	Male	Moderately	200±	160±	43±	....	24.0	18.0	16.5	....
Do	Unknown	No no., Berlin.	....	Slightly	205±	165±	41±	....	....	....	17.0	....
T. cuyonis.	Cuyo, Philippine Islands.	1 P. M.[1]	Male	Moderately	176	164	42	43.7	24.5	18.0	16.5	....
Do	do	22 do.[1]	Female.	Slightly	146	154	41	42.4	23.6	18.0	16.0	2 2
Do	do	23 do.[1]	Male	do	165	155	43	43.6	24.6	18.5	16.0	....
Do	do	24 do.[1]	do	Moderately	145	174	42	43.8	25.0	18.5	16.0	....
Do	do	25 do.[1]	do	Slightly	160	166	41	43.7	24.6	18.5	16.0	....
Do	do	26 do.[1] [3]	do	Moderately	154	166	41	43.0	24.4	18.0	16.5	....
Do	do	41 do.[1]	do	Slightly	157	152	42	43.3	24.0	18.5	16.5	....
Do	do	42 do.[1]	Female.	do. [2]	165	175	42	41.9	22.4	18.5	16.0	2-2
Do	do	43 do.[1]	Male	do	166	164	42	43.8	24.5	18.0	16.0	....

[1] Philippine Museum. [2] *di*[1] still in place and *i*[1] just appearing. [3] Type.

TUPAIA SPLENDIDULA Gray.

1865. *Tupaia splendidula* Gray, Proc. Zool. Soc. London, 1865, p. 322, pl. 12, entire animal in colors.

1867. *Tupaia ruficaudata* Mivart, Journ. Anat. Physiol., vol. 1, p. 293, footnote, 1867. (Same type-specimen and locality as *T. splendidula* above.) A publication of Gray's manuscript name.

1879. *Tupaia splendidula*, Anderson, Zool. Res. West. Yunnan, p. 132, pl. 7, figs. 10 and 11, skull, 1879.

1894. *Tupaia splendidula*, Thomas and Hartert, Nov. Zool., vol. 1, p. 656, September, 1894.

1896. *Tupaja mülleri* Kohlbrugge, Natuurk. Tijdschr. Nederl.-Indië, vol. 55 (ser. 9, 4), p. 196. 1896. (Type-locality, Banjermassin, southeastern Borneo.)

Type-locality.—Borneo, probably.

Type-specimen.—This species was based upon two specimens in the British Museum, one of them in alcohol from Borneo, Reg. No.

48.2.11.2, and a skin and skull without locality, Reg. No. $\frac{47.7.8.13}{48.1.27.14}$. From the account in the original description one would be inclined to take the specimen in alcohol as the type, but because a colored plate of the entire animal is given, one is justified in regarding the skin as the type. This has been done by authors generally, Mivart, Anderson, and Thomas.[1] This course is rendered imperative by the fact that an examination of the specimen in alcohol shows it to be an immature example of *Tanatana*, the first upper molar not being through the gum, and just appearing through the alveolus. The skin, Reg. No. 47.7.8.13, is mounted and in good condition, probably a female; the only original information concerning it is "Ex. coll. Verreaux."[1] The skull, Reg. No. 48.1.27.14, is in fairly good condition, but considerably damaged on the right side about the palate.

Geographic distribution.—Probably the entire island of Borneo, but known records are only from southern portion. See No. 37 on map on page 75.

Diagnosis.—About the size of or slightly smaller than *T. glis ferruginea*, upper parts seal or walnut brown, tail similar to body, its hairs without annulations. Mammæ, probably 2–2 = 4.

Color.—General color effect above something between seal brown and walnut brown, with indistinct grizzling with ferruginous posterior to neck, becoming almost obsolete on the rump, anterior to the neck color lighter and grizzling more distinct; in the type, top of neck and shoulders and sides something of a color between bay and chestnut; under parts anterior to chest, buffy in the type, ochraceous buffy in other specimens, posterior to chest tawny ochraceous; tail above similar to back, below tawny in center line, outer edges like back, hairs of tail without annulations; shoulder stripe rather poorly defined, tawny ochraceous.

Skull and teeth.—The skull and teeth of *Tupaia splendidula* are of the same general form as those of *T. glis ferruginea*, but are distinctly smaller, with smaller and more oval incisive foramina, and relatively larger orbits. The type has a slightly wider rostrum and wider brain case than Cat. No. 151883, U.S.N.M. (Plate 10, fig. 11.)

Measurements.—Type: Head and body, 190 mm.; tail, 140 (both from mounted skin); hind foot, 40; condylo-basal length, 45; zygomatic width, estimated, 27; width of brain case, 18; maxillary tooth row, 17.5. Collector's measurements of head and body are 173–188; tail, 130–157. Measurements of two adult skulls are: Condylo-basal length, 43.5–44; zygomatic width, 24.5–24.5; width of brain case, 18–18.5; maxillary tooth row, 16.5–18. See table, page 87.

Remarks.—*Tupaia splendidula* is a well-characterized species and representative of a rather definitely marked group. As seen on Borneo and as represented by geographic forms in the Natuna Islands, it is very different from members of the wide ranging *ferruginea* group, yet it seems to be not very distantly removed from it.

[1] See Thomas and Hartert, Nov. Zool., vol. 1, p. 656, September, 1894.

Its chief distinguishing feature is the lack of annulations on the hairs of the tail, generally dark color, and the small size of skull. On Sumatra, Singkep, and the Anamba Islands are Tupaias which, while evidently belonging to this *splendidula* group, are much closer to *T. glis ferruginea* than is *T. splendidula* itself. I have not seen Kohlbrugge's *Tupaia mülleri*, but the description would indicate it to be an example of *T. splendidula*. Neither have I seen *Glipora rufescens* "b" and "c" of Jentink's Catalogue,[2] judging by the name they may be examples of this species. Mivart's *Tupaia ruficaudata* was an accidental publication of Gray's manuscript name. Gray had evidently intended to call the species *ruficaudata*, but really published the name as *splendidula*, forgetting to change *ruficaudata* on the label of the specimen. As Kohlbrugge points out, attention to this species was first called by Müller and Schlegel[1] who considered it a hybrid between "*Hyl. tana* and *ferruginea*." Not unlikely it is specimen "*d*" under *Tupaia ferruginea* from Banjermassin in Jentink's catalogue of mammals in the Leyden Museum.[2] In the Berlin Museum is a skull without skin from Kutei, a district on the east coast of Borneo somewhat north of Klumpang Bay, where Doctor Abbott collected two examples. I have identified it as *Tupaia splendidula*, but not without some reservation, as I was unable to make a direct comparison with known *splendidula* skulls.

Specimens examined.—Five, four from southern Borneo, and one, the type, probably from Borneo. See table, page 87.

TUPAIA NATUNÆ Lyon.

1895. *? Tupaia splendidula typica* THOMAS and HARTERT (*nomen nudum*), Nov. Zool., vol. 2, p. 489, December, 1895.

1911. *Tupaia natunæ* LYON, Proc. Biol. Soc. Wash., vol. 24, p. 168, June 16, 1911.

Type-locality.—Bunguran, Natuna Islands, north of Borneo.

Type-specimen.—In United States National Museum, Cat. No. 104714, skin and skull of an adult female, collected on Bunguran, Natuna Islands, June 27, 1900, by Dr. W. L. Abbott; original number, 514; in good condition.

Geographic distribution.—Bunguran Island. See No. 32, on map on page 75.

Diagnosis.—Similar to *Tupaia splendidula* of Borneo, but differing in a generally brighter and more reddish coloration of the upper parts, sides, legs, and tail, and more inflated braincase; mammæ, 2–2 = 4.

Color.—Type: General color of upper parts of neck and body, in fresh pelage, slightly brighter than burnt sienna, being produced by a wide band on most of the hairs, of a bright ferruginous burnt sienna mixture, with blackish bases and a considerable number of long blackish hairs; on rump, in old pelage, general color darker and

[1] Verh. Nat. Gesch. Nederl. Overz. Bezitt., p. 164, 1839–44.

[2] Mus. Hist. Nat. Pays-Bas, Cat Syst., vol. 12, 1888, p. 117.

duller; sides of body and outer side of legs similar to upper parts, but slightly grizzled; top of nose a grizzle of raw sienna and blackish gradually blending on top of head with color of upper parts; under parts buff to olive buff; inner side of legs similar to sides of body, but lighter; tail above like back, under side of tail and bases of tail hairs generally tawny ochraceous, with outer and terminal margins of tail below, dark tawny; shoulder stripe buff, or ochraceous buff. Cat. No. 104715, U.S.N.M., has the central portion of the tail orange ochraceous in color, being fully as bright as the tail of *T. lucida*.

Skull and teeth.—These are of the same general form as they are in *Tupaia splendidula*, but the skull averages longer and has a more inflated braincase; the teeth are larger. (Plate 10, fig. 12.)

Measurements.—Type: Head and body, 184 mm.; tail, 140; hind foot, 40; condylobasal length, 46; zygomatic width, 25; width of braincase, 19; maxillary toothrow, 18. For measurements of individuals, see table, page 87.

Remarks.—*Tupaia natunæ* is closely related to *T. splendidula*, so much so that Thomas and Hartert in 1894[1] considered them the same species. At that time there were no definite records of *Tupaia splendidula* from the island of Borneo, the only available material being the type of unknown locality. They arrived at the conclusion that the type had not been obtained on Borneo, but had probably come from the Natuna Islands. Since Doctor Abbott has obtained specimens on Borneo almost identical with the type there can be but little doubt that it was originally collected on that island.[2] In working with the treeshrews in 1904 Mr. Miller in manuscript notes had come to the conclusion that the Bunguran *splendidula* was distinct from true *splendidula* and had applied the name *natunæ* to it.

Specimens examined.—Six. All from Bunguran. See table, page 87.

TUPAIA LUCIDA Thomas and Hartert.

1895. *Tupaia splendidula lucida* THOMAS and HARTERT, Nov. Zool., vol. 2, p. 490, 1895.

1901. *Tupaia lucida*, MILLER, Proc. Wash. Acad. Sci., vol. 3, p. 133, March 26, 1901.

Type-locality.—Pulo Laut, North Natuna Islands.

Type-specimen.—In the Tring Museum, skin and skull of female, collected on Pulo Laut, by Ernest Hose, September, 1894. I have not seen this type.

Geographic distribution.—Pulo Laut, North Natuna Islands. See No. 31 on map on page 75.

Diagnosis.—A member of the *splendidula* group of *Tupaia*, but upper parts, including tail, bright tawny; mammæ, 2–2 = 4.

Color.—Based on topotypes in the United States National Museum, and a paratype in the British Museum, Reg. No. 95.11.8.7. Upper

[1] Nov. Zool., vol. 1, p. 656, September, 1894.

[2] See remarks by Thomas in Lyon, Proc. U. S. Nat. Mus., vol. 40, p. 122, April 25, 1911.

parts of body, tail, and outer side of legs bright tawny, with a very slight admixture of blackish or black; head ochraceous finely sprinkled with blackish; underparts dull ochraceous buff; underside of tail similar to upper surface, but brighter in color, and in the middle line lightening almost to ochraceous buff; shoulder stripe, moderately distinct, dull ochraceous.

Skull and teeth.—These do not appear to differ essentially from those of *Tupaia splendidula.*

Measurements.—Type (from original description): Head and body, 210 mm.; tail, 154; hind foot (without claws), 39. Usual measurements of adults: Head and body, 170–180; tail, 145–155; hind foot, with claws, 40–44; condylobasal length, 44–46; zygomatic width, 24–25; width of brain case, 18.5–19; maxillary toothrow, 18–19. For individual measurements, see table below.

Remarks.—*Tupaia lucida* is a very distinct member of the *splendidula* group, at once distinguished from the Bornean form by its much lighter and brighter color. It is a much more highly differentiated form than *T. natunæ*, probably owing to the smaller size of the island it inhabits, and the greater distance of the island from Borneo.

Specimens examined.—Eight. All from Pulo Laut. See table below.

Measurements of Tupaia splendidula, natunæ, and lucida.

Name.	Locality.	Number.	Sex.	Molar teeth worn.	Head and body.	Tail.	Hind foot.	Condylo-basal length.	Zygomatic width.	Width of brain case.	Maxillary tooth row.	Number of mammæ.
					mm	*mm*	*mm*	*mm*	*mm*	*mm*	*mm*	
T. splendidula.	Borneo; Klumpang Bay.	151883	Male	Moderately	180	130	40	43.5	24.5	18	18	....
Do	do	151884	do		173	150	42	....	....	....	....	....
Do	Borneo; Kendawangan River.	153856 [1]	Female	Slightly	188 [2]	157 [2]	[2] 44	44.5	24.5	18.5	16.5	....
Do	Probably Borneo.	47.7.8.13 [3]	Female?	Moderately	190±	180±	40	45	27±	18	17.5	....
Do	Borneo; Kutei	No no., Berlin.	do		(1)	....	....	45	25	18.5	17	....
T. natunæ	Natuna Islands; Bunguran.	104714 [3]	Female	Much	184	140	40	46±	25	19	18	2-2
Do	do	104715	do	None [4]	178	140	43	46.5	23	18.5	18	....
Do	do	95.11.8.5	Male	Slightly	....	....	41	....	24.5	19	18.5	....
Do	do	95.11.8.6	Female	Moderately	....	....	42	48.5	25	19	18.5	2-2
Do	do	94.9.28.38 [5]	Male		200	140	43	....	....	....	....	....
Do	do	94.9.28.37	Female		185	135	44	....	....	....	....	2-2
T. lucida	Natuna Islands; Laut.	104716	Male	Moderately	171	159	42	46.5	25	19	18.5	....
Do	do	104717	do	Much	184	....	44	45.5	25	19	18	....
Do	do	104718	Female	Moderately	178	146	43	46.5	25.5	18.5	18	2-2
Do	do	104719	Male	Much	178	152	44	46	....	18.5	19	....
Do	do	104720	Female	None [6]	178	146	42	44	23	18.5	19	....
Do	do	104721 [5]	do	(7)	175±	140	42	....	....	....	....	....
Do	do	104722 [5]	do	(8)	145±	115	39	....	....	....	....	....
Do	do	95.11.8.7 [9]	do	Much	....	....	40	43.5	24	18.5	18.5	2-2

[1] Skull only.
[2] Collector's measurement.
[3] Type.
[4] Permanent *pm*^{3}, *pm*^{4} not in place.
[5] Preserved in alcohol.
[6] Permanent *pm*^{4} just appearing.
[7] About two-thirds grown.
[8] About one-half grown.
[9] Paratype.

TUPAIA CHRYSOMALLA Miller.

1900. *Tupaia chrysomalla* MILLER, Proc. Wash. Acad. Sci., vol. 2, p. 232, August 20, 1900.

Type-locality.—Pulo Siantan, Anamba Islands, South China Sea.

Type-specimen.—In United States National Museum, Cat. No. 101710, skin and skull of adult female collected on Pulo Siantan, August 24, 1899, by Dr. W. L. Abbott; in good condition.

Geographic distribution.—Known only from Pulo Siantan, Anamba Islands. See No. 33 on map on page 75.

Diagnosis.—A member of the *splendidula* group, having the general appearance above of a bright reddish *T. glis ferruginea*, inner half of the caudal hairs viewed from below, ochraceous or tawny ochraceous; mammæ, 2–2 = 4.

Color.—Upper parts of body a grizzle of a color between ferruginous and chestnut, and blackish, brightest anteriorly; head a grizzle of ochraceous and blackish; outer sides of legs similar in color to adjacent parts of body; upper side of tail like back; outer edge of underside of tail similar to its upper surface, basal half or more of the long caudal hairs ochraceous or tawny ochraceous; underparts, buff to olive buff, with dark bases of the hairs showing through.

Skull and teeth.—Intermediate in size between those of *T. splendidula* and *T. glis ferruginea*, and rather more like the latter in form; incisive foramina relatively short and wide. (Plate 10, fig. 10.)

Measurements.—Type: Head and body, 178 mm.; tail, 152; hind foot, 43; condylo-basal length, 48; zygomatic width, 25; width of brain case, 19; maxillary tooth row, 19. See table, page 93.

Specimen examined.—One, the type.

TUPAIA RIABUS, new species.

Type-locality.—Pulo Riabu, Anamba Islands.

Type-specimen.—In United States National Museum, Cat. No. 104881, skin and skull of adult female collected on Pulo Riabu, Anamba Islands, South China Sea, August 23, 1900, by Dr. W. L. Abbott, in good condition.

Geographic distribution.—Known only from Pulo Riabu. See No. 34 on map on page 75.

Diagnosis.—A member of the *splendidula* group, intermediate in characters between *Tupaia lucida* of Pulo Laut, Natuna Islands, and *T. chrysomalla* of Pulo Siantan, Anamba Islands; mammæ, 2–2 = 4.

Color.—Upper parts of body and back of head ferruginous or orange rufous, irregularly lined with blackish; on head anteriorly and above shoulder stripe, the ferruginous colors replaced by ochraceous tints; outer side of legs similar to adjacent parts of body; tail above similar to upper parts of body, but blackish element practically wanting in distal three-quarters; long hairs of underside of

tail almost clear orange rufous; underparts, including inner side of legs, and short appressed hairs on underside of tail, ochraceous buff; feet blackish brown finely lined with ochraceous.

Skull and teeth.—Not essentially different from those of *Tupaia lucida* or *T. splendidula*, but distinctly smaller, especially the teeth, as compared with *T. chrysomalla*.

Measurements.—Type: Head and body, 176 mm.; tail, 146; hind foot, 43; condylo-basal length, 45.5; zygomatic width, 23.5; width of brain case, 19; maxillary tooth row, 18. See table, page 93.

Remarks.—*Tupaia riabus* is a very different treeshrew from its geographic neighbors, and externally and cranially appears to be more closely related to *T. lucida* of the Natunas. It is interesting to note that Pulos Laut and Riabu are about the same general area. *Tupaia riabus* was collected on a second visit to the Anamba Islands by Doctor Abbott in 1900, and hence was not included in Mr. Miller's account of the mammals of the Anamba and other islands published in the same year.[1]

Specimens examined.—Two, the type, and a young individual also from Pulo Riabu.

TUPAIA ANAMBÆ, new species.

Type-locality.—Pulo Jimaja, Anamba Islands.

Type-specimen.—In United States National Museum, Cat. No. 101743, skin and skull of adult male collected on Pulo Jimaja, Anamba Islands, September 23, 1899, by Dr. W. L. Abbott.

Diagnosis.—Very closely allied to *Tupaia chrysomalla* of Pulo Siantan, but distinguished by a generally less reddish coloration of head and body; mammæ probably 2–2 = 4.

Geographic distribution.—Known only from Pulo Jimaja, Anamba Islands. See No. 35 on map on page 75.

Color.—The color of *Tupaia anambæ* is so like that of *T. chrysomalla* that no detailed description is necessary. The ferruginous or chestnut-like color in *T. chrysomalla* is much lighter in color and replaced by a color something like tawny ochraceous; the whole lower back, rump, and thighs are lighter; the underparts are lighter more buffy and less ochraceous than in *T. chrysomalla*, but the tawny ochraceous color of the underside of the tail is of a darker shade in *T. anambæ*. Some of the difference in color may be due to difference in pelage, as the type of *chrysomalla* appears to be in an old pelage, while the type of *T. anambæ* is mostly in a fresh pelage. There is one skin of *T. anambæ*, Cat. No. 101741, which has just begun to change pelage, and while not appearing so distinct from *T. chrysomalla* as the type skin of *T. anambæ*, it has distinct though slight color differences and

[1] Mammals collected by Dr. W. L. Abbott on islands in the South China Sea, Proc. Wash. Acad. Sci., vol. 2, pp. 203–246, August 20, 1900.

is quite as good a form as many of the recognized insular forms of *T. glis*.

Skull and teeth.—The skull and teeth of *Tupaia anambæ* do not show any differences from those of *T. chrysomalla*.

Measurements—Type: Head and body, 178 mm.; tail, 152; hind foot, 47.5; condylo-basal length, 24.5; zygomatic width, 18.5; maxillary tooth row, 18.5. See also table, page 93.

Remarks.—The treeshrews of the Anamba Islands fall into two groups, the species on Pulo Riabu closely related to *Tupaia lucida* of the Natuna Islands and the form on Pulo Jimaja and Pulo Siantan, closely related to one another and not being closely allied to any other form. All three of the islands are separated by water of about the same depth, and approximately the same depth of water is found between them and Borneo on one side and the Malay Peninsula on the other. In many respects *Tupaia chrysomalla* and *anambæ* show many resemblances to *T. glis ferruginea* in color of the head and body, but their smaller size and color of the tail serve to distinguish them.

Specimens examined.—Three, all from Pulo Jimaja.

TUPAIA CASTANEA Miller.

1903. *Tupaia castanea* MILLER, Smiths. Misc. Coll., vol. 45, p. 54, November 6, 1903.

Type-locality.—Pulo Bintang, Rhio Archipelago, East Indies.

Type-specimen.—In United States National Museum, Cat. No. 115608, skin and skull of adult female collected on Pulo Bintang, August 11, 1902, by Dr. W. L. Abbott, original number, 1872; in good condition.

Geographic distribution.—Known only from Pulo Bintang. See No. 17 on map on page 75.

Diagnosis.—Related to *Tupaia splendidula*, but not so dark in color, and in size equalling *T. glis ferruginea;* mammæ, 2–2 = 4.

Color.—General color effect of upper parts of back of head, neck, and body and outer side of legs something between hazel and chestnut, but rather darker and brighter; on closer examination this effect seen to be produced by an indistinct and coarse grizzling of black and a color something like a rich dark ferruginous; front of head a fine grizzle of blackish and ochraceous or tawny ochraceous; tail above similar to the back in places, especially near base or else a color between orange rufous and cinnamon rufous; underside of tail between orange and cinnamon rufous; general color of under parts, including innerside of legs, between ochraceous and tawny ochraceous, with darker bases of hairs showing through in places, especially on the inner side of legs; hands and feet a fine grizzle of blackish and ochraceous; shoulder stripe moderately distinct, light tawny ochraceous or ochraceous rufous.

Skull and teeth.—These are of the same general form as they are in *Tupaia splendidula*, but larger throughout. The incisive foramina are rather large and less slit-like and the bullæ somewhat larger than in the case of *T. glis ferruginea*. (Plate 10, fig. 9.)

Measurements.—Type: Head and body, 200 mm.; tail, 145; hind foot, 46; condylo-basal length, 49; zygomatic width, 25.5; width of brain case, 19.5; maxillary tooth row, 19. The measurements of the type are not materially departed from in a series of eight individuals, for measurements of which see table, page 93.

Remarks.—*Tupaia castanea* is a very distinct form; from *T. splendidula* it is at once distinguished by its larger size, equaling *T. glis ferruginea*, and from *T. glis ferruginea* by its *splendidula* style of coloring. Schneider's[1] record from the Indragiri, Sumatra was perfectly correct so far as the group is concerned, but his specimens are now identified as *Tupaia siaca*.

Specimens examined.—Eight, all from Pulo Bintang.

TUPAIA SIACA Lyon.

1908. *Tupaia siaca* LYON, Proc. U. S. Nat. Mus., vol. 34, p. 661, September 14, 1908.

Type-locality.—Little Siak River, lowlands of eastern Sumatra.

Type-specimen.—In United States National Museum, Cat. No. 144205, skin and skull of adult female collected along the Little Siak River, Sumatra, November 4, 1906, by Dr. W. L. Abbott; original number, 4856; in good condition.

Geographic distribution.—Known only from the Little Siak and Indragiri River regions, probably occurring in the intervening region, and for a moderate distance beyond, on either side. See No. 8 on map on page 75.

Diagnosis.—Very similar to *Tupaia castanea*, but underparts and inner side of legs buff to ochraceous buff, instead of ochraceous to ochraceous rufous; hairs of tail, seen above more distinctly annulated, but seen below without annulations except beyond middle of hairs; color of upper parts not quite so dark and rich as in *T. castanea*, especially in the region of the neck and shoulders, which are lighter and brighter, and more grizzled than in *T. castanea*; mammæ, 2–2 = 4.

Color.—*Tupaia siaca* is in general very similar in color to *T. castanea*, and the differences have been sufficiently pointed out under the diagnosis, so that no detailed description is necessary.

Skull and teeth.—The skull and teeth of *Tupaia siaca* are essentially like those of *T. castanea*. (Plate 10, fig. 8.)

Measurements.—Type: Head and body, 205 mm.; tail, 175; hind foot, 47; condylo-basal length, 50.5; zygomatic width, 25.5; width of brain case, 19.5; maxillary tooth row, 19. The tail of the type is from 10 to 15 mm. longer than is the case with most of the adult specimens

[1] Zool. Jahrb., vol. 23, p. 87, 1905.

examined, otherwise the measurements of the type represent the average for the species. For individual measurements, see table, page 93.

Remarks.—*Tupaia siaca* and *T. castanea* form a very interesting and at same time puzzling group of treeshrews. Both are very closely related to one another and geographically they are widely separated. Pulo Bintang is about as far removed from Sumatra as any island of the Rhio Archipelago, and no Tupaias of this group are found on the intervening islands. In fact treeshrews are poorly represented on the islands of the Rhio-Linga Archipelago. On Batam, the next island to Bintang, occurs a treeshrew that is separable with difficulty from *T. glis ferruginea*, and on Sinkep, an island close to Sumatra, is another member of the *glis* group. Other treeshrews in the Archipelago are without interest in this connection. *Tupaia castanea* and *siaca* as judged by color, are certainly related to *T. splendidula* of Borneo. In point of size they equal *T. glis ferruginea*, and I have been unable to find any definite constant character in the skulls or teeth, to separate them as a group from *T. glis ferruginea*. The question immediately arises what is their relation to *T. g. ferruginea*. The two forms, *T. castanea* and *siaca* may be geographic representatives of that widely spread species. So far as we know *T. g. ferruginea* does not occur at the same localities with them. Only on Borneo do we find *T. splendidula* occurring with what is evidently a representative of *T. glis ferruginea*, that is *T. longipes*. Those two forms are very different externally and cranially. On the Anamba Islands are found Tupaias which in point of size and lack of annulations on the tail are certainly members of the *splendidula* group, but some of them in general body color resemble *T. glis ferruginea* very closely. The available material indicates that typically the *glis ferruginea* and *splendidula* groups are very distinct, but forms of each occur strongly suggesting the other group. The relation of *T. demissa* to the *splendidula* group is puzzling. It occurs on Sumatra just to the northeast of the range of *T. siaca*. In the general color of its upper parts it is very similar to *T. siaca* and *T. castanea*. It has more grizzling along the sides than has the members of the *splendidula* group and less on the thigh than usual in *T. g. ferruginea*. The underparts are more like those of *T. g. ferruginea*, so is the skull. The hairs of the underside of the tail are certainly lacking in the annulations even more than the hairs of *T. siaca*. The species *demissa* could with almost as much propriety be considered an abnormal color form of *T. siaca* as it is so considered of *T. g. ferruginea* Schneider's specimens recorded[1] as *Tupaia custanea* from the Indragiri region Sumatra are *T. siaca*.

Specimen examined.—Eight from the Siak region and two from the Indragiri.

[1] Zool. Jahrb., vol. 23, 1905, p. 87.

Measurements of Tupaia siaca, castanea, chrysomalla, riabus, and anambæ.

Name.	Locality.	Number.	Sex.	Molar teeth worn.	Head and body.	Tail.	Hind foot.	Condylo-basal length.	Zygomatic width.	Width of brain case.	Maxillary tooth row.	Number of mammæ.
					mm	*mm*	*mm*	*mm*	*mm*	*mm*	*mm.*	
T. siaca	Sumatra, Little Siak River.	144201	Male	Moderately	210	156	48	49	26	19.5	19	....
Do	do	144205 [1]	Female	Much	205	175	47	50.5	25.5	19.5	19	2–2
Do	do	144209	Male	Moderately	198	165	49	50	26	19.5	19.5	....
Do	do	144206	Female	None [2]	172	148	45	43	23.5	20	18±	....
Do	do	144207	do	do.[3]	174	148	43	43	23.5	20	18	....
Do	do	144208	Male	do.[4]	159	156	48	41	22	19.5	....	....
Do	do	144210	do	do.[5]	190	170	46	46.5	23	19	18.5	....
Do	Sumatra, Siak River at Buwatan River.	144306	Female	do.[3]	160	150	45	....	....	....	17	2–2
Do	Sumatra, Indragiri	174610 [6]	Male	Much	200	170	48	47	26±	19.5	19	....
Do	do	4.6.9.2	do	do	190	152	49	51	27.5	21	20	....
T. castanea	Pulo Bintang, Rhio Archipelago.	115607	do		210	150	46	49	....	....	....	....
Do	do	115608 [1]	Female	Much	200	145	46	49	25.5	19.5	19	2–2
Do	do	9.4.1.99	Male	None [7]	178	137	45	47	....	20	18	....
Do	do	9.4.1.100	do	do.[8]	206	149	43	49.5	23	19	19	....
Do	do	9.4.1.101	Female	Moderately	207	151	45	50.5	26.5	20	9 16.5	2–2
Do	do	9.4.1.102	Male	do	184	162	48	50	26	19	20	....
Do	do	9.4.1.103	do	Slightly	186	153	46	49.5	27	20	19	....
Do	do	9.4.1.104	Female	do	177	150	45	50	....	20	19.5	2–2
T. chrysomalla	Anamba Islands, Siantan.	101710 [1]	do	Moderately	178	152	43	48	25	19	19	2–2?
T. riabus	Anamba Islands, Riabu.	104881 [1]	do	Slightly	178	146	43	45.5	23.5	19	18	2–2
Do	do	104880	Male	None [10]	165	140	42	40	21.5	19	....	....
T. anambæ	Anamba Islands, Jimaja.	101741	do	Moderately	171	140	42	46.5	24.5	19	18.5	....
Do	do	101743 [1]	do	do	178	152	43	47.5	24.5	18.5	18.5	....
Do	do	101742	Female	do	191	114	40	45.5	25±	19	17.5	2–2?

[1] Type.
[2] m^3 nearly level with m^1.
[3] m^3 just level with alveolus.
[4] m^2 just level with alveolus.
[5] Permanent pm^3 and pm^4 not in place.
[6] Preserved in alcohol.
[7] m^3 just appearing.
[8] di^1 still in place.
[9] Canines lacking (upper).
[10] m^2 last tooth in place.

TUPAIA MONTANA Thomas.

(Synonymy, type-specimens, etc., under the subspecies.)

Geographic distribution.—Mountains of northern Borneo. See Nos. 25 and 26 on map on page 75.

Diagnosis.—A medium-sized treeshrew, slightly smaller than *Tupaia glis ferruginea*, with rather long soft fur, general color Prout's brown or burnt umber, with or without a dark patch or stripe on back; tail not dissimilar in color from sides of body; skull in general similar to that of *T. glis ferruginea*, smaller and with a relatively shorter brain case, and rostrum strongly compressed from above downward; mammæ, 2–2 = 4.

Color.—Upper parts and sides of neck and body and outer side of legs a grizzle of blackish and a color between tawny olive and walnut brown, the black being slightly less evident than the other color; the tawny olive tint predominating anteriorly and the walnut brown posteriorly; back sometimes marked by a large black patch, beginning

narrowly between the shoulders, 2 to 3 mm. wide and widening over the lower back and hips to 25 or 30 mm.; head a fine grizzle of black and raw sienna, the latter predominating on the sides, the blackish on the crown; underparts an ill-defined grizzle of dark tawny ochraceous and slate, the tawny ochraceous lighter and more yellowish anteriorly; tail above, similar to adjacent parts of body, but grizzle coarser; tail, below, with short appessed hairs, in median line, a fine grizzle of blackish and ochraceous, the darker color predominating, the longer hairs, tawny ochraceous for their basal third, and a coarse grizzled mixture of this same color and dark brownish distally; feet and hands dark brownish with a very slight admixture of the light color of the adjoining parts of body; shoulder stripe practically obsolete.

Skull and teeth.—The skull of *Tupaia montana* is of moderate size slightly smaller than that of *T. glis ferruginea*, with relatively much wider brain case and more spreading zygomata; the rostrum has a more abrupt origin from rest of skull and is much compressed from above downward, especially the basal portion just posterior to the nasals. The first and second upper molars of *T. montana* are more quadrate in outline than they are in *T. glis ferruginea* and the hypocone of m^1 is better developed. (Plate 9, fig. 2.)

Subspecies.—There are two subspecies of *Tupaia montana*, the typical form *T. montana montana* from Mount Dulit and a form from Mount Kina Balu, described below as new. Aside from some slight color and cranial differences the two forms are chiefly distinguished by the presence in the Dulit specimens of a more or less well-defined dorsal patch and its absence in the animal from Mount Kina Balu.

Remarks.—*Tupaia montana* is a very distinct species and easily distinguished by external and cranial characters from other members of the genus. It does not appear to have any close resemblance to other members of the genus, except the later described *Tupaia carimatæ*. The presence or absence of a black patch on specimens does not appear to be attributable to age, sex, or season. Most specimens from Mount Dulit show it plainly, while on Kina Balu specimens it is but barely indicated.

TUPAIA MONTANA MONTANA Thomas.

1892. *Tupaia montana* THOMAS, Ann. Mag. Nat. Hist., ser. 6, vol. 9, p. 252, March, 1892.

1892. *Tupaia montana*, THOMAS, Proc. Zool. Soc. London, p. 223, 1892.

Type-locality.—Five thousand feet on Mount Dulit, Sarawak, Borneo.

Type-specimen.—In British Museum, Reg. No. 92.2.7.5, skin and skull of adult male collected October 14, 1891, at 5,000 feet on Mount Dulit, Borneo; skin in good condition; skull with part of occipital region cut away.

Geographic distribution.—Mount Dulit and probably neighboring mountains in Sarawak, Borneo. See No. 25 on map on page 75.

Diagnosis.—Distinguished by the greater frequency of the black back patch, heavier rostrum, slightly larger and darker feet, and facial portion of skull apparently larger and longer. (Plate 9, fig. 2.)

Measurements.—Type: Head and body (dried skin), 215 mm.; tail (dried skin), 140; hind foot, 45; condylobasal length, 47±; zygomatic width, 26.5; width of brain case, 19; maxillary tooth row, 18.5. For individual measurements see table, page 96.

Remarks.—A specimen with a well-defined dorsal stripe can certainly be identified with this subspecies, but if the stripe is practically obsolete as in Reg. No. 92.2.7.6, one is uncertain whether to place the specimen in this subspecies or the next. The Dulit subspecies appears to average larger than that from Kina Balu.

Specimens examined.—Twelve from Mount Dulit.

TUPAIA MONTANA BALUENSIS, new subspecies.

Type-locality.—Mount Kina Balu, northeastern Borneo.

Type-specimen.—In British Museum, Reg. No. 95.10.4.20, skin and skull of adult collected at 3,000 feet on Mount Kina Balu, northeastern Borneo, March, 1887, by J. Whitehead; skin in fair condition; skull with about a third of the right side of brain case wanting.

Geographic distribution.—Known only from Mount Kina Balu, Borneo. See No. 26 on map on page 75.

Diagnosis.—Differs from *Tupaia montana montana* in the absence of the distinct black back patch, smaller size; rostrum and whole facial portion of skull smaller and shorter; hind feet not quite so dark as in the typical form.

Measurements.—Type: Head and body (dried skin), 190 mm.; tail (dried skin), 90; hind foot, 39; condylobasal length, 43±; maxillary tooth row, 17. For measurements of two other individuals, which differ considerably from this type in having the tail 125 mm. long, see table, page 96.

Remarks.—In certain lights there is a suggestion of the broad dorsal stripe, which is almost as evident as in those Dulit specimens, where the stripe is practically lacking. Mr. Thomas has this note on the label of the type: "Of 15–20 specimens from Kina Balu (A. Everett) carefully compared, and some quite old, with worn teeth, not one had any trace of a dorsal line, not even as much as this." The absence of the dorsal stripe would appear to be very constant in this subspecies, much more so than the presence of the stripe is in *T. montana montana.* The Kina Balu specimens were identified by Mr. Thomas in 1889[1] as *Tupaia ferruginea.*

Specimens examined.—Three from Mount Kina Balu.

[1] Proc. Zool. Soc. London, 1889, p. 229.

Measurements of Tupaia montana.

Name.	Locality.	Number.	Sex.	Molar teeth worn.	Head and body.	Tail.	Hind foot.	Condylo-basal length.	Zygomatic width.	Width of brain case.	Maxillary tooth row.	Number of mammæ.
					mm	*mm*	*mm*	*mm*	*mm*	*mm*	*mm*	
T. montana montana.	Borneo, Mount Dulit.	84507.....	Male...	Moderately.	180±	150±	42	45.5	25.5	19	17.5	....
Do.....	Mount Dulit, 4,000 feet.	92.9.4.2....	...do...	Slightly....	220±	165±	43	44±	24.5	19	17.5	....
Do.....	Mount Dulit, 5,000 feet.	92.2.7.5[1]...	...do...	Moderately.	215±	140±	45	47±	26.5	19	18.5	....
Do.....	Mount Dulit, 2,000 feet.	90.12.9.7....	...do...	.....do.....	220±	160±	43	....	....	....	18	....
Do.....	Mount Dulit, 3,000 feet.	99.12.9.9....	Female.	.....do.....	220±	160±	42	46±	....	19	18	2–2
Do.....	Mount Dulit, 4,000 feet.	92.2.7.7....	...do...	([2]).....	215±	130±	43	....	....	....	....	2–2
Do.....	Mount Dulit, 2,000 feet.	99.12.9.8....	Male...	([2]).....	205±	160±	41	....	....	....	....	....
Do.....	Mount Dulit, 3,000 feet.	92.2.7.6....	...do...	None[3].....	205±	150±	41	44±	24	19	17.5	....
Do.....	Mount Poch, 4,000 feet.	93.4.1.3....	.....	.....do.[4]....	195±	130±	39	....	....	....	16.5	....
Do.....	Sarawak.....	93.4.1.38[5]..	Male...	.....	160	150	40	....	....	....	....	....
Do.....	Mount Dulit.....	92.6.1.2[5]...	Female.	.....	160	145	41	....	....	....	....	2–2
Do.....	Mount Dulit, 5,000 feet.	2230 Paris..	...do...	.....	190±	140±	38±	....	....	....	....	....
T. montana baluensis.	Mount Kina Balu, 8,000 feet.	95.10.4.21...	...do...	Slightly....	200±	125±	39	42±	25.5	19.5	17	....
Do.....	.....do.....	94.7.2.7....	.....	None[6].....	165±	125±	39	....	....	....	....	....
Do.....	Mount Kina Balu, 3,000 feet.	95.10.4.20[1].	.....	Moderately.	190±	90±	39	43±	....	....	17	....

[1] Type.
[2] Skull in skin.
[3] di^1 and di^2 still in place.
[4] pm^4 just appearing.
[5] Preserved in alcohol.
[6] m^1 last tooth in place.

TUPAIA PICTA Thomas.

1892. *Tupaia picta* THOMAS, Ann. Mag. Nat. Hist., ser. 6, vol. 9, p. 251, March, 1892.

Type-locality.—Apoh, Baram, northern Borneo.

Type-specimen.—In British Museum, Reg. No. 92.2.8.1, skin and skull of adult, sex unknown, collected by A. Everett, at Apoh,[1] Baram, Borneo, September, 1891; skin in good condition; skull with supra-occipital missing.

Geographic distribution.—Baram region, Sarawak, northern Borneo. There are no definite records of its occurring elsewhere. I have seen one specimen labeled "Sarawak," but this probably refers to the state and not the town, and another labeled "Balingean, Sarawak." I have been unable to find a town or other place of this name on any of the numerous maps of Borneo which I have examined. See No. 22 on map on page 75.

[1] The label of the type-specimen is marked "Baram, N. Borneo, Apoh." Apoh appears to be applied to a group of low (600 feet) hills south of Mount Mulu; the name is also applied to a river in the same neighborhood, a tributary of the Baram River. In his Mammals of Borneo, 1893, page 32, Mr. C. Hose says that the type of the species came from the Ridan River, a small tributary of the Baram, just below Claudetown, a distance of about 25 miles from the Apoh River.

Diagnosis.—A very distinct species of *Tupaia* at once characterized by a narrow black dorsal line, and distichously bushy rufescent tail; mammæ, 2–2 = 4.

Color.—Type: Upper parts of head, neck, and body anterior to rump a grizzle of blackish and ochraceous, with a very distinct narrow dorsal blackish line extending from region of neck to rump, the grizzling very coarse in the dorsal region; toward rump and base of tail, ochraceous color gradually replaced by ferruginous; tail a mixture of ferruginous and blackish, the two colors about equally mixed on basal half of tail above, the ferruginous predominating distally and below, except on outer edge, which is like upper surface; underparts including inner side of legs, dull buff to ochraceous buff; outer side of legs similar to adjacent parts of body, and feet similar in color to outer side of legs; shoulder stripe, well marked, dull ochraceous. The specimens from Mount Dulit, Mount Kulalong, and Balingean are slightly darker than the others, with the dorsal stripe less distinct; underparts are of a distinctly darker ochraceous about the neck and chest, and a grizzle of ochraceous or tawny ochraceous and blackish on rest of underparts and inner side of legs; the feet are blackish brown, perhaps due to a preservative, as they have an unnatural look. Two adults from Mount Mulu have the yellowish grizzling of the back, very coarse and conspicuous; the feet are of the usual yellowish brown color.

Skull and teeth.—The skull has about the same general build as that of *T. montana*, but lacks the above downward compression at base of rostrum, and approaches the skull of *T. glis ferruginea* in size; the bullæ are relatively larger than they are in *T. montana* or *T. g. ferruginea*. The brain case is relatively wide like that of *T. montana*. The zygomatic perforation is slightly smaller than it is in *T. glis ferruginea* The upper molar teeth are not so quadrate in outline as they are in *T. montana* and show no essential differences from the teeth of *T. glis ferruginea*. (Plate 9, fig. 3.)

Measurements.—Type: Head and body, 195 mm. (from dried skin); tail, 155 (from dried skin); hind foot, 45; condylobasal length, 47.5; zygomatic width, 26; width of brain case, 19.5; maxillary toothrow, 18.5. Measurements of the series do not depart materially from those of the type. See table, page 98.

Remarks.—*Tupaia picta* is a very distinct species and needs no comparison with any other. It is quite in a class by itself and appears to have no near relatives. The superficial external resemblance to the long-snouted treeshrews, *Tana tana* is very interesting; both have the same distichously bushy ferruginous tails, both have a narrow black dorsal stripe, bordered on either side by lighter grizzled areas. The dorsal stripe, however, is very short in *Tana* and a careful

examination of the markings in *Tana tana* and *Tupaia picta* shows that the resemblance is more superficial than real. The skull of *Tupaia picta* is a typical *Tupaia* skull, and the arrangement of the naked area on the end of the nose and the small size of the claws all show it to be a true *Tupaia*. The distribution of *Tupaia picta* seems to be quite restricted. Judging by the number of specimens examined it appears to be a fairly common animal in the Baram District, and I doubt if it occurs in southern Borneo, as Doctor Abbott would probably have encountered it sometime during his four expeditions there. In his Mammals of Borneo [1] Hose says of it: "This tree-shrew is more common in the low country than on the mountains; it is usually found in the dense forest and is particularly active in its movement."

Specimens examined.—Fourteen, all apparently from the Baram District, Borneo.

Measurements of Tupaia picta.

Locality.	Number.	Sex.	Molar teeth worn.	Head and body.	Tail.	Hind foot.	Condylo-basal length.	Zygomatic width.	Width of brain case.	Maxillary tooth row.	Number of mammæ.
				mm.	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	
Borneo, Baram	84506	Male	Moderately	.....	.....	46	48	27	20	18	....
Borneo, Mount Batu Sang.	669/4, Geneva.	Female	None [1]	190±	165±	43	48±	24	19	15	....
Borneo, Mount Dulit, 2,000 feet.	92. 9. 4. 1	Male	[2]	220±	155±	44	.....	.....	.....	.....	....
Balingean, Sarawak	5. 3. 1. 5	Female	Moderately	210±	135±	45	47.5	25.5	19	18	2-2
Mount Kalulong	93. 6. 1. 2	Male	[2]	235±	155±	45	.....	.....	.....	.....	....
Mount Mulu, 1,000 feet	8. 1. 27. 3	...do...	[2]	220±	150±	43	.....	.....	.....	.....	....
Mount Mulu	94. 6. 2. 2	...do...	Moderately	240±	150±	45	48.5	.....	20	19	....
Do	94. 6. 2. 3	...do...	None [3]	195±	140±	43	.....	.....	18.5	17	....
Batu Sang, 3,000 feet	92. 11. 8. 1	...do...	.....do.....	210±	155±	44	.....	.....	19	16.5	....
Baram River	92. 2. 7. 21	...do...	Moderately	215±	155±	45	.....	26	19.5	18	....
Baram, Apoh	92. 2. 8. 14	.....	.....do.....	195±	155±	45	47.5	26	19.5	18.5	....
Baram, Sarawak	0. 8. 4. 8	.....	[2]	205±	160±	43	.....	.....	.....	.....	....
Sarawak	99. 12. 9. 6	Male	Slightly	No skin.		.....	46.5	25	19.5	18	....
Mount Dulit, 2,000 feet	Berlin	...do...	[2]	210±	140±	46	.....	.....	.....	.....	....
(?)	11882, Phila [5].	.....	.....	170±	180±	40±	.....	.....	.....	.....	....

[1] Milk premolars still in place.
[2] Skin with skull inside.
[3] m^3 just appearing.
[4] Type.
[5] Skinned from alcohol and very abnormal in appearance. Academy of Natural Sciences, Philadelphia.

TUPAIA CARIMATÆ Miller.

1906. *Tupaia carimatæ* MILLER, Proc. U. S. Nat. Mus., vol. 31, p. 61, July 23, 1906.

Type-locality.—Telok Edar, Karimata Island, off west coast of Borneo.

Type-specimen.—In United States National Museum, Cat. No. 125123, skin and skull of adult male, collected on Karimata Island, September 2, 1904, by Dr. W. L. Abbott; original number, 3716; in good condition.

[1] Page 32, 1893.

Geographic distribution.—Known only from Karimata Island, but probably occurring on other islands of the same group. See No. 36 on map on page 75.

Diagnosis.—A very distinct species intermediate in general characteristics between *Tupaia splendidula* and *T. montana*, slightly smaller than either, without a black dorsal area, basal portion of hairs of underside of tail, almost without annulations, underparts not distinctly grizzled.

Color.—Type: Upper parts of head, neck, body, outer side of legs and tail a fine distinct grizzle of ochraceous and blackish, the two colors about equally mixed except on dorsal area posterior to shoulders where the black is in excess and suggests the condition found in *Tupaia montana baluensis;* underparts, including inner side of legs, varying from buff to ochraceous buff with dark bases of hairs showing through in places, but not finely grizzled as in *T. montana;* underside of tail ochraceous, distinctly grizzled with blackish along margins, and along the area of short appressed hairs; shoulder stripe, ochraceous, well developed.

Skull and teeth.—Skull slightly smaller than in either *Tupaia montana* or *T. splendidula*, relatively wide, zygomata spreading, braincase inflated, rostrum shortened. The teeth are essentially like those of *T. montana*, but first and second upper molars not quite so quadrate. As a whole the skull seems to have more affinities with that of *Tupaia montana* than with that of *T. splendidula*. (Plate 10, fig. 6.)

Measurements.—Type: Head and body, 176 mm.; tail, 147; hind foot 40; condylobasal length, 42.5; zygomatic width, 24; width of braincase, 18; maxillary toothrow, 16. For individual measurements, see table, page 100, none of which differ essentially from those of the type.

Remarks.—*Tupaia carimatæ* is a very distinct species and would scarcely be confused with any other form. It appears to possess more characteristics of *T. splendidula* than it does of any other species, namely, moderately well developed shoulder stripe, generally ochraceous underparts, without fine distinct grizzling, and basal portion of hairs of tail on underside practically clear ochraceous. Its *montana* characteristics are its generally finely grizzled upper parts, slight tendency to a dark dorsal area, and skull as a whole approaching that of *T. montana* more than that of *T. splendidula*. On geographic grounds it seems most likely that *Tupaia carimatæ* is an insular form of the Bornean *T. splendidula*. The mammalian fauna of Karimata has apparently been derived from forms similar to those occurring in southern Borneo,[1] a region where we know *T. splendidula* certainly occurs.

Specimens examined.—Seven, all from Karimata Island.

[1] See Lyon, Proc. U. S. Nat. Mus., vol. 40, p. 81, April 25, 1911, remarks on squirrels of the *prevostii* group.

Measurements of Tupaia carimatæ.

Locality.	Number.	Sex.	Molar teeth worn.	Head and body.	Tail.	Hind foot.	Condylo-basal length.	Zygomatic width.	Width of brain case.	Maxillary tooth row.	Number of mammæ.
				mm	*mm*	*mm*	*mm*	*mm*	*mm*	*mm*	
Karimata Island, Telok Edar.	125120...	Female..	Moderately .	175	145	40	43.5	23.5	18	13.5	2–2
Do	125121...	...do.....	.....do.....	175	145	40	44	23	18	17	2–2
Do	125122...	...do.....	Slightly.....	.....	.....	39	.....	.....	....	16.5	2–2
Do	125123 [1]..	Male....	Moderately .	176	147	40	42.5	24	18	16	....
Karimata Island, Telok Pai.	125096...	...do.....	.....do.....	170	150	40	43	24.5	18	16.5	....
Do	125097 ..	Female..	None [2].....	165	140	39	.....	22±	....	15	....
Karimata Island	153860...	Male....	Slightly.....	165	145	40	.....	23±	....	16	....

[1] Type.

[2] Permanent pm^3 and pm^4 not in place.

TUPAIA NICOBARICA (Zelebor).

(Synonymy, type-specimens, etc., under the subspecies.)

Geographic distribution.—Nicobar Islands, apparently confined to the closely adjacent islands of Great and Little Nicobar.[1] If it occurs on other islands of the group it is probable that the careful collecting of Dr. W. L. Abbott, and Mr. C. B. Kloss in 1901 would have revealed it, as judging by the large number of individuals secured on Great and Little Nicobar it can not be a particularly hard animal to see and secure.

Diagnosis.—One of the most distinct of all the species of *Tupaia*, in general size equaling *T. glis ferruginea*, but tail long and slender, greatly exceeding head and body in length; general color a grizzled yellowish brown, with a distinct blackish area over the middle and lower back, the black extending on to base of tail, but not on thighs or sides; mammæ, 1–1 = 2; claws on both fore and hind feet, half again as large as the claws of *T. glis ferruginea* strongly compressed laterally and very sharp; skull large and angular; central upper incisors strongly developed, greatly exceeding in size the lateral pair.

Color.—Sides of head, neck, and body, outer side of legs, and feet, and region of back over shoulders, and top of nose with the general color effect of wood brown, produced for the most part by a grizzle of tawny olive and blackish brown, entire underparts and inner side of legs generally similar, but often becoming quite light and rather buffy anteriorly; posterior two thirds of back including rump and base of tail, but not extending on thighs or very far down on sides, dark blackish brown; top of head, light blackish brown, the same color spreading down to behind ears and then posteriorly, as an

[1] See Miller, Proc. U. S. Nat. Mus., vol. 24, p. 792, May 29, 1902.

indistinct lateral stripe on either side to meet the dark blackish-brown area of the back, in many specimens, an indistinct median stripe extending from the dark area on top of head to the blackish-brown area of the back; tail, in unworn conditions, very similar to seal brown, both above and below except along the center line below where the color is much lighter. In some specimens the little mid-dorsal stripe from head to the dark area of the back is obsolete, and in others it is more conspicuous than the lateral stripes from ears to dark dorsal area, very rarely are the indistinct stripes from ears to back lacking. In worn condition the tail becomes much lighter in color, approaching cinnamon or russet. Also in worn pelages the dark area of the back becomes lighter and duller. (Plate 3, fig. 1.)

Skull and teeth.—Unlike most members of the genus the skull of *Tupaia nicobarica* is quite characteristic and would hardly be confused with the skulls of other species. The skull has about the same general size as that of *Tupaia glis ferruginea*, but appears more solidly built, and more angular with spreading zygomata and with a more abruptly arising rostrum; the palate is better ossified, the fenestra in zygoma less elongate, and more oval, and often much reduced in size; space between the external and internal pterygoid plates greater and bullæ slightly smaller; the impression for muscular attachment at the antero-inferior angle of the zygoma distinctly smaller, and its small size more noticeable in view of the otherwise greater angularity of the skull; the coronoid process of the mandible is heavier and wider. The teeth of *Tupaia nicobarica* are for the most part similar to those of *Tupaia glis ferruginea*, but the central pair of upper incisors greatly exceed the second pair of upper incisors and are very much larger and more recurved than the corresponding teeth of *T. glis ferruginea*; they have about the same relative degree of development that is seen in *Tupaia javanica*. The upper canines are more slender and pointed than they are in *T. glis ferruginea*. In comparison with other members of the genus, except *T. javanica*, the lower canines are greatly developed, approaching the enormous development of the lower canines in the genus *Urogale*. The third incisor in front and the first premolar behind the lower canine are correspondingly diminished in size, and the length of the lower canine exceeds or at least equals twice the length of incisor in front and often more, while in the species previously considered the lower canine is only one and one-half times the length of the incisor in front and often less.

Measurements.—Usual measurements of adults: Head and body, 180–195 mm; tail, 200–225; hind foot, 45–49; condylo-basal length, 47–50; zygomatic width, 27–29; width of brain case, 19–20; maxillary tooth row, 18–19. For individual measurements see tables, pages 104 and 105.

Subspecies.—Two; *Tupaia nicobarica nicobarica*, page 103, and *Tupaia nicobarica surda*, page 104.

Remarks.—As shown above, *Tupaia nicobarica* is a remarkably distinct species and sharply separated from all other members of the genus by its combination of coloration, large size, long tail, large sharp claws, angular skull, large central upper incisors, and large lower canines.

Tupaia nicobarica was probably first observed in 1846 by Captain Lewis,[1] who reported large squirrels as occurring on the Nicobar Islands. As no squirrels were collected or reported by Abbott and Kloss in 1901,[2] the inference is that Lewis's squirrels, like those seen by Captain Cook's party on Pulo Condore,[3] must have been Tupaias. Zelebor mentions this treeshrew as occurring on all the larger islands of the group, but particularly abundant on Great Nicobar; but as no specimens were collected or reported on other islands than Little and Great Nicobar, by Abbott and Kloss, it would seem that Zelebor's statement is too general. Apparently *Tupaia nicobarica* is a rather conspicuous and noisy treeshrew, otherwise it would not have called forth the few comments that have been made regarding it. Zelebor says it cries frequently and prolonged "Dänh–Dänh" when disturbed or pursued. Doctor Abbott remarks of them, "Common in the heavy jungle which covers the island (Little Nicobar); very active and generally in the tree tops." Kloss[4] writes: "They were very common (Little Nicobar); but unlike their representatives in the Malay Peninsula, etc., which are ground animals, we saw them only in trees. Tupais were plentiful (Great Nicobar). These appear to be entirely arboreal in habits and are quite as active as squirrels in running along branches, or climbing about amongst smaller twigs in search of insects. Their cry is a sort of trilling squeak, which is easily confounded with the call of a bird." The rather large, compressed, sharp claws and the long tail also lead one to believe it more arboreal than most of its relatives.

As to the origin of this treeshrew on the Nicobars it is impossible to say. It is so unlike any of the other treeshrews at present known that it seems highly improbable that it can be descended from any of them, should they have been accidentally carried to the islands, or have been brought there by man. On the other hand, if *Tupaia nicobarica* is the survivor of an old wide-ranging species, one would expect to find other mammals surviving with it. As Mr. Miller shows, the mammals of the Nicobars, "with the single exception of *Tupaia nicobarica*, are all types well known to be closely associated with

[1] Journ. Asiat. Soc. Bengal, vol. 15, p. 368.

[2] Proc. U. S. Nat. Mus., vol. 24, pp. 751-795, May 29, 1902.

[3] See account of *Tupaia dissimilis* in the present paper, p. 67.

[4] In the Andamans and Nicobars, 1903, pp. 122, 136.

man throughout the Malayan region." [1] I can not agree with him that any of the existing treeshrews introduced into the Nicobars by man would have had sufficient time to develop into such a striking species as *Tupaia nicobarica*. Its origin and relationship must for the present remain unsolved.

TUPAIA NICOBARICA NICOBARICA (Zelebor).

1861. *Cladobates nicobaricus* FITZINGER, Sitz. Akad. Wiss. Math. Nat. Wien, vol. 42, 1860, p. 392 (*nomen nudum*).

1869. *Cladobates nicobaricus* ZELEBOR, Reise *Novara*, Zool. Theil, vol. 1, p. 17, pl. 1, fig. 1, entire animal natural size in colors; figs. 2 and 3, soles of fore and hind feet; pl. 2, skull, skeleton, and teeth.

1879. *Tupaia nicobarica*, ANDERSON, Zool. Res. West. Yunnan, p. 136, pl. 7, fig. 3, skull.

1902. *Tupaia nicobarica nicobarica*, MILLER, Proc. U. S. Nat. Mus., vol. 24, p. 773, May 29, 1902.

Type-locality.—Great Nicobar, of the Nicobar Islands.

Type-specimens.—According to Fitzinger,[2] these are in the Imperial Zoological Museum at Vienna. I have not seen them. In the original account are mentioned an alcoholic specimen, a skeleton, and four stuffed individuals.

Geographic distribution.—Great Nicobar, of the Nicobar Islands. See No. 40 on map on page 75.

Diagnosis.—Distinguished by having the light areas brighter and more yellowish, and more strongly contrasted with the dark areas than in the case of the form from Little Nicobar Island; mammæ 1–1=2

Color.—With the differences noted in the diagnosis, the color of *Tupaia nicobarica nicobarica* is sufficiently described in the general account of the species.

Skull and teeth.—There are no characters by which these may be distinguished from those of the other subspecies.

Measurements.—Usual measurements of adults: Head and body, 180–195 mm; tail, 200–225; hind foot, 45–50; condylo-basal length, 47–50; zygomatic width, 26–29; width of brain case, 19–20; maxillary tooth row, 18–19. See table, page 104.

Specimens examined.—Twenty-four.

Remarks.—There are a few individuals in the series of specimens of this, the typical subspecies, that cannot be distinguished with certainty from the form *T. n. surda* that follows.

[1] Proc. U. S. Nat. Mus., vol. 24, p. 791, May 29, 1902.

[2] Sitz. Akad. Wiss. Math. Nat. Wien, vol. 60, 1869, pt. 1, p. 279.

Measurements of Tupaia nicobarica nicobarica.

Locality.	Number.	Sex.	Molar teeth worn.	Head and body.	Tail.	Hind foot.	Condylo-basal length.	Zygomatic width.	Width of brain case.	Maxillary tooth row.	Number of mammæ.
Nicobar Islands; Great Nicobar				*mm.*	*mm*	*mm*	*mm.*	*mm.*	*mm.*	*mm.*	
Do	111766	Male	Much	180	203	45	46.5	27.5	19	18	....
Do	111767	...do....	Moderately	195	220	48	51.5	29	20	19	....
Do	111768	...do....	.....do.....	185	190	45	49	28.5	19.5	18.5	....
Do	111769	...do....	.....do.....	180	200	46	47.5	27.5	19.5	18.5	....
Do	111770	...do....	Slightly....	180	210	46	47	27	19	18.5	....
Do	111774	...do....	.....do.....	195	215	49	49.5	27.5	20	19	....
Do	111776	...do....	None [1].....	178	232	47	47	25	19.5	18.5	....
Do	111777	...do....	Slightly....	192	221	46	49	27	19.5	19	....
Do	111780	...do....	Moderately	191	225	49	49.5	27.5	20	19	....
Do	111764	Female	Slightly [2]...	175	210	44	46.5	26.5	20.5	18	....
Do	111765	...do....	Slightly....	190	220	46	49	28	20	19	1-1
Do	111771	...do....	.....do.....	187	223	49	50	27.5	19	19	1-1
Do	111775	...do....	.....do.....	185	225	48	48.5	27.5	20	19	1-1
Do	111778	...do....	None [3].....	180	215	47	49	25.5	19.5	18	....
Do	111779	...do....	Slightly....	187	215	48	49	28	19.5	18.5	1-1
Do	111781	...do....	Moderately	190	230	49	51	27.5	19	19	1-1
Do	111783 [4]	Male	([5]).....	220±	230	50	.....	.....	.....	.....	....
Do	111784 [4]	Female	([6]).....	215±	220	47	.....	.....	.....	.....	1-1
Do	111786 [4]	...do....	([6]).....	215±	220	48	.....	.....	.....	.....	1-1
Do	111787 [4]	...do....	([7]).....	165±	200	45	.....	.....	.....	.....	....
Do	111782 [9]	(?)	Moderately	.....	.....	44	49	28	19	19.5	....
Do	6.7.2.1	.....	None [8].....	.....	.....	48	47	25	19.5	17.5	....
Do	6.7.2.2	.....	.....	.....	.....	47	.....	.....	.....	.....	....
Do	85.8.1.94	Male	Slightly....	175	.....	48	.....	.....	.....	19	....

[1] *pm* [4] in place, *pm* [3] appearing, but *dpm* still in.
[2] *di* [1] still in place, *i* [1] appearing, *i* [2] halfway through.
[3] *di* [1] still in place, *c* [1] halfway through.
[4] Preserved in alcohol.
[5] Adult, genitalia well developed.
[6] Adult.
[7] About two-thirds grown.
[8] *di* [1] and *di* [2], *dpm* [3] still in place.
[9] Skeleton.

TUPAIA NICOBARICA SURDA Miller.

1902. *Tupaia nicobarica surda* MILLER, Proc. U. S. Nat. Mus., vol. 24, p. 774 May 29, 1902.

Type-locality.—Little Nicobar of the Nicobar Islands.

Type-specimen.—In United States National Museum, Cat. No. 111757, skin and skull of adult male, collected on Little Nicobar Island, March 1, 1901, by Dr. W. L. Abbott; original number, 899; in good condition.

Geographic distribution.—Little Nicobar Island. See No. 41 on map on page 75.

Diagnosis.—*Tupaia nicobarica surda* differs only from *T. n. nicobarica* in having the light areas of the pelage less yellow, generally duller, and less contrasted with the dark areas.

Color.—Sides of head, neck, and body, outerside of legs and feet, and region of back over shoulders, wood brown, generally duller or less "yellow" than in *T. n. nicobarica* above; entire underparts and innerside of legs generally similar, but often lighter and more buffy, especially anteriorly; posterior two-thirds of back, including rump

and base of tail, blackish brown, not contrasting with the light area of the pelage so noticeably as in the typical subspecies; top of head light blackish brown, this color spreading down to behind ears, and usually posteriorly as an indistinct lateral stripe, to meet dark area of back; in many specimens an indistinct median streak extending from top of head to dark area of back.

Skull and teeth.—These do not differ from those of *Tupaia nicobarica nicobarica.* (Plate 10, fig. 7.)

Measurements.—Type: Head and body, 190 mm.; tail, 220; hind foot, 48; condylo-basal length, 49.5; zygomatic width, 28.5; width of brain case, 20; maxillary tooth row, 19. The measurements of the type are slightly in excess of the usual measurements. See table below.

Remarks.—*Tupaia nicobarica surda* is not a highly differentiated form, but it is quite as distinct as some of the insular forms of *Tupaia glis* to which binomial names have been given. The present form is a member of such a distinct species group of which there are only two members so closely related geographically, it would seem a matter of convenience to employ trinomial names even though the two forms were more highly differentiated than they are. As noticed in the original description there are a few specimens in each series of the two subspecies which can not be distinguished with certainty one from the other.

Specimens examined.—Sixteen.

Measurements of Tupaia nicobarica surda.

Locality.	Number.	Sex.	Molar teeth worn.	Head and body.	Tail.	Hind foot.	Condylo-basal length.	Zygomatic width.	Width of brain case.	Maxillary tooth row.	Number of mammæ.
				mm.	*mm.*	*mm*	*mm.*	*mm.*	*mm.*	*mm.*	
Nicobar Islands, Little Nicobar.	111749...	Male....	Moderately .	189	215	46	.....	.....	19±	18±	....
Do.....	111750...	...do.....	Slightly.....	187	220	48	48	28.5	20	19	....
Do.....	111752...	...do.....	.....do.[1].....	190	200	48	46.5	25.5	20	18	....
Do.....	111753...	...do.....	None [2].....	180	200	44	47.5	25.8	19.5	18	....
Do.....	111756...	...do.....	.....do.[2].....	175	215	46	48	25	19	19	....
Do.....	111759...	...do.....	.....do.[3].....	185	215	45	48.5	26.5	19.5	19	....
Do.....	111760...	...do.....	Slightly [2]....	178	225	47	47	25.5	20	18.5	....
Do.....	111761...	...do.....	Moderately .	180	220	47	49.5	28	19	18.5	....
Do.....	111757[4].	...do.....	Slightly.....	190	220	48	49.5	28.5	20	19	....
Do.....	111751...	Female .	None [5].....	170	220	46	49.5	25	21	18	....
Do.....	111754...	...do.....	Moderately .	190	225	46	48	27.5	19.5	18.5	1-1
Do.....	111755...	...do.....	.....do.....	185	210	45	47.5	27.5	18.5	18.5	1-1
Do.....	111758...	...do.....	Slightly.....	180	210	45	47.5	27.5	20	18.5	1-1
Do.....	111762...	...do.....	Moderately .	190	210	47	47.5	27.5	19.5	18	1-1
Do.....	111763...	...do.....	Much.....	182	200	47	48.5	28.5	19.5	18.5	1-1
Do.....	111785[6].	...do.....	(7).....	200±	225	47	.....	.....	.....	.....	1-1

[1] di^1, di^2 still in place, c^1 not at full development.
[2] c^1 just appearing, di^1, di^2, and dc still in place.
[3] di^1 still in place, i^1 appearing, di^2 shed, i^2 nearly in place.
[4] Type.
[5] m^3 just appearing.
[6] Preserved in alcohol.
[7] Adult, pregnant, uterus 30 mm. long.

TUPAIA JAVANICA Horsfield.

1821. *Tupaia javanica* HORSFIELD, Zool. Res. Java, No. 3. Pages not numbered. Plate of entire animal and figures of fore foot and teeth on another unnumbered plate. Date on title page of entire work, 1824. (In the next reference below the third part of Horsfield's Researches is referred to. This reference is dated December, 1821.)

1821. *Sorex-Glis Javanica* or *Tupaya Javanica*, GEOFFROY and CUVIER, Hist. Nat. Mamm., vol 3, livr. 35, p. 1 and plate, December, 1821.

1842. *Cladobates javanica*, CUVIER, Hist. Nat. Mamm., vol. 7, Tab. gen. Meth., p. 2, 1842.

1843. *Hylogalea javanica*, SCHLEGEL and MÜLLER, Verh. Nat. Gesch. Nederl. Overz. Bezitt., p. 165, pl. 26, fig. 4; pl. 27, figs. 11 to 16.

1879. *Tupaia javanica*, ANDERSON, Zool. Res. West. Yunnan, p. 134, pl. vii, figs. 14 and 15.

Type-locality.—Java, Province of Blambangan, probably near the present town of Banyu-wangi at extreme eastern end of Java. See Horsfield's Plantae Javanicae Rariores, 1838–1842, map in front, and page v of postcript.

Type-specimens.—In British Museum. This species was based on two specimens collected by Thomas Horsfield in 1806, in extensive forests in the Province of Blambangan, Java. One of these was sent to the Museum of the Honorable East India Co. in 1812. It is now in the British Museum, Reg. No. 79.11.21.574; it is not mounted, is in poor condition; skull immature with the milk incisors still in place, zygomata broken away, as well as occipital bones and anterior third of right half of mandible. The other specimen was brought to England by Horsfield in 1819, and is now in British Museum, No. 52a; it is an old specimen, was formerly mounted, and is in poor condition; parts of the cranium posterior to the tooth rows are broken away; mandible perfect. A third specimen marked "cotype" is in the British Museum, No. 52b, Java, "pres. by E. F. Comp"; neither its skin nor skull are in good condition. I do not consider this specimen a cotype and see no reason why it should be so marked.

Geographic distribution.—Java, western part of Sumatra back from coast, and islandof Nias. See No. 1 on map on page 111.

Diagnosis.—Tail longer than head and body; skull shaped like that of *Tupaia nicobarica*, but much smaller, condylobasal length not exceeding 41 mm.; central upper incisors and lower canines enlarged in the manner of those of *T. nicobarica*; general coloration of upper parts and tail olivaceous finely grizzled, under parts moderately dark and grizzled; hind foot about 38 mm.; mammæ, 2–2=4.

Color.—Upper parts and sides of head, neck, body, tail, outerside of legs and feet, with the general color effect of something between olive and bister, produced by a fine distinct grizzling of blackish and light tawny olive or raw sienna; the two colors about equally mixed, the grizzling on the tail coarser and on the feet finer; underparts of body always rather dark, the bases of the hairs being

extensively slate-color, which shows through usually to a considerable extent; general effect of underparts varying from an almost clear gray, not unlike olive gray slightly tinged with buffy, to an almost uniform ochraceous, with more or less of dark bases of hairs showing through, the ochraceous colors of the underparts more pronounced anteriorly and the gray better developed posteriorly; shoulder stripe conspicuous, buff or cream buff in color.

Skull and teeth.—The skull and teeth of *Tupaia javanica* are almost an exact miniature of those of *Tupaia nicobarica*, but the zygomata are relatively less spreading, the brain case relatively more inflated, the bullæ relatively larger, and the palate less completely ossified. The enlargement of the central upper incisors, and lower canines, and reduction in size of the third lower incisors are in the same relative degree in *Tupaia javanica* as they are in *T. nicobarica*. (Plate 10, fig. 1.)

Measurements.—The available measurements of cotype Reg. No. 79.11.21.574, a specimen not fully adult, the milk incisors still being in place, are: Hind foot, approximately, 36 mm.; width of brain case, 17.5; maxillary tooth row, 14; the other cotype, 52a has the maxillary tooth row 14.5; the specimen is in such poor condition that the other usual measurement can not be taken. Usual measurements of adults: Head and body, 145–155 mm; tail, 160–175; hind foot, 37–39; condylobasal length, 38–41; zygomatic width, 22–23; width of brain case, 17–18; maxillary tooth row, 14–15. For individual measurements see table, pages 108, 109.

Remarks.—*Tupaia javanica* is a very distinct species with no near relatives; its large size, dark underparts, and *nicobarica* shape of skull at once separates it from the other small olivaceously colored members of the genus, while the smaller size and differences in color serve, of course, to distinguish it from *Tupaia nicobaria*, and its smaller size and longer tail to distinguish it from the *chinensis* group. Whether or not it is true *Tupaia javanica* that occurs on Sumatra and Nias it is impossible to say with the available material. The mounted skin in Genoa from Pulo Nias appeared unusually dark, especially the tail, which is quite blackish. I have little doubt that more material will show it to be a distinct geographic form of *Tupaia javanica*.[1] The specimens from Sumatra, Si Rambi, Mount Singalang, and Pajo resemble the Javan specimens, but the material is not sufficient to establish their true status. Apparently *Tupaia javanica* on Sumatra is confined to the higher regions. Although Doctor Abbott has visited many places on the Sumatran coast, he found no examples of it.

Specimens examined.—Java, 58; Sumatra, 12; Nias, 1. Although this material seems abundant, yet an examination of the list of specimens, pages 108, 109, will show most of it is made up of immature individuals, and specimens preserved in alcohol.

[1] Recorded by Modigliani, Ann. Mus. Civ. Stor. Nat. Genoa, ser. 2, vol. 7 (27), p. 239, 1889.

Measurements of Tupaia javanica.

Locality.	Number.	Sex.	Molar teeth worn.	Head and body.	Tail.	Hind foot.	Condylo-basal length.	Zygomatic width.	Width of brain case.	Maxillary tooth row.	Number of mammæ.
				mm.	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	
Java, Mount Salak, 3,500 feet.	154593	Female.	Adult	145	160	37	.....	.....	.....	.....	2-2
Java, Mount Salak, 3,000 feet.	154580	Male	.....	.....	.....	36	.....	.....	.....	.....	.....
Java, Mount Salak, 2,200 feet.	154594	do	None [1]	110	145	36	33	20	17	.....	.....
Java, Mount Gede, 4,500 feet.	155656	Female.	Slightly	134	170	38	39	21.5	17	15	.....
Java, Pelaboean Ratoe	155659	do	None [2]	115	150	36	34	19.5	18	.....	.....
Java, Mount Salak	154598	Male	Slightly	.....	.....	.....	39.5	22.5	16.5	14.5	.....
Java, Buitenzorg	1431 [3]	do	(4)	125±	135	35	.....	.....	.....	.....	.....
Java, Tanjong Priok, near Batavia.	121492	do	Moderately	.....	.....	37	40	22.5	17.5	14.5	.....
Do	121491	do	do	.....	.....	36	39	22	17	14.5	.....
Do	121489	(?)	Slightly	.....	.....	36	38	20	16.5	14	.....
Do	121488	Female.	Moderately	.....	.....	36	40	22	18	14.5	2-2
Do	121490	do	do	.....	.....	38	41	22±	18	14.5	2-2
Do	121493	do	None [5]	.....	.....	37	40±	21.5	18	14.5	2-2
Java, Province of Blambangan.	52a [6]	.....	Moderately	.....	.....	.....	.....	.....	.....	14.5	.....
Do	79.11.21.574 [8]	.....	None [7]	.....	.....	36±	.....	.....	17.5	14	.....
Java	52b	.....	do [7]	.....	.....	37	.....	.....	.....	13.5	.....
Java, Prigen (slopes of Ardjoeno Volcano) 1,800 to 2,300 feet, Bangit.	96.10.31 [8]	Female.	.....	150	160	39	.....	.....	.....	.....	2-2
Java, Tasikmalaja	9.1.5.1116 [8]	do	.....	155	160	38	.....	.....	.....	.....	2-2
Java, Preanger	9.1.51117 [8]	Male	.....	140	160	38	.....	.....	.....	.....	.....
Java, Buitenzorg	94.7.4.7 [8]	Female.	.....	145	155	37	.....	.....	.....	.....	2-2
Java, southeast	84.4.24.5 [8]	do	.....	140	150	35	.....	.....	.....	.....	2-2
Java, Tasikmalaja, Preanger, 1,145 feet.	9.1.5.532	Male	Moderately	155	178	39	41	23	17.5	15	.....
Do	9.1.5.533	do	Slightly	(9)	.....	.....	41	22.5	18	15	.....
Do	9.1.5.534	do	None	150	175	38	39.5	22.5	17.5	14.5	.....
Do	9.1.5.535	do	do [10]	125	160	37	33.5	18.5	17	.....	.....
Do	9.1.5.536	do	do [10]	.....	.....	37	34.5	19.5	17.5	.....	.....
Do	9.1.5.537	do	Moderately	155	190	38	40.5	23.5	17.5	14.5	.....
Do	9.1.5.538	do	Slightly	150	163	37	41	22.5	18	15	.....
Do	9.1.5.539	do	Moderately	147	167	38	39.5	21.5	17.5	14.5	.....
Do	9.1.5.540	do	None [10]	118	160	37	34	.....	18	.....	.....
Do	9.1.5.541	do	do [7]	148	158	36	38.5	21.5	18.5	14.5	.....
Do	9.1.5.542	Female.	do [10]	120	155	34	33.5	.....	17.5	.....	.....
Do	9.1.5.543	do	do [11]	150	176	39	38	21	18	15	2-2
Do	9.1.5.544	do	do [7]	145	158	38	38.5	.....	17.5	14	2-2
Do	9.1.5.545	do	do [10]	125	178	36	33.5	.....	17.5	.....	.....
Do	9.1.5.546	do	do [10]	115	145	36	.....	.....	.....	.....	.....
Do	9.1.5.547	do	Slightly	145	175	38	38.5	21	17.5	14	2-2
Do	9.1.5.548	do	None [12]	135	154	37	36.5	19	17	13.5	.....
Do	9.1.5.549	do	Moderately	150	172	37	38.5	21.5	17	14	2-2
Do	9.1.5.550	do	None [7]	145	170	37	37	.....	18	14	.....
Do	9.1.5.551	do	do [10]	125	173	38	34	.....	17	.....	.....
Java, Tji Wangie, Preanger, 4,000 feet.	9.1.5.561	Male	Moderately	150	165	37	40	23	17	14.5	.....
Do	9.1.5.562	Female.	Slightly	155	150	39	.....	.....	.....	14	.....
Java, Buitenzorg	9.1.5.556	Male	None [11]	.....	.....	.....	38	21	17.5	14.5	.....
Java, Buitenzorg, 855 feet.	9.1.5.552	do	Slightly	145	170	36	38	21	16.5	14	.....
Do	9.1.5.553	do	Moderately	150	170	38	40.5	23	17	14.5	.....
Do	9.1.5.554	do	Slightly	140	165	38	39	21.5	17.5	14.5	.....
Do	9.1.5.555	do	None [10]	120	150	37	33	.....	17	.....	.....
Do	9.1.5.557	Female.	do [10]	110	140	34	32	16.5	17	.....	.....
Do	9.1.5.558	do	do [11]	140	165	36	37.5	.....	17.5	14	.....
Java, Tjilatjap, sea level.	9.1.5.560	do	Slightly	160	165	37	.....	.....	.....	14	.....
Do	9.1.5.559	Male	None [13]	145	162	36	.....	.....	.....	13.5	.....
Java, Tjigombong	99.8.6.45	do	do [7]	13.6	16.4	37	37	21	.....	14	.....
Java, Kedirie	83.8.13.1 [8]	do	Immature	111	125	37	.....	.....	.....	.....	.....
Do	83.8.13.2 [8]	Female.	do	120	130	35	.....	.....	.....	.....	.....

[1] m^1 halfway up.
[2] m^1 not quite level with tooth row.
[3] Wm. Palmer, collector.
[4] Not quite adult.
[5] pm^4 not quite in place, dpm^3 still in place.
[6] Cotype.
[7] di^1, di^2 still in place.
[8] Preserved in alcohol.
[9] No skin.
[10] m^1 last tooth in place.
[11] i^3 just appearing.
[12] m^2 last in place.
[13] dpm^4 still in place.

Measurements of Tupaia javanica—Continued.

Locality.	Number.	Sex.	Molar teeth worn.	Head and body.	Tail.	Hind foot.	Condylo-basal length.	Zygomatic width.	Width of brain case.	Maxillary tooth row.	Number of mammæ.
				mm.	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	
Java	Berlin, 654 [1]			165±	135±	36					
Do	Berlin, 636 [2]			170±	150±	37					
Do	Berlin, 633 [3]			165±	140±	36					
Java, Negrok, Preanger.	Berlin, 11352		Slightly				40	21.5	18	15	
Sumatra, Pajo	79.6.28.16		Moderately			37	39±		17.5	14	
Do	79.6.28.17	Female	do			37				14.5	2-2
Do	79.6.28.18		do			36				14.5	
Sumatra, Si Rambi	Genoa [4]	Male	Adult	125	145	37					
Do	do [4]	do	Young [5]	115	125	33					
Do	do [4]	do	Adult	125	135	37					
Do	do [4]	Female	do	135	150	36					2-2
Do	do [4]	do	do	135	150	38					2-2
Do	do [4]	do	do	135	150	36					2-2
Sumatra, Mount Singalang.	do [6]		Nearly adult. [7]	165±	155±	40±	38		18.5	14.5	
Do	88.12.1.7 [4]	Male	Adult	145	150	37					
Do	88.12.1.8 [4]	Female	do	145	160	38					2-2
Nias Island, Sitoli	Genoa [8]	Male	Moderately	150±	155±	38±	39±	23	17.5	14.5	

[1] Mounted specimen, collected by Temminck.
[2] Mounted specimen, collected by Kinder.
[3] Mounted specimen, collected by Becker.
[4] Specimen collected by Modigliani. Preserved in alcohol.
[5] *dpm*[4] last tooth in place.
[6] Mounted specimen, collected by Beccari.
[7] *dpm*[4] still in place.
[8] Mounted specimen, collected by Modigliani.

TUPAIA MINOR Günther.

(References, synonymy, type specimens, etc., under the subspecies.)

Geographic distribution.—Borneo, the adjacent islands of Banguey and Laut; Sumatra; southern portion of Malay Peninsula; islands of Linga and Singkep. See Nos. 2, 3, and 4 on map on page 111.

Diagnosis.—The smallest member of the genus *Tupaia* characterized by a uniformly grizzled olivaceous style of coloration, tail longer than head and body, enlarged central upper incisors and lower canine, like those of *T. javanica*, and a short stubby rostrum, so that the distance between the two lachrymal notches equals the distance from the notch to the front of the central upper incisor; mammæ, 2-2=4.

Color.—Upper parts and sides of head, neck, and body and outer side of legs and the feet a fine grizzle of blackish and a color that varies from cream buff to russet, the russet color when present being always more prominent posteriorly. The general effect is very similar to that seen in *Tupaia javanica*, but in that species a russet tinge is practically lacking. Tail a coarse grizzle of black and buff or ochraceous buff, the darker color predominating except at base of tail, which is generally colored like the back. Underparts of head, neck, and body and inner side of legs varying from whitish to buff, the hairs not at all or scarcely darker at their bases. Underside of tail generally similar to upper side except along the middle line, where the buff-ochraceous color predominates instead of the blackish. Shoulder stripe conspicuous, whitish or buffy.

Skull and teeth.—The skull and teeth of *Tupaia minor* are the smallest of any member of the genus. The rostrum is relatively very short and stubby, and the brain case appears large and rounded in contrast. The distance between the two lachrymal notches is about equal to the distance from that notch to the front of the central upper incisors. In *Tupaia javanica* the distance between the two lachrymal notches is equal to the distance from the notch to the space between the first and second upper incisors. The whole shape of the skull of *Tupaia minor* is quite unlike that of *Tupaia javanica* or other species of *Tupaia* except *Tupaia gracilis*, which has a skull of the same general style as *Tupaia minor* but slightly larger. The teeth of *Tupaia minor* are of the same form as those of *T. javanica* and *T. nicobarica*. The central upper incisors are large and heavy in comparison with most species of *Tupaia*, and the lower canines strongly developed and the third lower incisor correspondingly reduced in size. Quite a little variation in the shape and size of the skull of *Tupaia minor* appears to exist, more so than is usually seen in most species of *Tupaia;* most of it, however, may be accounted for by differences in age.

Subspecies.—Three geographic races of *Tupaia minor* are here recognized—typical *minor*, the most distinct of them confined to Borneo; *malaccana*, occurring in Sumatra, the Malay Peninsula, and the island of Linga; and what is in reality a subspecies of this form, occurring on the island of Singkep.

Remarks.—*Tupaia minor* is a well-marked species. It differs from *T. javanica* in being smaller, in having light, clear-colored underparts, and in its peculiar form of skull. It differs from *Tupaia gracilis* in its smaller size, less bushy tail, and in having teeth like those of *T. javanica* and not like those of *T. glis ferruginea*. The forms of *Tupaia minor* recognized here are perhaps as distinct as some forms often recognized as species, but the three are so closely allied to one another and they form such a compact group that it is a matter of great convenience to regard them as all belonging to one species. The available material of this species is not entirely satisfactory, although a large number of specimens exists in various museums, much of it is unsuited for systematic work, and many of the specimens are immature.

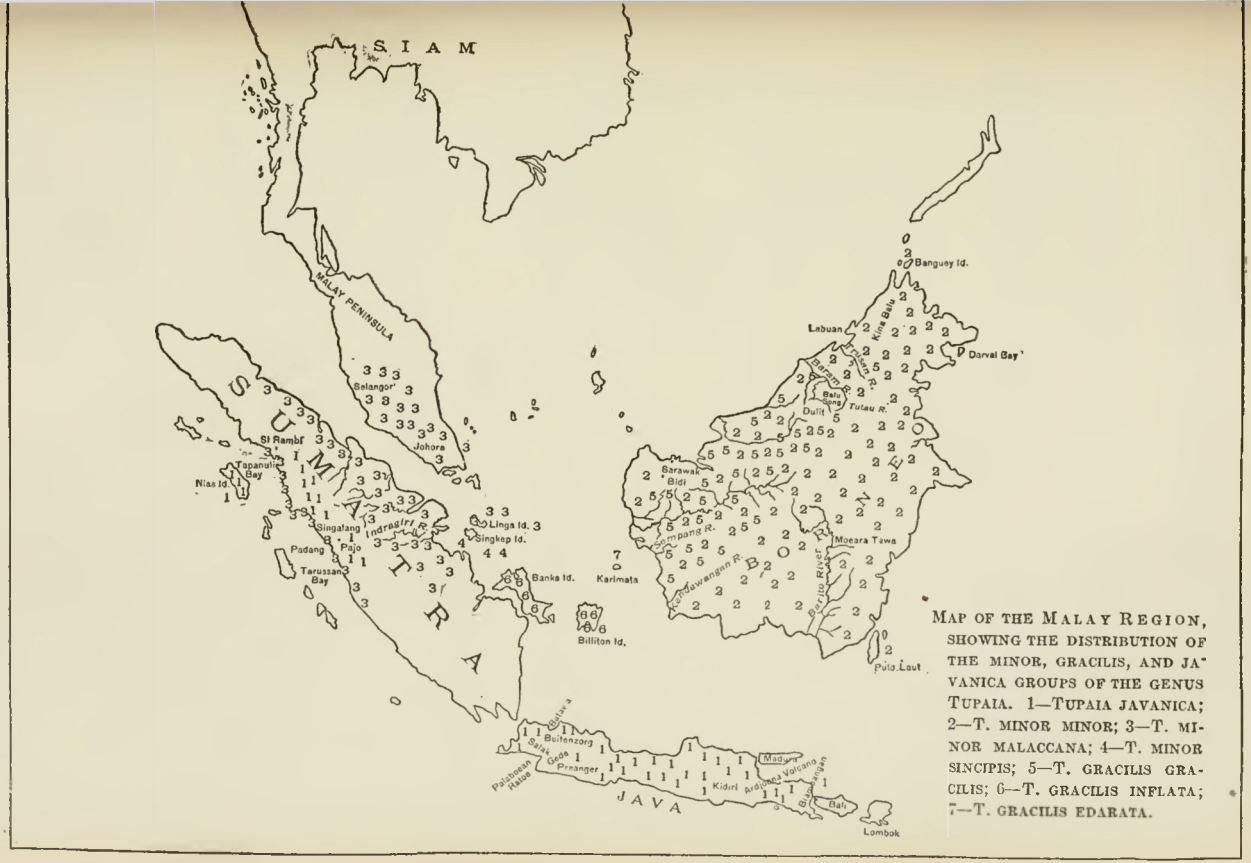
TUPAIA MINOR MINOR Günther.

1876. *Tupaia minor* GÜNTHER, Proc. Zool. Soc. London, 1876, p. 426.

1888. *Glipora leucogaster* JENTINK, Cat. Syst. Mamm. Mus. Hist. Nat., vol. 12, p. 116, 1888. A manuscript name of Diard, published by Jentink in a list of specimens of *Tupaia javanica*. As *T. javanica* does not occur in Borneo, and the two specimens have white bellies, they are probably examples of this species. Type-locality Pontianak, western Borneo.

Type-locality.—Borneo, opposite the island of Labuan.

Type-specimens.—In the British Museum, five cotypes, Reg. Nos. 76.5.2.21, 76.5.2.22, 76.5.2.23, 76.5.2.24, 76.5.2.25, skins and skulls,



MAP OF THE MALAY REGION, SHOWING THE DISTRIBUTION OF THE MINOR, GRACILIS, AND JAVANICA GROUPS OF THE GENUS TUPAIA. 1—TUPAIA JAVANICA; 2—T. MINOR MINOR; 3—T. MINOR MALACCANA; 4—T. MINOR SINCIPIS; 5—T. GRACILIS GRACILIS; 6—T. GRACILIS INFLATA; 7—T. GRACILIS EDARATA.

all collected on the Bornean mainland, opposite the island of Labuan, by Mr. Hugh Low; skins in fair condition; skulls all considerably damaged in occipital region.

Geographic distribution.—Throughout the island of Borneo, and the island of Banguey at the northeastern extremity, and the island of Laut at the southeastern extremity of Borneo. See No. 2 on map on page 111.

Diagnosis.—This subspecies is distinguished from the others in having a distinct russet wash over the lower back and slightly extended on to base of tail and in having the tails very dark and blackish.

Skull and teeth.—There are no characters by which the skulls and teeth of *Tupaia minor minor* may be distinguished from those of the other subspecies. (Plate 10, fig. 3.)

Measurements.—For measurements of the five cotypes see table, page 113. Usual measurements of adults: Head and body, 125–130 mm.; tail, 145–160; hind foot, 32–33; condylobasal length, 32–34; zygomatic width, 19–20; width of brain case, 16–17; maxillary tooth row, 12–12.5. For individual measurements, see table, page 113.

Remarks.—*Tupaia minor minor* is widely distributed throughout Borneo and appears fairly constant in its characters. There is some variation in the distinctness of the shoulder stripe. The shoulder stripe in the cotypes is rather dull and inconspicuous, but in a specimen from the Trusan River, close to the locality of the cotypes, the shoulder stripes are quite white and conspicuous, nearly as much so as are those in the specimens from Mount Dulit, which have very conspicuous shoulder stripes. The four mounted Sarawak skins in Genoa also have very distinct whitish shoulder stripes. The single specimen from Palo Laut has the tail darker than usual, while in the specimen from Banguey the tail is lighter.

Müller and Schlegel [1] did not distinguish between the three groups—*javanica, minor, gracilis*—of the small long-tailed olivaceous tree shrews, but grouped them all as *Tupaia javanica.* The skull of a young individual illustrated on plate 27,[1] figures 13 and 14, is apparently an example of *Tupaia minor* and not of *T. javanica.* The other figures on that plate intended for *T. javanica* undoubtedly represent that species.

The skins recorded as *Tupaia javanica* from Pontianak, Borneo, by Jentink [2] are probably examples of *T. m. minor.*

Concerning its habits, Hose [3] remarks: "This little tree shrew is fairly common, both on the mountains to a height of 4,000 feet and in the low country. It breeds in a nest in an old stump covered with creepers, but I am not sure whether it makes the nest itself or occupies the nest of a bird. I have found two of these nests, but the material used was different."

Specimens examined.—Twenty-two. See table, page 113.

[1] Verh. Nat. Gesch. Ned. Overz. Bez., 1839–44, p. 165, pls. 26 and 27.
[2] Cat. Syst. Mamm. Mus. Hist. Nat., vol. 12, 1888, p. 116.
[3] Mammals of Borneo, 1893, p. 30.

Measurements of Tupaia minor minor.

Locality.	Number.	Sex.	Molar teeth worn.	Head and body.	Tail.	Hind foot.	Condylo-basal length.	Zygomatic width.	Width of brain case.	Maxillary tooth row.	Number of mammæ.
				mm.	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	
Borneo, Sempang River, at mouth.	145575	Female	Slightly	130	156	33	33.5	19	15.5	12.5	2–2?
Borneo, Kendawangan River.	153857	Male	do	132	148	33	33.5	19.5	16	12	....
Borneo, Pulo Laut, southeast coast.	151881	do	Moderately	130	145	33	.....	.....	.....	12.5	....
Baram River, northwest Borneo.	88.8.13.5	.....	None	.....	.....	33	32±	19.5	15.5	12	....
Mount Dulit, 4,000 feet.	92.2.7.9	Female	do	.....	.....	32	.....	.....	17	12.5	2–2
Mount Dulit, 4,500 feet.	92.2.7.8	Male	None [1]	.....	.....	34	34	19	16.5	12.5	....
Mount Dulit, 4,000 feet.	8.1.27.4	Female	.....	.....	.....	34	.....	.....	.....	.....	2–2
Mount Dulit, 2,000 feet.	99.12.9.11	Male	Slightly	.....	.....	32	32	19	16	12	....
Kina Balu, 3,000 feet.	93.4.1.4	.....	None [2]	.....	.....	33	32.5	19	15	12	....
Tutau River	94.6.2.5	Male	Slightly	.....	.....	35	33	20.5	16.5	11.5	....
Trusan, opposite Labaun.	88.8.13.6	Female	do	.....	.....	36	33.5	.....	16	12.5	2–2
Mainland, opposite Labaun.	76.5.2.25 [3]	.....	Moderately	.....	.....	33	.....	.....	.....	12.5	....
Do	76.5.2.22 [3]	.....	Slightly	.....	.....	33	.....	.....	.....	12	....
Do	76.5.2.21 [3]	.....	Moderately	.....	.....	33	.....	19.5	15.5	12.5	....
Do	76.5.2.23 [3]	.....	None [4]	.....	.....	33	33	19	17	12.5	....
Do	76.5.2.24 [3]	.....	Moderately	.....	.....	34	33±	20	15.5	12.5	....
Sarawak	7.1.1.51	Male	do	.....	.....	32	34	21	16.5	12.5	....
Poeroek Tjahoe, 115 feet, Barito River, central Borneo.	10.4.5.78	do	None [5]	118	150	32	31.5	19	16.5	11.5	....
Do	10.4.5.79	do	Slightly	122	160	31	32	19	16.5	11.5	....
Moera Tewe, south central Borneo, Barito River, 65 feet.	10.4.5.80	do	None [5]	97	135	30	.....	.....	.....	.....	....
Karanginton, Martapoera River, 30 feet.	10.4.5.77	Female	Slightly	130	150	30	32	19	16	11.5	2–2
Hilly country, south Borneo.	10.4.5.76	Male	do	128	160	32	33	19.5	16.5	12.5	....
Banguey Island	94.7.2.9	do	Moderately	.....	.....	31	.....	.....	.....	12.5	....
Bidi Caves, Sarawak, Bidi.	3.3.31.2 [7]	do	None [6]	100	135	31	.....	.....	.....	.....	....
Lower Padas River, north Borneo.	94.7.2.56 [7]	do	Adult	125	150	33	.....	.....	.....	.....	....
Sarawak, Borneo	Genoa, 143	do	do	125	145	33	.....	.....	.....	.....	....
Do	do	Female	Immature	115	115	33	.....	.....	.....	.....	....
Do	Genoa, 4L [8]	.....	Slightly	115	125	33	32.5	20	17	12.5	....
Do	Genoa, 4C [9]	Male	.....	115±	130±	30±	.....	.....	.....	.....	....
Do	Genoa, 4D [9]	do	.....	120±	130±	32±	.....	.....	.....	.....	....
Do	Genoa, 4F [9]	do	.....	120±	125±	32±	.....	.....	.....	.....	....
Do	Geona, 4G [9]	Female	.....	130±	130±	32±	.....	.....	.....	.....	....
Mount Dulit, 2,500 feet, Borneo.	Genoa, Hose	do	.....	150±	150±	33	.....	.....	.....	.....	2–2
Mount Dulit, 1,000 feet.	Berlin, Hose	do	.....	170±	160±	32	.....	.....	.....	.....	....
Do	do	Male	.....	150±	150±	32±	.....	.....	.....	.....	....
Darvel Bay, Borneo	Berlin, Pagel	.....	Slightly	135±	135±	.....	33	19	16.5	12.5	....
Borneo	Berlin, 5127	.....	Moderately	.....	.....	32	.....	.....	16.5	13	....
Do	Paris, 676 [9]	.....	.....	.....	.....	32±	.....	.....	.....	.....	....
Do	Paris, 676 bis [9]	.....	.....	.....	.....	32±	.....	.....	.....	.....	....
Do	Paris, 49	.....	.....	140±	125±	32±	.....	.....	.....	.....	....
Sarawak, Borneo	Turin, 2114 [7]	Male	Adult	140	155	34	.....	.....	.....	.....	....

[1] i^1, just appearing.
[2] i^2 and pm^3, just appearing.
[3] Cotype.
[4] Permanent incisors, just appearing.
[5] di^1 and di^2, still in place.
[6] m^1, last tooth in place.
[7] Preserved in alcohol.
[8] Skeleton.
[9] Mounted.

TUPAIA MINOR MALACCANA Anderson.

1879. *Tupaia malaccana* ANDERSON, Zool. Res. West. Yunnan, p. 134, pl. 7, fig. 16.

Type-locality.—Malacca, Malay Peninsula.

Type-specimen.—The two specimens on which Anderson's description was based are said by him to have been "procured at Malacca and referred by Blyth to *T. javanica.*" They are without doubt No. 242, "A. B. Specimens from Malacca, and C. Skull, presented by Mr. Frith (1846)," (p. 82), in the Catalogue of the Mammalia in the Museum Asiatic Society, by Edward Blyth, 1863. I have not seen the specimens.

Geographic distribution.—Southern end of Malay Peninsula, Selangor, Malacca, Johore, Sumatra, and the island of Linga. See No. 3 on map on page 111.

Diagnosis.—*Tupaia minor malaccana* differs from the other subspecies of *Tupaia* in having the tail more like the general color of the head and body, less blackish, and in having less of a chestnut or russet wash on posterior half of body.

Skull and teeth.—These show no characters but slightly larger size to distinguish them from the other subspecies. (Plate 10, fig. 4.)

Measurements.—Usual measurements of adults: Head and body, 125–140 mm.; tail, 150–165; hindfoot, 32–34; condylobasal length, 33–35; zygomatic width, 20–21; width of braincase, 16–17; maxillary toothrow, 12–13. The measurements are nearly all very slightly larger than the corresponding ones in *Tupaia minor minor.*

Remarks.—*Tupaia minor malaccana* is not a very different form from *T. m. minor.* Although *T. m. minor* was described in 1876, Anderson in describing *T. m. malaccana* in 1879 did not seem to be aware of Günther's work. If he had, he would probably have identified the Malaccan specimens with it. The specimens that I have identified as *T. m. malaccana* show a few variations. The Linga specimens seem to be slightly larger than the others, and are rather intermediate in color between the subspecies from Singkep and typical *T. m. malaccana,* but generally more like the Malaccan specimens. The Sumatra skins as a whole, especially shown in one from the Indragiri River, have a greater tendency to a russet wash on the lower back than the Peninsular skins. Specimens of *T. m. malaccana* are recorded by Schneider[1] from Unter Lankat, Sumatra. The specimen "*ee,*" recorded by Jentink[2] as *Tupaia javanica* from Deli, Sumatra, is probably an example of *T. minor malaccana.* The other Sumatra specimen, *c,* from Upper Padang, and *c–i,* may be the present species or may be examples of *T. javanica.*

Specimens examined.—Ten from Malay Peninsula, 6 from Sumatra, and 4 from Linga Island.

[1] Zool. Jahrb., vol. 23, Heft 1, 1905, p. 88.
[2] Cat. Syst. Mamm. Mus. Hist. Nat., vol. 12, 1888, p. 117.

Measurements of Tupaia minor malaccana.

Locality.	Number.	Sex.	Molar teeth worn.	Head and body.	Tail.	Hind foot.	Condylo-basal length.	Zygomatic width.	Width of brain case.	Maxillary tooth row.	Number of mammæ.
				mm.	*mm.*	*mm*	*mm.*	*mm.*	*mm.*	*mm.*	
Selangor, Batu	152186	Female	Moderately	120	159	33	32.5	19.5	16	12	2-2
Johore, Sungei Malayu	143271	do	do	135	160	33	33	20	16.5	12	2-2
Johore, Sembrong River	112618	Male	do	139	146	33	34.5	21	16.5	12.5	....
Johore	85.8.1.95.	.....	None	.....	.....	32	.....	19	.....	12	....
Ka Aming, Johore	5.12.7.8.	Male	do	130	160	32	33.5	20.5	16.5	12	....
Ka Kuli, Southwest Johore	5.12.7.9.	Female	Slightly	130	150	34	33.5	.....	16.5	12.5	2-2
Selangor	85.8.1.96.	do	In skin	.....	.....	32	.....	.....	.....	.....	2-2
Semang Ko Pass, Selangor, Pahang boundary, 2,509–4,500 feet.	8.7.20.11.	Male	None [2]	121	154	33	33.5	18.5	16	12	....
Do	8.7.20.12.	do	do.[3]	117	138	34	.....	.....	.....	12	....
Cheras, Selangor	8.7.20.13.	Female	do	130	150	33	32	20	17	12	....
Sumatra Indragiri River	113166	do	Slightly	125	150	33	33	20	16.5	12.5	....
Sumatra, Tarussan Bay	141076	do	Moderately	136	156	33	35.5	21.5	16.5	12.5	....
Sumatra, Tapanuli Bay	114550	do	Slightly	132	152	32	35±	19.5	17	13	....
Sumatra	64.4.12.4.	do	None [1]	.....	.....	35	.....	.....	.....	12	....
South Sumatra	81.3.15.5.	.....	do	.....	.....	33	.....	.....	16.5	12.5	....
Talum, Upper Batang, Padang, Sumatra.	3.2.5.1.	Male	Moderately	142	165	35	34	20	17	12.5	....
Linga Island, Peak, 2,000 feet.	101598	do	do	133	165	31	34.5	20.5	16.5	12.5	....
Do	101600	do	do	140	165	33	35±	21.5	17	13	....
Linga Island, west coast	113068	do	Moderately	141	156	34	34.5	21.5	17	13	....
Do	101599	Female	do	140	165	33	35.5	21	17	13	2-2

[1] di^1 and di^2 still in place. [2] i^2 just appearing. [3] m^3 appearing.

TUPAIA MINOR SINCIPIS Lyon.

1911. *Tupaia sincipis* Lyon, Proc. Biol. Soc. Wash., vol. 24, p. 169, June 16, 1911.

Type-locality.—Sinkep Island, between the Malay Peninsula and Sumatra.

Type-specimen.—In United States National Museum. Cat. No. 123105, skin and skull of adult male, collected on Pulo Sinkep, August 8, 1903, by Dr. W. L. Abbott; original number, 2732; in good condition.

Geographic distribution.—Pulo Sinkep. See No. 4 on map on page 111.

Diagnosis.—*Tupaia minor sincipis* differs from the other subspecies in being slightly larger. Hind foot, 34–35 mm.; maxillary tooth row, 13–13.5, instead of 32–34 and 12–13; the color of the back is much more russet than it is in the other forms; the tail is dark and blackish, as in the Bornean subspecies.

Skull and teeth.—Except for their slightly larger size the skull and teeth of *Tupaia minor sincipis* do not show any appreciable differences from those of the other subspecies.

Measurements.—Type and a second adult: Head and body, 140 mm., 130; tail, 165, 160; hind foot, 35, 35; condylo-basal length, 36.5,

34.5; zygomatic width, 20.5, 19.5; width of brain case, 16.5, 16.5; maxillary tooth row, 13.5, 13. See table below.

Remarks.—*Tupaia minor sincipis* is a fairly distinct form; it is sufficiently distinguished by its slightly larger size and more russet color of the lower back. It is rather closely approached by the small tree shrews of the neighboring island of Linga, which specimens are rather intermediate between *T. m. sincipis* and *T. m. malaccana*, but in general more like the latter form. The Sinkep specimens have previously been identified as *T. malaccana*.[1]

Specimens examined.—Six from Sinkep Island.

Measurements of Tupaia minor sincipis.

Locality.	Number.	Sex.	Molar teeth worn.	Head and body.	Tail.	Hind foot.	Condylo-basal length.	Zygomatic width.	Width of brain case.	Maxillary tooth row.	Number of mammæ.
				mm.	*mm.*	*mm*	*mm.*	*mm.*	*mm.*	*mm.*	
Pulo Sinkep	123105[1]	Male	Moderately.	140	165	35	36.5	20.5	16.5	13.5	....
Do	113145	Female.	None [2]	133	180	34	35±	19	16.5	13.5	....
Do	113146	do	Slightly [3]	130	160	35	34.5	19.5	16.5	13	....
Do	123104	do	None [4]	127	150	34	34	18	16.5	12.5	....
Do	123106	do	do.[5]	130	160	34	34.5	19	16.5	13	....
Do	123107	do	do.[5]	120	150	34	31	.....	16.5	13	....

[1] Type. [2] *pm.*[4] just appearing. [3] *dl*,[1] *di*[2], *dc*[1] still in place.
[4] *dpm*[3], *dpm*[4] still in place. [5] *m*[3] just appearing.

TUPAIA GRACILIS Thomas.

(Synonymy, type locality, etc., under the subspecies.)

Geographic distribution.—Borneo, and the islands of Karimata, Billiton, and Banka, west of Borneo. See Nos. 5, 6, 7 on map on page 111.

Diagnosis.—One of the small long-tailed olivaceous members of the genus *Tupaia* intermediate in size between *Tupaia javanica* and *T. minor;* skull of the same general shape as that of *T. minor*, only larger, but teeth resemble those of *T. glis ferruginea* in form, that is, central upper incisors and the lower canines are not unusually enlarged as they are in *T. javanica*. Number of mammæ not known.

Color.—General color effect of upper parts of head, neck, and body and outer side of legs olive often washed with russet posteriorly, produced by a very fine (much finer than that of *Tupaia minor*), grizzle of blackish and a color that varies from cream buff to russet, the latter color when present more prominent posteriorly; underparts, including inner side of legs whitish to buff in color, sometimes with dark bases of the hairs showing through, especially on hind legs, rarely with indications of grizzling, but never so dark or grizzled as

[1] Miller, Proc. U. S. Nat. Mus., vol. 31, p. 272, Sept. 11, 1906. Lyon, Proc. U. S. Nat. Mus., vol. 36, p. 490, June 1, 1909.

in *Tupaia javanica* and usually of a less clear whitish or buff color than in *T. minor;* tail, long, soft, and more distichously haired than in either *T. javanica* or *T. minor,* the upper surface a fine grizzle of blackish and buffy or sometimes russet, the darker color in excess; underside of tail similar, but the dark element less conspicuous, except along the edges and at tip, on either side of middle line a clear or nearly clear area of the buff or russet color; shoulder stripe light buffy in color, less conspicuous than it is in *Tupaia minor.*

Skull and teeth.—The skull of *Tupaia gracilis* is of the same general shape as that of *T. minor,* with a rather large inflated brain case and a short stubby rostrum, but as a whole the skull is larger and the brain case relatively more enlarged. The teeth are strikingly different from those of *Tupaia minor* or *T. javanica* in the moderate development of the central upper incisors, the lack of special development of the lower canines, and the relatively greater size of the third lower incisor. The teeth are essentially of the same form as those of *Tupaia glis ferruginea,* while the skull as a whole is essentially of the form of that of *T. minor.*

Subspecies.—Three subspecies of *Tupaia gracilis* are here recognized, the typical form on Borneo, a race on Karimata and another on Banka and Billiton.

Remarks.—*Tupaia gracilis* is a very distinct species and its combination of external, cranial, and dental characters serve to distinguish it very clearly from *T. javanica* and *T. minor,* which resemble it superficially. The available material of *T. gracilis* is even more unsatisfactory than that of *T. minor.* It is apparently a rare animal and many of the specimens are not fully adult, or are not in the best condition for systematic work. The distribution of this species is rather limited. Outside of Borneo the only islands on which it occurs are islands whose fauna is very closely related to that of Borneo.

TUPAIA GRACILIS GRACILIS Thomas.

1893. *Tupaia gracilis* THOMAS, Ann. Mag. Nat. Hist., ser. 6, vol. 12, p. 53, July, 1893.

Type-locality.—Apoh River, base of Mount Batu Song, Baram District, northern Borneo.

Type-specimen.—In British Museum, Reg. No. 92.9.6.2. Collected on Apoh River, base of Mount Batu Song, northern Borneo, in September, 1891, by A. H. Everett; skin in good condition, but skull with occipital region and basal parts of brain case broken away.

Geographic distribution.—Probably generally distributed throughout Borneo; specimens in collection are known only from Baram District and southwestern Borneo. See No. 5 on map on page 111.

Diagnosis.—*Tupaia gracilis gracilis* is the largest of the three subspecies, hind foot over 40 mm., without special peculiarities of color, less russet color present posteriorly, and slightly larger skull.

Measurements.—Type: Head and body (from dried skin), 155 mm.; tail (from dried skin), 160; hind foot, 40; zygomatic width, 20.5; width of brain case, 17.5 ±; maxillary tooth row, 14. Usual measurements of adults: Head and body, 140–150; tail, 155–170; hind foot, 40–42; condylo-basal length, 36–36.5; zygomatic width, 20.5–21; width of brain case, 17.5; maxillary tooth row, 13–14. See also table, page 119.

Specimens examined.—Ten, including the type from Baram District, northern Borneo, and one from southwestern Borneo. See table, page 119.

TUPAIA GRACILIS INFLATA Lyon.

1906. *Tupaia inflata* Lyon, Proc. U. S. Nat. Mus., vol. 31, p. 600, December 18, 1906.

Type-locality.—Tanjong Rengsam, Island of Banka.

Type-specimen.—In United States National Museum, Cat. No. 124709. Skin and skull of adult male, collected at Tanjong Rengsam, Banka, May 20, 1904, by Dr. W. L. Abbott; original number, 3241; skin and skull in good condition.

Geographic distribution.—Islands of Banka and Billiton. See No. 6 on map on page 111.

Diagnosis.—Of the same general color as *Tupaia gracilis gracilis*, but with more of a russet tinge posteriorly, hind foot slightly smaller, not exceeding 40 mm.; skull with relatively larger bullæ. (Plate 10, fig. 2.)

Measurements.—Type: Head and body, 150 mm.; tail, 172; hind foot, 37; condylo-basal length, 37; zygomatic width, 21; width of brain case, 17.5; maxillary tooth row, 13.5. Usual measurements of adults: Head and body, 140–150; tail, 160–170; hind foot, 37–39; condylo-basal length, 36–37; zygomatic width, 20–21; width of brain case, 16.5–17.5; maxillary tooth row, 13–13.5. See table, page 119.

Remarks.—*Tupaia gracilis inflata* is only slightly differentiated from *T. g. gracilis*. At the time it was originally described it was compared with *T. javanica* and *T. minor*, and of course appeared to be a very distinct form. It is well established now that it has nothing in common with those two species. Two of the specimens, Cat. No. 124985, Billiton, and Cat. No. 124909, Banka, have the tails very different in color from other specimens, the usual buffy annulations being replaced by russet or tawny ochraceous; it appears to be a difference in pelage.

Specimens examined.—Three, including the type, from Banka, and three from Billiton.

TUPAIA GRACILIS EDARATA, new subspecies.

Type-locality.—Telok Edar, Karimata Island, off west coast of Borneo.

Type-specimen.—In United States National Museum, Cat. No. 153859, skin and skull of young adult female, collected on Karimata

Island by Dr. W. L. Abbott, October 5, 1908; original number, 6226; skin in good condition; skull imperfect.

Geographic distribution.—Known only from Karimata Island. See No. 7 on map on page 111.

Diagnosis.—Characterized by having the general olivaceous color of the upper parts strongly approaching bister, the effect produced by a fine grizzling of blackish and ochraceous; tail more brownish and less different in color from head and body than in the case of the other subspecies; light colors of underside of tail distinctly ochraceous.

Skull and teeth.—There are no characters by which the skull and teeth of *Tupaia gracilis edarata* may be distinguished from those of *T. g. inflata.*

Measurements.—Type: Head and body, 135 mm.; tail, 156; hind foot, 38; condylo-basal length, 36±; zygomatic width, 19; width of brain case, 17; maxillary tooth row, 13.

Remarks.—*Tupaia gracilis edarata* is more like the subspecies *inflata* than the typical form and I identified it as *Tupaia inflata* in 1911.[1] It is browner than any of the Banka-Billiton specimens, and although based on the examination of but a single skin it is apparently a fairly well defined geographic form.

Specimen examined.—One, the type.

Measurements of Tupaia gracilis.

Name.	Locality.	Number.	Sex.	Molar teeth worn.	Head and body.	Tail.	Hind foot.	Condylo-basal length.	Zygomatic width.	Width of brain case.	Maxillary tooth row.	Number of mammæ.
					mm.	*mm.*	*mm*	*mm*	*mm*	*mmm*	*mm*	
T. gracilis gracilis.	Borneo, Kendawangan River.	153858	Male	Slightly	143	174	40	36	21	17.5	13	..
Do	Borneo, foot of Batu Song.	92.9.6.2 [2]	do	None	155±	160±	40	....	20.5	17.5±	14	..
Do	Claudetown, Baram, Sarawak.	0.7.29.21 [3]	do	do.[4]	140	170	42	....	....	.....	....	..
Do	Sarawak, Borneo.	88.12.1.6 [3]	do	.....	140	165	43	....	....	.....	....	..
Do	do	Genoa, 142 [3]	do	Adult	140	155	40	....	....	.....	....	..
Do	do	Genoa [3]	do	do	140	160	41	....	....	.....	....	..
Do	do	Genoa, 4K [5]	.....	Moderately	135	140	40	36.5	21	17.5	13.5	..
Do	do	Genoa, 4E	.....	.....	135±	130±	38±	....	....	.....	....	..
Do	do	Genoa, 4B	.....	.....	130±	140±	38±	....	....	.....	....	..
Do	do	Genoa, 4A	.....	.....	140±	135±	40±	....	....	.....	....	..
Do	do	Berlin, 4459 [3]	Male	None	135	145	40	37	21	17	13.5	..
T. gracilis inflata.	Banka, Tanjong Rengsam.	124709 [2]	do	Moderately	150	172	37	37	21	17.5	13.5	..
Do	Banka, T. Mengkudu.	124909	do	Slightly	140	175	38	35.5	20	17.5	13	..
Do	do	124910	Female	do.[6]	140	162	37	35	20±	17±	13	..
Do	Billiton, T. Batu.	124946	Male	Moderately	140	165	40	36	21	16.5	13.5	..
Do	do	124947	do	do	140	170	38	35.5	21	17.5	13.5	..
Do	Billiton, Buding Bay.	124985	do	None.[7]	130	168	39	35±	19.5	17.5	13.5	..
T. gracilis edarata.	Karimata Island.	153859 [2]	Female	Slightly	135	156	38	36±	19	17	13	..

[1] Proc. U. S. Nat. Mus., vol. 40, p. 122, Apr. 25, 1911.
[2] Type.
[3] Preserved in alcohol.
[4] *m* [3] nearly in place.
[5] Skeleton.
[6] i^1 and i^2 not fully in place.
[7] dpm^3 still in place, pm^4 halfway through.

ANATHANA, new genus.

Type.—*Tupaia ellioti* Waterhouse, Proc. Zool. Soc. London, 1849, p. 107, Plate, mammalia, 13.

Diagnostic characters.—A member of the mammalian family Tupaiidæ differing from typical *Tupaia* as restricted on page 30 in having larger and better haired ears, coarser reticulations on naked area of nose; unusually well-developed hypocones on the upper molars, lower canines not projecting above the level of the adjacent teeth; relatively short and heavy rostrum; and a small and inconspicuous fenestra in zygoma.

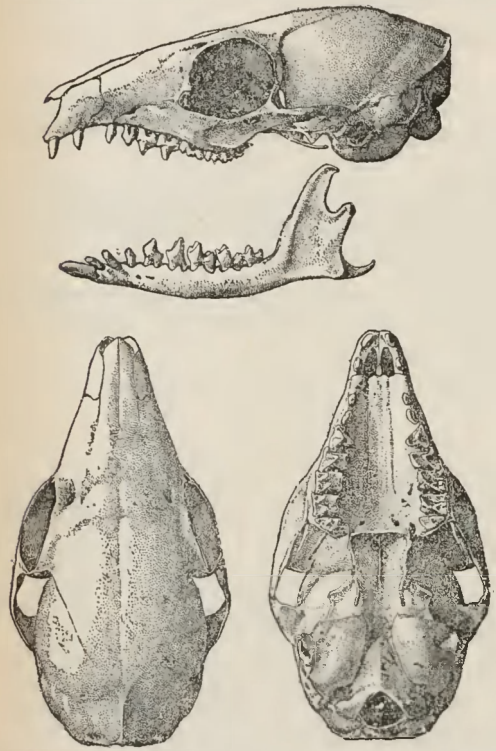


FIG. 6.—ANATHANA WROUGHTONI, TYPE × 1¼. REG. NO. 96. 11. 7, 1, BRITISH MUSEUM, MANDVI, INDIA.

External characters.—Externally the genus *Anathana* is very similar to *Tupaia*, more like it than any other member of the family. The most tangible differences are the distinctly greater size of the lower portion of the external ear in comparison with the upper portion, due to a widening out of the lower lobe, which projects backward to a considerable extent, and slightly forward. The interior of the ear is much better haired than is the ear of *Tupaia*. The rhinarium is squarely cut across posteriorly as in *Tupaia*, but is apparently more coarsely reticulated than in *Tupaia* and the reticulations are more regularly arranged. The footpads in *Anathana* are essentially as they are in *Tupaia*, but on the hind foot the internal proximal pad is perfectly distinct from the first interdigital pad in the few specimens that have been suitable for making the observations; but in *Tupaia* itself this distinctness of the two pads is often indicated, but usually the two are fused to form one long pad. The pelage of *Anathana* appears distinctly coarser and harsher than that of *Tupaia*, and the grizzling of the colors is coarser, differences something like those seen between *Sciurus* and *Xerus*. Nearly all the skins of *Anathana* depending, however, a good deal upon the manner of arranging and

stuffing the head, show ill-defined but still evident light lines over and below the eye, thus suggesting the more pronounced face markings seen in most species of *Dendrogale*. A shoulder stripe is present. Mammæ are 3–3=6, 1 axillary, 1 inguinal, 1 ventral near the inguinal one. (Plate 4.)

Cranial characters.—The skull of *Anathana* shows little deviation from the typical *Tupaia* skull. The rostrum is short and heavy, does not arise from the skull abruptly as in the *Tupaia minor* group, where the rostrum is also relatively short. The distance from the lachrymal notch to end of premaxilla is about equal to the distance from that notch to end of external pterygoid plate. In *Tupaia*, with the exception of the *minor* group, the distance from the lachrymal notch to end of premaxilla equals the distance from the notch to the external auditory meatus. Correlated with the shortened rostrum the premaxilla is correspondingly short, antero-posteriorly and relatively high, supero-inferiorly. Usually in *Tupaia* the naso-premaxillary suture is considerably lengthened or apparently obliquely pushed backward, making the premaxilla a rather obliquely elongated bone. In *Anathana* the premaxilla is somewhat quadrate in shape and only slightly distorted. Extreme obliquity of the premaxilla is seen in the genus *Tana*. The fenestra in the zygoma in *Anathana* is reduced to a small oval foramen quite different from the large opening found in *Tupaia*. While it appears a trivial character, yet in the Tupaiidæ the size of this opening is an important feature correlated with other peculiarities. See fig. 6 on page 120.

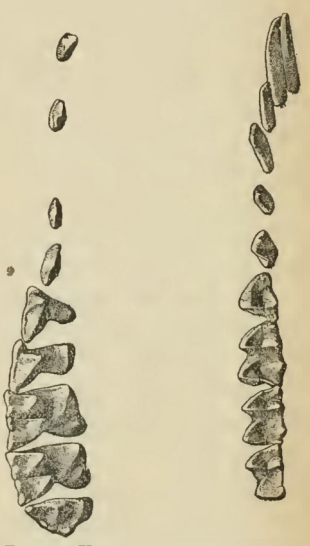


FIG. 7.—UPPER AND LOWER TOOTHROWS OF ANATHANA WROUGHTONI TYPE × 3, REG. NO. 96. 11. 7. 1, BRITISH MUSEUM, MANDVI, INDIA.

Dental characters.—The most evident of the dental characters in *Anathana* is the relatively small size of the lower canine, so that when the lower jaw is viewed from the side this tooth does not stand conspicuously higher than the adjacent incisor and premolar. The development of hypocones on the first and second upper molars is very conspicuous in *Anathana;* they are larger than in any other member of the family though nearly equalled by the hypocones on the first two upper molars of *Urogale* and *Ptilocercus*. All the upper molariform teeth of *Anathana* are relatively wider and shorter than they are in the other genera. This is especially well shown in the third and fourth premolars, where the protocones are better developed and extend inward toward the median line more than is the case in other genera of Tupaiidæ. Looked at on its grinding surface the fourth

premolar is distinctly four-sided in outline, while in *Tupaia* it is rather triangular. The third premolar in *Anathana* has a very evident protocone, while in *Tupaia* and *Tana* it is quite rudimentary. Corresponding with the conspicuous development of the protocones of the third and fourth premolars the metaconid of the fourth lower premolar is much increased in size as compared with its development in *Tupaia*. See fig. 7 on page 121.

A cecum about 25 mm. long is perhaps one of the generic characters. See page 14.

Geographic distribution.—*Anathana* is confined to the Indian peninsula, south of the River Ganges. The northeastern part of its range almost meets the southwestern limit of *Tupaia chinensis*. So far as our present knowledge goes the two genera do not overlap in their distribution. See map, page 125, Nos. 1, 2, 3.

Number of forms.—The genus *Anathana* contains but a single species group, easily separable into three forms. Perhaps they are nothing more than subspecies, but material is at present lacking to show intergradation.

Anathana ellioti, eastern India; upper parts and tail reddish brown, feet and hind legs buff or ochraceous, page 122.

Anathana pallida, northeastern India; upper parts a less conspicuous reddish brown, different in color from tail, feet and hind legs grizzled buffy, page 124.

Anathana wroughtoni, western India; upper parts dull grizzled brownish, tail slightly dissimilar, feet and hind legs grizzled grayish, page 123.

Remarks.—*Anathana* is clearly closely related to *Tupaia* in most of its characters. In the small size and oval shape of the zygomatic fenestra it resembles *Dendrogale*, as well as in the barely indicated face markings, which are even lacking in one species of *Dendrogale*. In the development of the hypocones of the upper molars and the protocones of the premolars it is approached by *Urogale* and *Ptilocercus*. It is quite distinct from any of the family in the relatively small size of the lower canines, and is the antithesis of *Urogale*, which has the lower canines exceedingly well developed.

ANATHANA ELLIOTI (Waterhouse).

1849. *Tupaia ellioti* Waterhouse, Proc. Zool. Soc. London, 1849, p. 107, plate, mammalia, 13.

1879. *Tupaia ellioti*, Anderson, Zool. Res. West Yunnan, 1879, p. 124, pl. 7, figs. 12 and 13.

1888. *Tupaia ellioti*, Blanford, Fauna Brit. Ind. Mamm., p. 209, 1888.

Type-locality.—Hills between Cuddapah and Nellore, eastern Ghats, India, not far from Madras.

Type-specimen.—In British Museum, Reg. No. 50.1.21.5, adult male, collected by W. Elliot, who procured specimens "from the hills between Cuddapah and Nellore in what may be termed the eastern

Ghats." The label of the specimen reads "Madras," the nearest large city to the locality mentioned by Waterhouse. The specimen is rather old, mounted, and without skull, but in a good state of preservation and apparently not injured as to color by exposure to light. There are two other specimens, paratypes, collected by Elliot at the same locality: 50.1.21.7, a young individual recently made into a modern study skin, in good condition and color, and with fragments of skull present, and 50.1.21.6, with skull, 50.8.21.16, an adult female, long mounted and much exposed to the light and so bleached that the grizzling is lost, and the brownish color of the back merely indicated.

Geographic distribution.—Eastern Ghats, and Sheveroy Hills to the south, India. See No. 1 on map on page 125.

Diagnosis.—Upper parts of body and tail distinctly reddish brown; feet buff to ochraceous.

Color.—Upper parts of body and tail a coarse grizzle of tawny ochraceous and blackish, the former much in excess and the grizzle coarser on the tail; head, neck, and sides of body a grizzle of ochraceous and blackish, both colors about equally mixed; outer side of legs similar to adjacent parts of body; underparts and inner side of legs buffy; upper surfaces of hands and feet, dark buff or ochraceous buff; shoulder stripe whitish cream color; underside of tail similar to upper side, except in the median line where the short appressed hairs have the general color of the underparts.

Skull and teeth.—There are apparently no characters by which the skull and teeth of *Anathana ellioti* may be distinguished from those of other species in the genus.

Measurements.—Type: All from skin, head, and body, 180 ± mm.; tail, 180 ±; hindfoot, 40. Skull of an adult paratype, Reg. No. 50.1.21.6, condylobasal length, 42; zygomatic width, 22.5; width of braincase, 17.5; maxillary toothrow, 16. External measurements of specimens preserved in alcohol: Head and body, 160–180; tail, 185–190; hindfoot, 44–45. See table, page 126.

Remarks.—The Sheveroy Hills specimen, represented by a flat skin with skull, is not typical, the head being darker, the back, and especially the tail being less reddish than in the Cuddapah specimens, but the underparts, feet, and underside of tail being distinctly buffy, as in the others.

Specimens examined.—Eight: 5 skins and 3 preserved in alcohol.

ANATHANA WROUGHTONI, new species.

Type-locality.—Mandvi, near Bombay, India.

Type-specimen.—In British Museum, Reg. No. 96.11.7.1, skin and skull of adult female, collected at Mandvi, near Bombay, India, March 21, 1896, by R. C. Wroughton; in good condition.

Geographic distribution.—Region of Satpura Hills, and Dangs, near Bombay, western India. See No. 2 on map on page 125.

Diagnosis.—Upper parts of body dull grizzled brownish, tail slightly dissimilar in color from body, feet and hind legs, grizzled grayish.

Color.—Same general pattern as in *Anathana ellioti*, but upper parts of body not a conspicuous reddish brown, but a grizzle of blackish and ochraceous; tail a coarse grizzle of buff and blackish, the latter color in excess; sides of head, neck, and body, and outer side of legs and feet a grizzle of pale or cream buff and blackish; underparts and inner sides of legs whitish; shoulder stripe whitish, but not conspicuous.

Skull and teeth.—There are no tangible characters by which the skull and teeth of *Anathana wroughtoni* may be distinguished from those of *A. ellioti*.

Measurements.—Type: Head and body, 177 mm.; tail, 187; hind foot, 44; condylobasal length, 42; zygomatic width, 22.5; width of braincase, 18; maxillary toothrow, 15.

Specimens examined.—Three, one each from Mandvi, Dangs, and Matheran.

Remarks.—The "Indian Tupaia," recorded in the Satpura Hills by Ball in 1874,[1] is undoubtedly this species.

ANATHANA PALLIDA, new species.

Type-locality.—Munbhum, northeastern India.

Type-specimen.—In British Museum, Reg. No. 66.12.28.2, skin and skull of young adult female, collected at Munbhum, India, in 1865 by R. C. Beavan; in good condition.

Geographic distribution.—Northeastern India, ranging from Raipur northeastward as far as the Ganges River. See No. 3 on map on page 125.

Diagnosis.—Generally paler in color than is *Anathana ellioti*, upper parts only slightly reddish brown; tail not concolor with body; hind feet and legs grizzled buffy.

Color.—Of the same general pattern as that of *Anathana ellioti*, but the reddish brown of the back is not nearly so dark or conspicuous, and is not continued on to the tail; tail similar in color to sides of body; shoulder stripe quite conspicuous and nearly clear white; underparts and inner side of legs whitish.

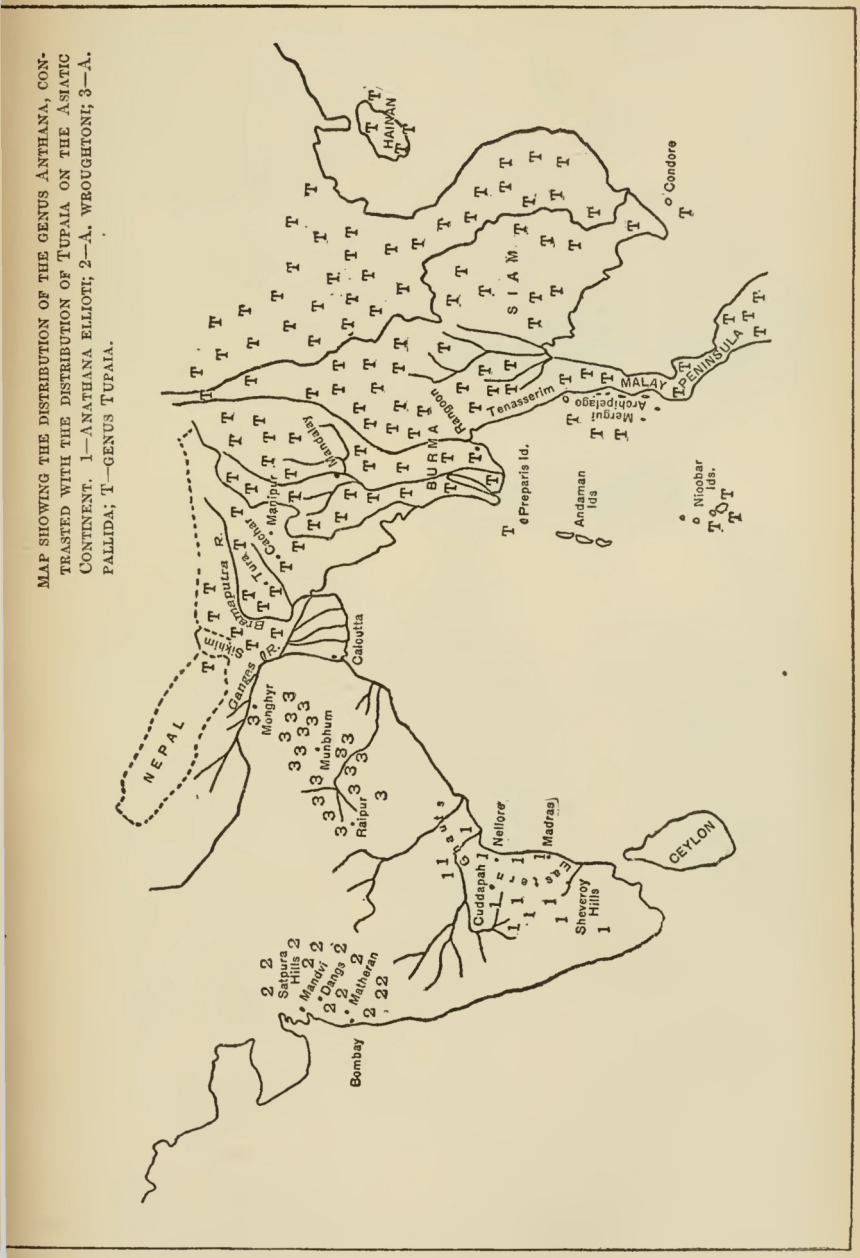
Skull and teeth.—These show no evident characters by which they can be distinguished from those of *Anathana ellioti*.

Measurements.—Type: Head and body (from dried skin), 185 ± mm.; tail, from dried skin, 165 ±; hind foot, 41; zygomatic width, 21; width of braincase, 17; maxillary toothrow, 15. For measurement of a second specimen see table, page 126.

Remarks.—Several specimens are recorded by Anderson in the Indian Museum from Monghyr or near there. They are probably examples of this species. The Monghyr specimens bring the range of *Anathana* very close to that of *Tupaia chinensis*, to the northeast of the Ganges Valley.

Specimens examined.—Two, the type and one from Raipur.

[1] Proc. Asiat. Soc. Bengal, 1874, p. 95.



MAP SHOWING THE DISTRIBUTION OF THE GENUS ANTHANA, CONTRASTED WITH THE DISTRIBUTION OF TUPAIA ON THE ASIATIC CONTINENT. 1—ANATHANA ELLIOTI; 2—A. WROUGHTONI; 3—A. PALLIDA; T—GENUS TUPAIA.

Measurements of the genus Anathana.

Name.	Locality.	Number.	Sex.	Molar teeth worn.	Head and body.	Tail.	Hind foot.	Condylo-basal length.	Zygomatic width.	Width of brain case.	Maxillary tooth row.	Number of mammæ.
					mm.	*mm.*	*mm*	*mm*	*mm*	*mm*	*mm*	
A. ellioti.....	Eastern Ghats, near Cuddapah.	50.1.21.5[1].	Male...	.....	180±	180±	40	....	....	....	....	....
Do.....	.....do.....	50.1.21.6..	Female.	Much.....	.....	.....	40	42	22.5	17.5	16	....
Do.....	.....do.....	50.1.21.7..	.....	None.....	155±	150±	40	....	....	....	....	....
Do.....	.....do.....	50.8.21.16[2]	.....	Moderately	.....	.....	....	....	22.5	18.5	15.5	....
Do.....	Cuddapah, Madras	81.3.3.13..	Male[4]..	Adult.....	160	190	44	....	....	....	....	....
Do.....	.....do.....	81.3.3.23[3]..	Female.	...do.....	180	185	44	....	....	....	....	3-3
Do.....	.....do.....	Genoa[3]...	Male[4]..	...do.....	180	185	45	....	....	....	....	....
Do.....	Sheveroy Hills....	91.10.7.49.	Male...	Much.....	.....	.....	....	42	21.5	18.5	15	....
A. wroughtoni	Maudvi.....	96.11.7.1[1].	Female.	Slightly...	177	187	44	42	22.5	18	15	....
Do.....	Dangs.....	96.11.7.2..	Male...	...do.....	165	195	45	42.5	23	18	15	....
Do.....	Matheran.....	73.7.22.5..	.....	.....	.....	.....	....	....	....	....	....	....
A. pallida....	Munbhum.....	66.12.28.2[1]	Female.	Slightly...	185±	165±	41	....	21	17	15	....
Do.....	Raipur.....	85.8.1.97..	.....	None[6].....	180±	.....	41	....	....	....	14.5	....

[1] Type.
[2] Skull only.
[3] Preserved in alcohol.
[4] Genitalia well developed.
[5] One inguinal, one axillary, one ventral nearer the inguinal one.
[6] *pm* [4] just appearing.

Genus DENDROGALE Gray.

Type.—Hylogalea murina Schlegel and Müller.[1]

Diagnostic characters.—A small member of the family Tupaiidæ with a skull closely resembling that of *Tupaia*, but fenestra in zygoma reduced to a minute foramen; externally characterized by a close-haired rounded tail and by absence of shoulder stripe, and usually by presence of conspicuous face markings. Mammæ probably, 1–1=2.

External characters.—Dendrogale is one of the smallest members of the family; its head and body measurements are about the same as those of *Ptilocercus;* its tail is decidedly shorter. It is the only small member of the family with a round, uniformly close-haired tail. *Urogale* has a somewhat similar tail, but is one of the largest members of the family and has a much lengthened snout. The hairs of the tail are comparatively short and appressed, producing a small, inconspicuous terminal pencil. The base of tail is clothed with relatively long hairs, like those of the adjacent parts of body, but they rapidly diminish in size to become the short appressed form. The naked area of the nose is cut squarely across as in *Tupaia.* The fifth digit on the hind foot is relatively longer than it is in *Tupaia* and the first relatively smaller. The ears are relatively larger than they are in *Tupaia,* due to increase in size of upper and posterior portions; they are also better haired. In the genus *Anathana,* which also has larger ears than *Tupaia,* the increase in size takes place in the lower

[1] Verh. Nat. Gesch. Nederl. Overz. Bezitt., 1843, p. 160.

portion. Some members of the genus have conspicuous face markings, caused by a dark streak extending from half way between nostril and eye through the eye to the ear, and a lighter stripe above and one below this line. In the dark species *Dendrogale melanura* these markings are only barely traceable. Similar face markings are also faintly indicated in *Anathana*. The shoulder stripe present (sometimes almost obsolete in *Tupaia*) in all the other members of the family except *Ptilocercus* is absent in *Dendrogale*. There is probably only only one pair of mammæ and they are inguinal.

Cranial characters.—The skull of *Dendrogale* is in general proportioned as in *Tupaia*. The only very striking difference is the reduction of the zygomatic fenestra to a small foramen. In the comparatively few specimens that I have examined the skull, in addition to being generally small, has a more rounded brain case, is less angular, has less conspicuous temporal ridges as compared with *Tupaia*. Unfortunately none of the specimens have been old adults. The skull figured by Schlegel and Müller [1] is quite as angular as the majority of *Tupaia* skulls. See below under type-specimens of *Dendrogale murina*, page 130.

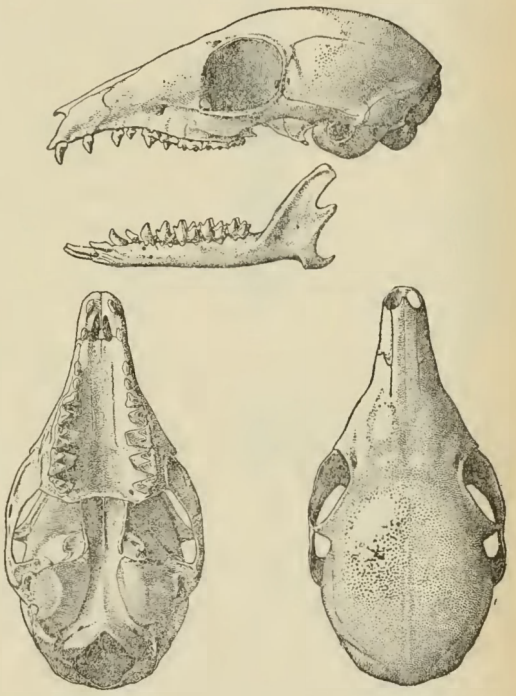


FIG. 8.—DENDROGALE MELANURA MELANURA, TYPE × 1½. REG. NO. 92. 2. 7. 11, BRITISH MUSEUM, 5,000 FEET ON MOUNT DULIT, NORTHERN BORNEO.

Dental characters.—The teeth of *Dendrogale* are very similar to those of *Tupaia*. The hypocones of the upper molars are considerably reduced, so that practically none are found on the second and third molars. The anterior teeth, i^1, i^2, c^1, c_1, pm_2, pm_3, are more trenchant in character than they are in *Tupaia*, especially seen in the second upper incisor. The dental characters, however, are relatively unimportant and would not be of themselves sufficient to warrant the generic distinctness of *Dendrogale*, but in conjunction with other characters serve to emphasize the validity of the genus.

[1] Verh. Nat. Gesch. Nederl. Overz. Bezitt., 1843, pl. 27, figs. 17–18.

Geographic distribution.—So far as known *Dendrogale* occurs only in Borneo and southeastern French Indo-China. As members of the genus *Dendrogale* are very rare in collections, it is not at all probable that this represents the extent of its distribution. When explorations of the Malayan region are more complete it will probably be found elsewhere, particularly Sumatra, where the rare genus *Ptilocercus* was unknown for some time. See also remarks under *Dendrogale murina* below, page 131. See A, B, M, N, on map on page 133.

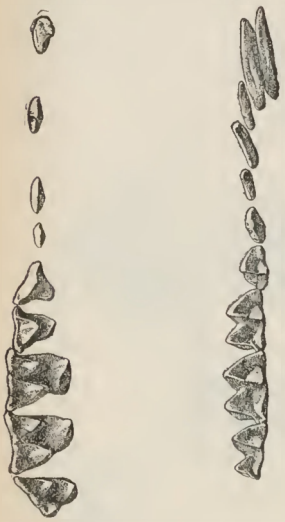


FIG. 9.—UPPER AND LOWER TOOTHROWS OF DENDROGALE MELANURA MELANURA, × 3¼. REG. NO. 92. 2. 7. 10, BRITISH MUSEUM, 5,000 FEET ON MOUNT DULIT, NORTHERN BORNEO.

Number of forms.—Four named species or subspecies are recognized. They fall into two very distinct almost subgeneric groups:

1. *Murina* group; color light, face-markings present, claws small, plate 5.
   Dendrogale murina, Pontianak, Borneo, page 129.
   Dendrogale frenata, Cambodia, page 128.
2. *Melanura* group, color dark, face-markings absent, claws long.
   Dendrogale melanura melanura, Mount Dulit, Borneo, page 132.
   Dendrogale melanura baluensis, Mount Kina Balu, Borneo, page 132.

KEY TO THE SPECIES OF DENDROGALE.

Color light, face marking conspicuous, claws small, 1.5–2 mm.
- Hind foot more than 25 mm. (27–29) (southeastern French Indo-China) ..... *D. frenata*, p. 128.
- Hind foot less than 25 mm. (22) (Borneo) ..... *D. murina*, p. 129.

Color very dark brown, face markings absent, claws large, 4 mm.
- Upper parts darker, base of tail and rump distinctly rusty, tail and feet darker (Borneo; Mount Dulit) ..... *D. melanura melanura*, p. 132.
- Upper parts lighter, base of tail and rump less rusty, tail and feet lighter (Borneo; Mount Kina Balu) ..... *D. melanura baluensis*, p. 132.

DENDROGALE FRENATA (Gray).

1860. *Tupaia frenata* GRAY, Ann. Mag. Nat. Hist., ser. 3, vol. 6, p. 217, August, 1860.

1879. *Dendrogale frenata*, ANDERSON, Zool. Res. West. Yunnan, 1879, p. 110.

Type-locality.—Cambodia.

Type-specimen.—In British Museum, Reg. No. 60.8.28.11, skin and skull, collected in Cambodia by M. Mouhot; skin is mounted and in fair condition; skull considerably damaged between the palate and foramen magnum, not fully adult, dpm^3 still in place and pm^3 just appearing beneath it.

Geographic distribution.—Cambodia and Anam. See A on map on page 133.

Diagnosis.—Color light, face markings conspicuous, claws small and blunt, 1.5–2 mm.; hind foot 25 mm. or over.

Color.—Type, with rather soft and close fur, upper parts of neck, body, and base of tail a fine grizzle of brownish black and ochraceous, (the ochraceous inclining to buff anteriorly and to tawny posteriorly) the two colors about equally mixed; outer side of legs similar to adjacent parts of body; upper parts of head a fine grizzle of blackish and buff, the former in excess; underparts and inner side of legs pale buffy; side of head with a blackish line beginning at base of whiskers, gradually becoming wider, and running through eye to ear, bordered above by a buffy line and below by a similar line; tail above similar to back, but darker for distal three-fourths, below, a dark line in the middle, bordered by an ochraceous line, and on the extreme outer edge by the color of the tail above. Plate 5.

A paratype is essentially like the type, but is more tawny on the rump and base of tail. Reg. No. 7.1.1.1, a topotype collected in 1861 (?), is ochraceous buff on the underparts instead of pale buffy. Two modern skins, Reg. Nos. 6.11.6.5 and 6.11.6.6, from Nhatrang, Anam, are in general similar to the original series, but are slightly more yellowish anteriorly, and one of them, 6.11.6.5, has rather long soft fur like that of *Dendrogale melanura*.

Skull and teeth.—These are practically indistinguishable from those of other species of *Dendrogale* that I have examined; the brain case is not quite so inflated or arched as that of *D. melanura*.

Measurements.—Type: Head and body (from mounted skin), 135 mm.; tail (from mounted skin), 95; hind foot, 27; condylobasal length, 31; zygomatic width, 17; width of brain case, 15.5; maxillary tooth row, 12. For individual measurements, see table, page 134.

Specimens examined.—Four from Cambodia and two from near Nhatrang, Anam.

DENDROGALE MURINA (Schlegel and Müller).

1843. *Hylogalea murina* SCHLEGEL and MÜLLER, Verh. Nat. Gesch. Nederl. Overz. Bezitt., p. 167, pl. 26, fig. 5; pl. 27, figs. 17 and 18; entire animal in colors, and lateral and dorsal views of skull both apparently very good.

1879. *Dendrogale murina*, ANDERSON, Zool. Res. West. Yunnan, p. 110, pl. VII, figs. 18 and 19, skull.

1888. *Glipora murina*, JENTINK, Mus. Hist. Nat. Pays-Bas, Cat. Syst. Mamm., vol. 12, 1888, p. 118. Publication of Diard's manuscript name under the heading *Typaja murina*.

Type-locality.—Pontianak, western Borneo.

Type-specimen.[1]—In the Leyden Museum, mounted skin and skull; male, skin somewhat faded and dust stained; skull broken away

[1] I have not seen this specimen, which appears to be the only representative of the species known. My information regarding the specimen and species is obtained from notes made by Mr. G. S. Miller, jr., in the Leyden Museum in 1905.

behind orbits but perfect in front and with complete lower jaw. (The skull figured by Schlegel and Müller is perfect. It is possible that the posterior portion of their figure was made up by analogy from a *Tupaia* skull. Anderson figures a perfect skull but I suspect he copied Schlegel and Müller's figures, transposing their lateral view from right to left, and apparently the dorsal view also in the process of lithographing. The skull was very incomplete in 1888 according to Jentink.[1] (See Plate 5.)

Geographic distribution.—Known only from the type-locality, but undoubtedly occuring elsewhere in Borneo. See B on map on page 133.

Diagnosis.—Differs from *Dendrogale frenata* mainly in the smaller size of hind feet, and if the illustrations of the skull are accurate, in having much narrower nasals; and tail above different in color from body.

Color.[2]—"Underparts and under surface of tail dull light ochraceous-buff. Upperparts the same but much darkened dorsally by admixture of a dark broccoli brown. Tail an indefinite dark tawny brown above, line of demarkation on tail sharp, but colors not forming any strong contrast. Median line of tail below not different from rest of its lower surface. At middle the hairs alongside of tail are 5 mm. in length, at tip they are 10 mm. Outer surface of legs slightly less yellowish than sides of body. Feet dark. A faint dark shade passes from muzzle through eye to ear; above, it is bordered by a light area 3 mm. wide behind eye, less distinct in front. Below, the light border may be detected behind eye, but not in front."

Skull and teeth.—If the illustrations are to be relied on the skull of *Dendrogale murina* would appear to be much more angular and with better developed temporal ridges than that of *D. frenata*, and to have much slenderer nasals. The teeth in the two species are probably essentially the same; their measurements agree almost exactly.

Measurements.[2]—"Head and body, 115 mm.; tail, 110; hind foot (distorted), 22 (all from mounted specimen); least distance from orbit to tip of premaxillary 13.6 (13.8);[3] least interorbital breadth 9.8 (10); zygomatic breadth (approximately) 17; mandible, 22 (22); maxillary tooth row (entire including incisors) 17.4." The maxillary tooth row, including incisors, in the illustration is the same or nearly so, and the measurement of the maxillary tooth row without the incisors in the illustration is 12, the same as the maxillary tooth row of *D. frenata*.

Remarks.—It is unfortunate that direct comparisons of *Dendrogale frenata* and *D. murina* have not been made. The two animals

[1] Mus. Hist. Nat. Pays-Bas Cat. Osteol. Mamm., vol. 12, 1888.

[2] Quoted from manuscript notes made by Mr. G. S. Miller, jr.

[3] Measurements in parentheses are those made by Mr. Miller or the type of *T. frenata*.

appear to be very similar. Their most apparent differences have been pointed out above, and from what is known of the fauna in general of Borneo and Anam, the two animals would certainly be expected to be different; in fact much more different than they appear to be. Both species have probably some peculiarity of habit making them difficult to secure. So far as I know only one specimen of *Dendrogale murina* has been collected. It is curious that no subsequent specimen has been obtained since the original. As the geographic distribution of the genus is so peculiar and so totally unlike that of any of the related genera or in fact of most genera of mammals there is just a possibility that *Dendrogale murina* is an example of *D. frenata* wrongly labeled as coming from Pontianak, Borneo. Dr. W. L. Abbott, with much careful collecting in the region of the type-locality, failed to secure it.

Specimens examined.—None.

DENDROGALE MELANURA (Thomas).

(Synonymy, type-specimens, etc., under the subspecies.)

Geographic distribution.—High mountains of northern Borneo. No specimens recorded below 3,000 feet. See M and N on map on page 133.

Diagnosis.—Distinguished from the other members of the genus by its dark-brown color, lack of face markings, and by its large sharp claws, about 4 mm. in length, fur long and soft; mammæ 1–1=2.

Color.—Upper parts of head, neck, and body a fine grizzle of blackish and ochaceous buff, anteriorly, and cinnamon rufous, posteriorly and at base of tail, the darker color in excess; bases of hairs slate black; outerside of legs similar to adjacent parts of body; feet dark brownish; underparts ochraceous with slate bases of hairs showing through; inner side of legs similar to adjacent underparts; immediately above and below eye, a short ochraceous line, both together appearing like an eye ring with indistinct corners; tail a mixture of black or blackish, and cinnamon rufous with the black very prominent when viewed from above; tail, seen below, with the short appressed hairs in middle line black or brownish black, bordered on either side by other short hairs with more or less evident cinnamon rufous bases.

Skull and teeth.—These are practically indistinguishable from those of *Dendrogale frenata*, except that the braincase is slightly more inflated and arched.

Subspecies.—Two races of *Dendrogale melanura* are known, one from Mount Dulit and the other from Mount Kina Balu, neither of them very highly differentiated.

DENDROGALE MELANURA MELANURA (Thomas).

1892. *Tupaia melanura* THOMAS, Ann. Mag. Nat. Hist., ser. 6, vol. 9, p. 251, March, 1892.

1892. *Tupaia melanura*, THOMAS, Proc. Zool. Soc. London, 1892, p. 224, pl. 19, figs. 4, 5, skull.

Type-locality.—Mount Dulit, northern Borneo, 5,000 feet altitude.

Type-specimen.—In British Museum, Reg. No. 92.2.7.10, skin and skull of adult female, collected at 5,000 feet on Mount Dulit, Borneo, October, 1891, by Mr. Charles Hose; skin well preserved, but somewhat damaged about the head; skull in fair condition, slightly damaged in supraoccipital region. (See figures 8 and 9 on pages 127 and 128.)

Geographic distribution.—Known only from Mount Dulit, Borneo. See M on map on page 133.

Diagnosis.—Upper parts of head and body dark, due to a deeper shade of the ochraceous buff element of the color; base of tail and rump with the cinnamon rufous element of the color more conspicuous, so that that part of the animal appears distinctly rusty; feet and especially the tail darker, the latter with more black and the ochraceous on the underside less in evidence.

Skull and teeth.—These are without distinguishing characteristics.

Measurements.—See table, page 134.

Specimens examined.—Three from Mount Dulit.

Remarks.—Hose, in Mammals of Borneo (p. 33, 1893), remarks of this animal: "The type of this pretty little treeshrew was obtained by me on the top of Mount Dulit at 5,000 ft., living amongst the moss-covered stunted jungle, and it is apparently a true mountain species, as I have since obtained other specimens, none of which were found below 3,000 ft."

DENDROGALE MELANURA BALUENSIS, new subspecies.

Type-locality.—Mount Kina Balu, northeastern Borneo.

Type-specimen.—In British Museum, Reg. No. 92.9.6.3, skin and skull of adult female, collected on Mount Kina Balu, Borneo, by Mr. A. Everett; skin in good condition; skull imperfect.

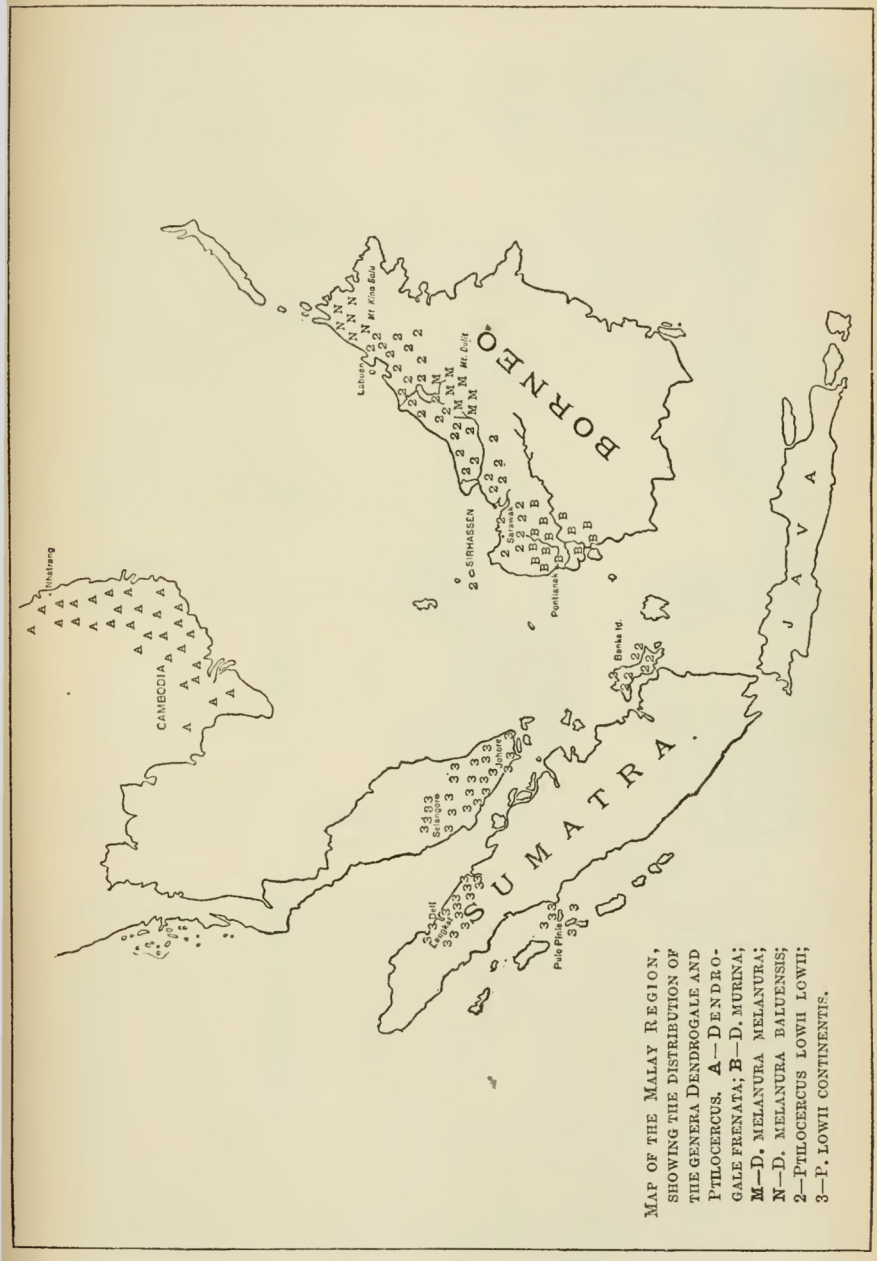
Geographic distribution.—Known only from the type locality. See N on map on page 133.

Diagnosis.—Distinguished from *Dendrogale melanura melanura* by having the ochraceous buff of the anterior upper parts lighter and more in evidence, and the cinnamon rufous posteriorly lighter, feet light brownish; underparts ochraceous buff, rather than ochraceous: tail with black hairs less in evidence and with the appearance of a narrow line of ochraceous on either side of the middle line.

Skull and teeth.—These show no distinguishing characteristics.

Measurements.—See table, page 134.

Specimens examined.—Three, all from Mount Kina Balu.



MAP OF THE MALAY REGION, SHOWING THE DISTRIBUTION OF THE GENERA DENDROGALE AND PTILOCERCUS. A—DENDROGALE FRENATA; B—D. MURINA; M—D. MELANURA MELANURA; N—D. MELANURA BALUENSIS; 2—PTILOCERCUS LOWII LOWII; 3—P. LOWII CONTINENTIS.

Measurements of specimens of the genus Dendrogale.

Name.	Locality.	Number.	Sex.	Molar teeth worn.	Head and body.	Tail.	Hind foot.	Condylo-basal length.	Zygomatic width.	Width of brain case.	Maxillary tooth row.	Number of mammæ.
					mm	*mm*	*mm*	*mm*	*mm*	*mm*	*mm*	
D. frenata	Cambodia	60.8.2.12[1]			125	.....	27	.....	.....	.....	.....	....
Do	....do	60.8.28.11[2]		None[3]	135±	95±	27	31	17	15.5	12	....
Do	Chautabean Cambodia.	7.1.1.2		Slightly	120±	100±	27	.....	.....	15	11	....
Do	....do	7.1.1.1		None[4]	125±	95±	27	30.5	16	15	11.5	....
Do	Buli near Nhatrang Anam.	6.11.6.5		....do[5]	120±	110±	28	32.5	17	15.5	12	....
Do	....do	6.11.6.6		....do[6]	140±	110±	29	32.5	17	15	12	....
D. murina[7]	Pontianak, Borneo.	Leyden[8]	Male	.....	115±	110±	22±	.....	17	.....	12±	...
D. melanura melanura.	Mount Dulit, 5,000 feet, Borneo.	92.2.7.10[8]	Female.	Slightly	130±	130±	32	32.5	17.5	15	12	1-1
Do	Mount Dulit, 3,000 feet.	99.12.9.12	Male	Moderately	.....	.....	31±	.....	.....	.....	12	....
Do	Mount Dulit, 5,000 feet.	Paris, 2231	.....	(9)	140±	135±	30±	.....	.....	.....	.....	....
D. melanura baluensis.	Mount Kina Balu, Borneo.	92.9.6.38	Female.	Slightly	150±	125±	33	.....	17	15.5	11.5	1-1
Do	....do	93.4.1.39[9]	Male	Adult	115	115	30	.....	.....	.....	.....	....
Do	....do	Berlin, 11055	.....	Moderately	130±	130±	30	.....	.....	.....	11.5	....

[1] Mounted.
[2] Type, mounted.
[3] di^1 and dpm^3 still in place.
[4] dpm^4 still in place.
[5] Permanent canines appearing.
[6] i^2 appearing.
[7] From notes made by Mr. Miller in Leyden, 1905.
[8] Type.
[9] Preserved in alcohol.

TANA, new genus.

Type.—*Tupaia tana* Raffles, Trans. Linn. Soc. London, vol. 13, p. 257, May, 1821.

Diagnostic characters.—A member of the mammalian family Tupaiidæ, similar to typical *Tupaia*, differing in the possession of a much attenuated snout and rostrum and a recession backward on top of nose of the naked hairless portion.

External characters.—The external form of *Tana* is essentially like that of *Tupaia* with the exception of the elongated snout and the backward extension of the naked area of the nose on top into the haired area instead of being cut square across as in *Tupaia*. All the members of the genus are characterized by the possession of a middorsal stripe of varying length and width. This, however, is not diagnostic as one member of the genus *Tupaia*, *T. picta*, has a well-marked dorsal stripe, and *Tupaia montana* frequently has a broad, dark dorsal area. The squirrel-like appearance of treeshrews in general is still carried out by the genus *Tana*, which may be compared with the long-snouted genus of squirrels, *Rhinosciurus* Gray.[1] The mammæ are 2–2 in number. (See figure 2, p. 31, plate 6, figs. 1 and 2.)

[1] List Spec. Mamm. Brit. Mus., 1843, pp. xxv, 195.

Cranial characters.—Rostrum considerably elongated and attenuated, so that the distance from the lachrymal notch to the end of premaxilla is equal to the distance from the notch to the occipital condyles. The length of the rostrum is mainly brought about by a lengthening of the premaxillary and nasal bones and not by any appreciable increase in length of the maxilla. Fenestra in zygoma large and conspicuous, elongated oval in shape.

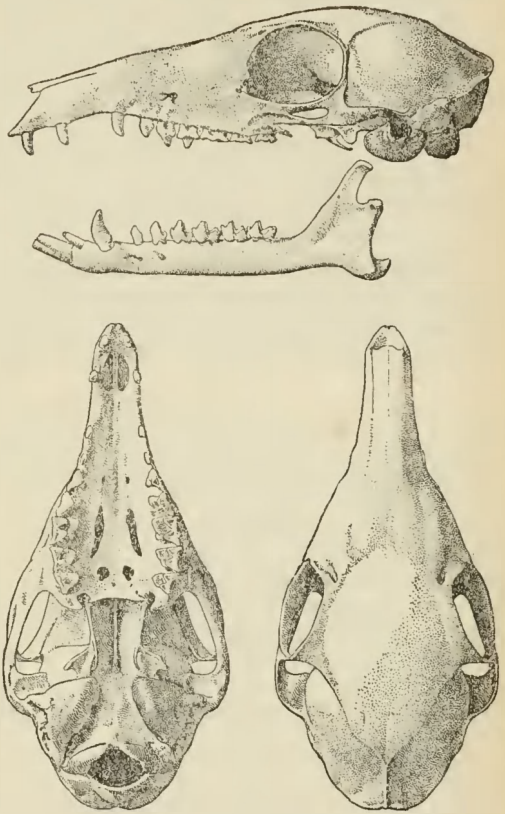


FIG. 10.—TANA TANA BESARA, TYPE × 1. CAT. NO. 142247, U.S.N.M., KAPUAS RIVER, BORNEO.

Dental characters.—The teeth of *Tana* do not differ in form or number from those of *Tupaia*. Owing to the elongation of the rostrum the anterior teeth are somewhat differently spaced. Thus the lower canine stands closer to the last lower incisor than it does to the adjacent premolar, while in *Tupaia* it stands midway between the two teeth. The combined length of the three upper molars is about one-third the length of the entire upper tooth row in *Tupaia*, but in *Tana* it is distinctly less than one-third the length of entire tooth row.

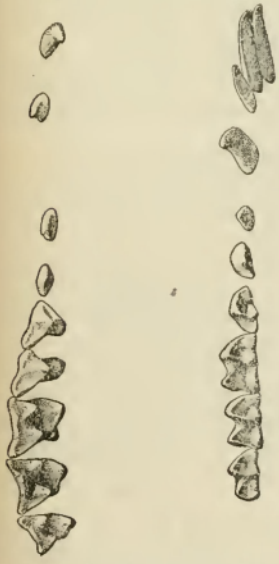


FIG. 11.—UPPER AND LOWER TOOTH-ROWS OF TANA TANA BESARA, TYPE × 2. CAT. NO. 142247, U.S. N.M. KAPUAS RIVER, BORNEO.

The absence of a cecum may be one of the generic characters. See page 14.

Geographic distribution.—The genus *Tana*, so far as known, is confined to the land masses of Borneo and Sumatra and certain of the small adjacent islands. Unlike *Tupaia* it is not

found in Java, the Malay Peninsula, or elsewhere on the Asiatic mainland. See map on page 143.

1. *Dorsalis* group; delicate build, short claws, pl. 6, fig. 2.
   Tana dorsalis, Borneo, pl. 11, fig. 1, page 152.
2. *Tana* group; heavy build, stout claws, pl. 6, fig. 1.
   Tana tana tana, Sumatra, southern Borneo, pl. 11, fig. 4, page 139.
   Tana tana besara, Kapuas River, Borneo, pl. 11, fig. 8, page 141.
   Tana tana utara, northern Borneo, page 141.
   Tana tana sirhassenensis, Sirhassen Island, pl. 11, fig. 3, page 142.
   Tana tana bunoæ, Tambelan Islands, pl. 11, fig. 5, page 144.
   Tana tana tuancus, Banjak Islands, page 145.
   Tana lingæ, Linga Island, pl. 11, fig. 2, page 145.
   Tana cervicalis cervicalis, Tana Bala, Batu Islands, page 147.
   Tana cervicalis masæ, Tana Masa, Batu Islands, page 148.
   Tana chrysura, Borneo, opposite Labuan, page 149.
   Tana paitana, northeastern Borneo, Banguey Island, page 150.

KEY TO THE SPECIES OF TANA.

Size small, a narrow dorsal stripe extending the entire length of the back; claws small and short; hairs of tail of medium length not strongly distichous. *Dorsalis* group.
Borneo, *T. dorsalis*, p. 152.

Size large, a narrow dorsal stripe on anterior half of back, and bordered by a light area different in color from rest of back; claws large and well developed; hairs of tail long and strongly distichous ..... *Tana* group.

Tail, buff, very different in color from rest of body. North Borneo, *T. chrysura*, p. 149.

Tail, reddish brown, not noticeably different in color from rest of body.

Shoulder stripe bordered above and below by the light or grayish or buffy color of the anterior back..... Northeast Borneo, *T. paitana*, p. 150.

Shoulder stripe bordered above and below by the reddish brown color of the sides of body.

Size small; hind foot, 40 mm.; tail, 135; rostrum very narrow and slender.
Linga Island, *T. lingæ*, p. 145.

Size medium or large, hind foot over 45 mm. and tail over 150; rostrum not so narrow and slender.

Reddish colors bright, and back with a very large well marked brilliant black area..... *T. cervicalis*, p. 147.

Light areas beside the dorsal stripe, cream buff slightly mixed with black.
Tana Bala Island, *T. cervicalis cervicalis*, p. 147.

Light areas beside the dorsal stripe tawny ochraceous slightly mixed with black..... Tana Masa Island, *T. cervicalis masæ*, p. 148.

Reddish color usually not so bright, generally rather dull, without a large wide brilliant black area on back, the lower back, however, is always darker than rest of upper parts and sometimes black, but the black color is never widely spread ..... *T. tana*, p. 137.

General coloration decidedly dull.

Size very large; hind foot 53 mm.; condylo-basal length 59.
Western Borneo, *T. tana besara*, p. 141.

Size medium; hind foot about 48 mm.; condylo-basal length about 55; tail about 175..... Sumatra, southern Borneo, *T. tana tana*, p. 139.

Size small; hind foot about 44; condylo-basal length about 53; tail about 155..... Tambelan Islands, *T. tana bunoæ*, p. 144.

General coloration relatively bright.

Light areas beside the dorsal stripe very light and grayish; condylo-basal length 53 mm. or more .... Northern Borneo, *T. tana utara*, p. 141.

Light areas beside the dorsal stripe duller and darker, more ochraceous; condylo-basal length 53 mm. or less.

Size slightly smaller; reddish color duller; underside of tail lighter; shoulder stripe buff, well marked.

Sirhassen Island, *T. tana sirhassenensis*, p. 142.

Size slightly larger; reddish color brighter; underside of tail darker; shoulder stripe ochraceous; rather poorly developed.

Tuangku Island, *T. tana tuancus*, p. 145.

TANA TANA (Raffles).

(Synonymy, type-specimens, etc., under the subspecies.)

Geographic distribution.—Borneo, Sumatra, and adjacent small islands. See Nos. 3, 4, 5, 6, 7, and 8 on map on page 143.

Diagnosis.—General color of sides and shoulder region hazel; lower back with an area distinctly darker than rest of upper parts, but sometimes presenting a distinct but rather small black patch; shoulder stripe bordered above and below by the hazel of the sides; size large.

Color.—Sides of body and shoulder region and outer side of legs, hazel, somewhat brighter than Ridgway's, and more or less lined with blackish annulations of the hairs, especially posteriorly, where the darker color gradually spreads upward to concentrate itself in a dark area on the lower back, which sometimes appears as a small distinct black patch, dorsal stripe beginning faintly at occiput but becoming very distinct over shoulders, blackish reddish brown, and gradually losing itself in with the dark area of lower back; dorsal stripe bordered on either side by a light area sometimes poorly and sometimes well defined, made up of a rather coarse grizzling of cream buff (when light area is well marked) or ochraceous buff (when light area is less conspicuous) and blackish brown; top and sides of head and neck generally like the light areas on each side of dorsal stripe, but rather lighter and the grizzling finer; underparts, including inner side of legs, orange rufous to ferruginous; feet generally a dull and often darker extension of the color of the outer side of legs; tail above, bright hazel or ferruginous, more or less, and irregularly suffused with blackish; underside of tail similar to upper side for its outer half, but the inner portion orange rufous; shoulder stripe well marked and of the same general colors as light area on each side of dorsal stripe, but lighter in tint.

Skull and teeth.—There are no apparent characters by which the skull and teeth of *Tana tana* may be distinguished from other species of equal size.

Measurements.—Usual measurements of adults: Head and body, 200–230 mm.; tail, 160–190; hind foot, 45–50; condylobasal length, 53–60; zygomatic width, 25–28; width of brain case, 20–22; maxillary tooth row, 20–22.

Subspecies.—The following geographic forms may be recognized: *Tana tana tana*, Sumatra, southern Borneo; *T. t. utara*, northern

Borneo; *T. t. besara*, lower Kapuas River, Borneo; *T. t. sirhassenensis*, Sirhassen, Natuna Islands; *T. t. bunoæ*, Tambelan Islands, and *T. t. tuancus*, Banjak Islands.

Remarks.—*Tana tana* is distinguished from *T. cervicalis* by its duller and less brilliant colors and less conspicuous black area on lower back, from *T. paitana* by having the shoulder stripe bordered above and below by general color of sides, and from the Linga species by its greater size. The material for making a comparison of the Sumatran and Bornean tanas is not entirely satisfactory. Good Sumatran specimens are rather scarce, as an examination of the list of specimens on page 140 will show. There is not one good fully adult modern study skin of *Tana tana tana* from the island that is its type-locality. Probably the best material is in the United States National Museum (represented by two specimens from Deli almost as far from the exact type-locality, Bencoolen, as one can find) and in the Philadelphia Academy of Natural Sciences. One of the National Museum specimens is in alcohol, the other a skin made from one in alcohol. The colors of both of them are not beyond question, although apparently unchanged. Their underparts are distinctly darker than the underparts of Bornean examples. Most of the Philadelphia skins are immature, and none shows any tangible character by which to distinguish them from Bornean skins. The skulls and teeth show no distinguishing features between the Bornean and Sumatran specimens. For the present at least the same subspecies of *Tana tana* must be regarded as occurring in southern Borneo and Sumatra. In Paris, Berlin, and London are a few specimens of *Tana tana* simply labeled "Borneo." I have not included them in the lists and measurements of specimens, and have made no attempt to assign them to any particular subspecies. Many of them are old and mounted. A fair number of specimens of *Tana tana* exist in museums from definite localities in Borneo, and while they show considerable individual variation, yet as a whole they fall into two groups, those from Sarawak being brighter colored and those from southern Borneo duller, with a large member of the dull form on the lower Kapuas River. The brighter-colored specimens seem to be associated with the mountains while all those from southern Borneo have been taken in the lowlands. Future explorations may show that on Borneo the bright colored form is an inhabitant of the higher regions of that island and the duller form are inhabitants of the lowlands of the coastal region. The present division into northern and southern races may simply be owing to the fact that the lowlands of southern Borneo have been explored, mainly by Abbott and by Shortridge; while in the north Hose worked in the higher altitudes. Our knowledge of this species on both Sumatra and Borneo is very elementary at present. On Sirhassen of the Natuna Islands is a well-marked geographic race closely related to the lowland Bornean form.

TANA TANA TANA (Raffles).

1821. *Tupaia tana* RAFFLES, Trans. Linn. Soc. London, vol. 13, p. 257, May, 1821.
1825. [*Cladobates*] *tana*, CUVIER, Dents Mamm., 1825, p. 61.
1840. *Erinaceus* (*Glisorex*) *tana*, BLAINVILLE, Ostéogr. Mamm., vol. 1, p. 112, pl. 6, fig. 1.
1841. *Cladobates speciosus* WAGNER, Schreber's Säugthiere, Supplementband. pt. 2, p. 43, 1841. (Type-locality, Borneo.)
1843. *Hylogalea tana*, SCHLEGEL AND MÜLLER, Verh. Nat. Gesch. Nederl. Overz. Bezitt., p. 161, pl. 26, fig. 2; pl. 27, figs. 1–6, 1843.
1879. *Tupaia tana*, ANDERSON, Zool. Res. West. Yunnan, 1879, p. 136, pl. 7, figs. 1 and 2.

Type-locality.—Sumatra, probably Bencoolen.

Type-specimen.—In British Museum, Reg. No. 95.3.21.4, collected by Sir Stamford Raffles in Sumatra, probably at Bencoolen, a badly damaged skull (no skin can be found), nearly everything posterior to palate lacking, as well as right premaxilla, several of the maxillary teeth lost; mandible perfect; not fully adult, the permanent upper incisors just appearing.

Geographic distribution.—Sumatra, southern Borneo, in the low country. See No. 5 on map on page 143.

Diagnosis.—A relatively dark and dull member of the species, especially in region of sides and shoulders, light area on either side of dorsal stripe a mixture of ochraceous buff and blackish brown, neither color in excess.

Skull and teeth.—Without definite subspecific characters. (Plate 11, fig. 4.)

Measurements.—Usual measurements of adults: Head and body, 200–220 mm.; tail, 160–180; hindfoot, 47–50; condylo-basal length, 54–56; zygomatic width, 25–27; width of braincase, 20–21; maxillary toothrow, 19.5–21.5. For details of measurements see table, page 140.

Remarks.—Two Sumatran specimens of *Tana tana tana* in the United States National Museum differ slightly from the Bornean ones in having the underparts ferruginous instead of orange rufous; but both specimens have been subjected to alcohol and one is still preserved in that fluid. The bullæ of one of them, Cat. No. 174611, are very small in comparison with the bullæ of Bornean skulls, but the latter show marked variation in the size of the bullæ. The skull of the second Sumatran specimen has bullæ equaling in size the smaller bullæ of the Bornean specimens. Specimens from the Lampong District, Sumatra, in the Philadelphia Academy of Natural Sciences, do not show tangible differences from the Bornean specimens.

Wagner's name *speciosus* was applied by him to a specimen in the Erlangen Museum. His description applies more closely to the southern Bornean form than to the brighter colored northern form. Until the distinctness of the Sumatran longnosed treeshrew from the lowland Bornean animal is established, *speciosus* must stand as a synonym of *tana*, but in the event of their distinctness it will be available for the Bornean form. It is rather unfortunate that the exact locality for Wagner's specimen is not known, but as most of the old

collecting in Borneo was done in the southern part, it is probable that it came from southern Borneo, especially as the description seems more applicable to the southern form. Wagner did not have a skin of the Sumatran tana when he applied the name *speciosus*, hence his error of considering the two forms different.

The specimen in the British Museum from Pajo is not typical, and if the characters it presents are constant for the longnosed treeshrews of that region, it represents a distinct form. It is very dark and dull in color and the red element much suppressed. Some of this difference in color may be the result of preservatives. (See remarks under *Tana tana utara*, p. 142.)

The Bornean specimens in the United States National Museum have been previously called *Tupaia speciosa*.[1]

Specimens examined.—From Sumatra 16, and 11 from Borneo. See list of specimens below.

Measurements of Tana tana tana.

Locality.	Number.	Sex.	Molar teeth worn.	Head and body.	Tail.	Hind foot.	Condylo-basal length.	Zygomatic width.	Width of brain case.	Maxillary tooth row.	Number of mammæ.
				mm.	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	
Deli, Sumatra	174611	Male	None [2]	200±	160±	46	55.5	25	20	21	....
Do	174612	Female	Slightly [3]	10	180	48	54	25.5	21	20	2-2
Lampong, South Sumatra.	81.3.15.3	Male	None	.....	.....	47	50±	25	19.5	19.5	....
Do	81.3.15.4	...do	.....do	.....	.....	47	52±	.....	20	19.5	....
Sumatra	79.7.2.2 [4]	.....	Moderately	.....	.....	50	59	27	20.5	22	....
Sumatra (Raffles)	95.3.21.5	.....	None	.....	.....	(5)	.....	.....	.....	20	....
Do	95.3.21.4 [6]	.....	.....do [7]	.....	.....	(5)	.....	.....	.....	20.5	....
Sumatra (Higgins)	77.3.4.1 [4]	.....	Moderately	.....	.....	46	53	25	20	20	....
Sumatra, Blalau, 1,700 feet.	82.7.28.6 [3]	Female	Adult	185	160	50	.....	.....	.....	.....	2-2
Sumatra, Pajo	79.6.28.14	Male	Slightly	.....	.....	50	.....	26	21	20.5	....
Sumatra	Berlin, 631	.....	(8)	.....	.....	46	.....	.....	.....	.....	.....
Sumatra, Gunong Sugi, under 500 feet.	Phila., 6664	.....	(9)	130±	120±	39	.....	.....	.....	.....	....
Do	Phila., 6662	.....	(9)	145±	130±	39	.....	.....	.....	.....	....
Do	Phila., 6661	.....	(10)	165±	145±	45	.....	.....	.....	.....	....
Do	Phila., 6659	.....	(11)	190±	180	47	.....	.....	.....	.....	....
Do	Phila., 6660	Female	Moderately	200±	160±	47	53	.....	.....	20.5	2-2
Borneo, Sungei Matan.	145574	...do	.....do	220	180	53	56	25.5	20.5	21	2-2
Do	145573	Male	Unworn	207	188	49	53.5	25	21.5	20	....
Borneo, Klumpang Bay.	151885	Female	Moderately	210	180	48	55	26	20±	19.5	2-2
Borneo, Pamukang Bay.	154341	Male	Slightly	210	170	48	54	27	20	19.5	....
Borneo, Pasir River	154339	...do	.....do	209	175	47	53.5	26	20	19.5	....
Borneo, Balik Papan Bay.	154340	Female	.....do	210	180	49	55	27	20	20	2-2
Borneo, Martapoera River, Karangintan, 30 feet.	10.4.5.74	Male	.....do	205	180	46	52	25	19.5	19.5	....
Do	10.4.5.75	Female	Moderately	210	190	47	51.5	26.5	20	19.5	2-2
Boentok, Barito River.	10.4.5.73	...do	Slightly	190	185	48	.....	25	20	19	2-2
Southwest Borneo	Berlin, $\frac{6333}{11111}$ [8]	.....	.....do	.....	.....	45±	56±	27	21	22.5	....
Southeast Borneo	Berlin, 6144 [8]	Male	.....do	230±	150±	45±	56	27	20	22	....

[1] See Proc. U. S. Nat. Mus., vol. 40, p. 121, Apr. 25, 1911.
[2] $\frac{1}{11}$ just appearing.
[3] Preserved in alcohol.
[4] Skeleton; no skin.
[5] Skull only; no skin.
[6] Type.
[7] Permanent incisions halfway through.
[8] Mounted.
[9] About one-half grown.
[10] About three-fourths grown.
[11] Adult, or nearly so.

TANA TANA BESARA, new subspecies.

Type-locality.—Opposite Pulo Jambu, below Tyan, on north or right bank of Kapuas River, western Borneo.[1]

Type-specimen.—In United States National Museum, Cat. No. 142247, skin and skull of adult male, collected opposite Pulo Jambu, Kapuas River, on the north or right bank of the river, September 17, 1905, by Dr. W. L. Abbott; original number, 4458; skin and skull in good condition. (See figures 10 and 11 on page 135.)

Geographic distribution.—Known only from the type-locality, but probably found throughout the low swampy area of western Borneo, north of the Kapuas River.[1] See No. 4 on map on page 143.

Diagnosis.—Similar in general coloration to *Tana tana tana* of southern Borneo, but even darker and duller in color and with considerably more black on the lower back, forming a fairly well-defined black patch, underparts darker and duller; size very large; hind foot, 53 mm.; condylo-basal length, 59.5.

Skull and teeth.—Aside from their distinctly larger size these do not differ from those of the related subspecies. (Plate 11, fig. 8.)

Measurements.—Type, the only adult specimen known: Head and body, 229 mm.; tail, 196; hind foot, 53; condylo-basal length, 59.5; zygomatic width, 29; width of brain case, 21; maxillary tooth row, 23.

Remarks.—This subspecies is at once distinguished from the others by its large size and dull color. Its distribution would appear to be coincident with that of *Sciurus borneoensis palustris*,[2] and like that squirrel its color appears darker than it does in related subspecies. Doctor Abbott in his field catalogue refers to the large size of this treeshrew. It has hitherto been called by me *Tupaia speciosa*.[3]

Specimens examined.—Two, the type, and a young individual from near Tyan.

TANA TANA UTARA, new subspecies.

Type-locality.—Three thousand feet on Mount Dulit, Baram district, northern Borneo.

Type-specimen.—In British Museum, Reg. No. 99.12.9.5, skin and skull of adult male, collected October, 1898, at 3,000 feet altitude on Mount Dulit, Borneo, by Charles Hose; in good condition.

Geographic distribution.—Northern Borneo, probably confined to the more elevated regions. See No. 3 on map on page 143.

Diagnosis.—A bright-colored subspecies of *Tana tana*, with sides, shoulder, and underparts lighter, and the light areas on either side of the dorsal stripe very light and gray in appearance, black area on back better defined.

[1] Proc. U. S. Nat. Mus., vol. 33, map opposite p. 547, Dec. 24, 1907.
[2] Idem, p. 553, Dec. 24, 1907.
[3] Idem, p. 562, Dec. 24, 1907, and vol. 40, p. 121, Apr. 25, 1911

Skull and teeth.—These appear to be a trifle larger in this subspecies than they do in *T. tana tana*, but the difference is so slight as to be practically negligible.

Measurements.—Type: Hind foot, 50 mm.; condylo-basal length, 55.5; zygomatic width, 28; width of brain case, 20; maxillary tooth row, 21. Usual measurements of adults: Head and body, 225–240; tail, 160–175; hind foot, 47–51; condylo-basal length, 54–57; zygomatic width, 27–28; width of brain case, 20–21; maxillary tooth row, 21–22. For individual measurements see table, page 146.

Remarks.—The brighter colors of this subspecies, and especially the grayish area on either side of the dorsal stripe, are well-marked characters for *T. t. utara*. The most characteristically marked specimens are from Mount Dulit. A single specimen from Mount Mulu, 1,000 feet, British Museum, Reg. No. 94.6.2.1, is larger than the Mount Dulit specimens, is generally "redder," with narrower and grayer areas on either side of dorsal stripe, has a more anterior extension of hazel color of the sides over the shoulder stripe, the dorsal stripe rather reddish and less black on the lower back. If these characters should prove to be constant in Mount Mulu specimens, they would of course represent another race of *Tana tana*. The specimens from British North Borneo are provisionally referred to the present race. The material representing them is poor. Three skins from there in the United States National Museum have been so altered in color by pickling fluid that they are of no systematic value whatever. The reddish elements of the pelage have everywhere been turned to brown, and if one were unaware of their altered condition they would appear to be the most distinct of any of the forms in the genus except *Tana dorsalis*.

Specimens examined.—Fifteen from the Baram district and nine from elsewhere in northern Borneo. See table, page 146.

TANA TANA SIRHASSENENSIS (Miller).

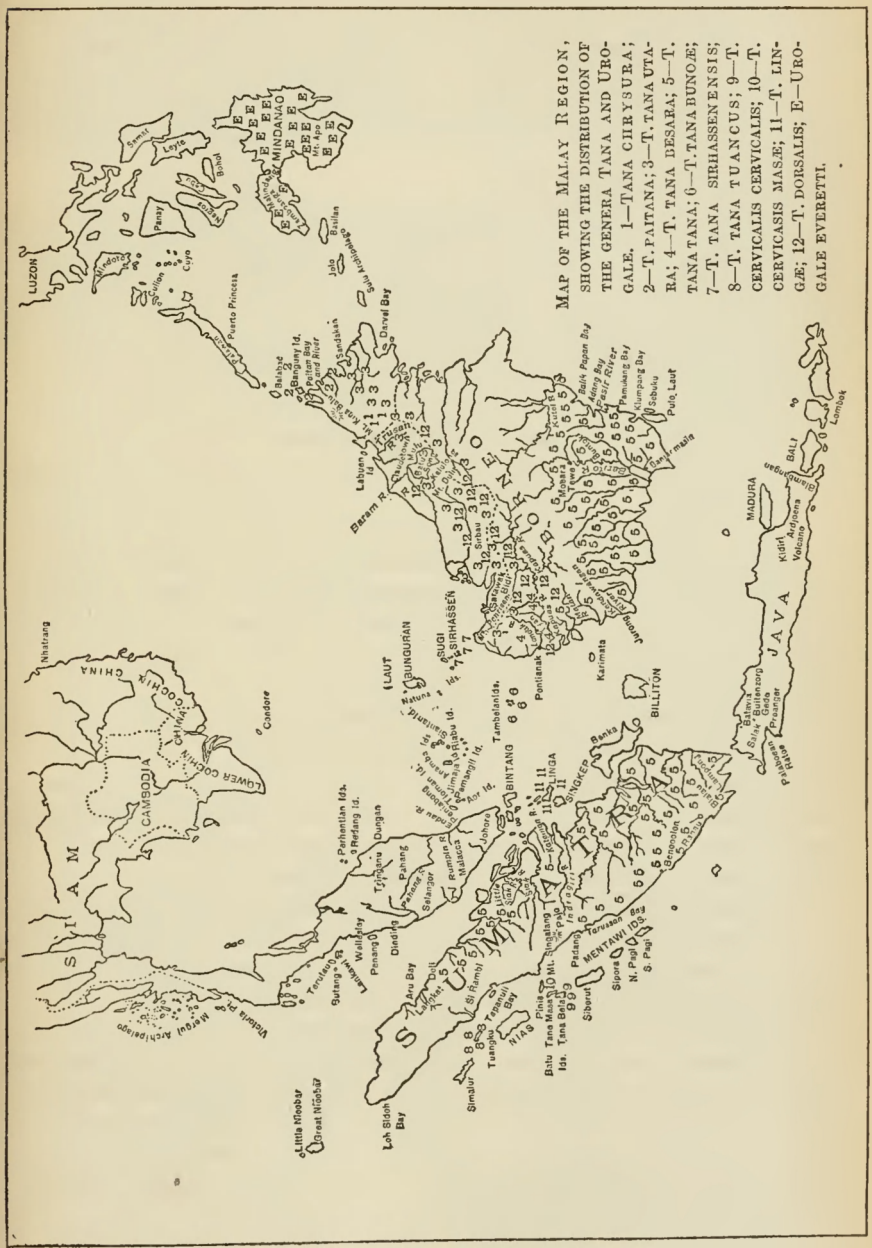
1901. *Tupaia sirhassenensis* MILLER, Proc. Wash. Acad. Sci., vol. 3, p. 133, March 26, 1901.

Type-locality.—Sirhassen, Natuna Islands.

Type-specimen.—In United States National Museum, Cat. No. 104712, skin and skull of adult male, collected on Sirhassen, Natuna Islands, June 5, 1900, by Dr. W. L. Abbott; original number, 442.

Geographic distribution.—Sirhassen Island. See No. 7 on map on page 143.

Diagnosis.—Slightly smaller than either *Tana tana tana* or *T. t. utara* and rather intermediate in color between the two but more like the form from northern Borneo, having the same bright color of the sides, shoulders, and tail, but the upper parts in the region of the dorsal stripe duller and approaching the condition found in *T. t. tana;* in some specimens, including the type, the head, and the light areas on either side of dorsal stripe being quite as dark and


LUZON
MINDANAO
Mt. Apo
Panay
Leyte
Bohol
Basilan
Jolo
Davao Bay
Puerto Princesa
Balabac
Balabac Str.
Palawan
Busuanga Id.
Culion
Coron Bay
Calamian Gr.
Cuyo
Sibutu
Tawitawi
Sulu Sea
Sandakan
Labuan Id.
Brunei
Baram R.
Tanjong Kidurong
Miri
Seria
Belait R.
Balik Papan Bay
Kutei R.
Kutei
Tanjong Mangkalihat
Tanjong Batu
Tanjong Redeb
Berau R.
Tarakan Id.
Sebuku
Pulo Laut
Pulo Sambilangan
Pulo Sebittik
Pulo Tarakan
Pulo Nanukan
Pulo Sibuko
Pulo Sebatik
Pulo Bunju
Pulo Bukat
Pulo Sebangkat
Pulo Sebaung
Pulo Sebetul
Pulo Sebaung Besar
Pulo Sebaung Kechil
Pulo Sebaung Tengah
Pulo Sebaung Utara
Pulo Sebaung Selatan
Pulo Sebaung Timur
Pulo Sebaung Barat
Pulo Sebaung Kechil Timur
Pulo Sebaung Kechil Barat
Pulo Sebaung Kechil Utara
Pulo Sebaung Kechil Selatan
Pulo Sebaung Kechil Tengah
Pulo Sebaung Kechil Timur Laut
Pulo Sebaung Kechil Barat Laut

dull as in the south Bornean race, and in some of the others nearly as bright and light as in the north Bornean race. (Plate 11, fig. 3.)

Measurements.—Type: Head and body, 203 mm.; tail, 152; hind foot, 47; condylo-basal length, 51.5; zygomatic width, 25; width of brain case, 19.5; maxillary tooth row, 20. Maximum and minimum measurements of four adult specimens: Head and body, 203–203 mm.;[1] tail, 152–162;[1] hind foot, 45–47; condylo-basal length, 51.5–53; zygomatic width, 25–26; width of brain case, 19–19.5; maxillary tooth row, 19–20.5. See table, page 149.

Remarks.—Tana tana sirhassenensis is a fairly well-marked form of long-nosed treeshrew, but hardly distinct enough to warrant specific separation. In color it closely resembles the north Bornean race and its maximum measurements easily extend into the range of the mainland forms. In 1894 Thomas and Hartert[2] considered it identical with that form under the name *Tupaia tana.*

Specimens examined.—Eight, all from Sirhassen Island.

TANA TANA BUNOÆ (Miller.)

1900. *Tupaia bunoæ* MILLER, Proc. Wash. Acad. Sci., vol. 2, p. 229, August 20, 1900.

1904. [*Tupaia*] *bunoai* (sic) TROUESSART, Cat. Mam. Suppl., 1904, p. 123.

Type-locality.—Pulo Bunoa, Tambelan Islands, South China Sea.

Type-specimen.—In United States National Museum, Cat. No. 101640, skin and skull of adult female collected on Pulo Bunoa, Tambelan Islands, August 5, 1899, by Dr. W. L. Abbott, in good condition.

Geographic distribution.—The Tambelan Islands, Pulos Bunoa, and Big Tambelan. See No. 6 on map on page 143.

Diagnosis.—Very much like *Tana tana tana* in general coloration, but sides slightly brighter in color, and under parts lighter and paler, tending more toward ochraceous; tail very distinctly shorter, hind foot shorter and skull slightly smaller. (Plate 11. fig. 5.)

Measurements.—Type: Head and body, 210 mm.; tail, 152; hind foot, 45; condylo-basal length, 53.5; zygomatic width, 26; width of brain case, 20; maxillary tooth row, 19.5. The rest of the specimens do not differ materially from the type. See table, page 149.

Remarks.—The shortness of tail and hind foot of this race would be sufficient to warrant its specific distinction from *Tana tana tana* were it not for *T. t. sirhassenensis*, which bridges the gap between them so far as size is concerned. It differs from *T. t. sirhassenensis* in its duller color of the upper parts, and its very much duller and lighter color of the underparts tending to dull ochraceous or ochraceous buff instead of ochraceous rufous.

Specimens examined.—Four, two from Big Tambelan and two from Bunoa, Tambelan Islands.

[1] These measurements were made by Dr. W. L. Abbott in the flesh in inches, the head and body of all the adults being 8 inches; fractions of an inch were probably disregarded.

[2] Nov. Zool., vol. 1, p. 657, September, 1894.

TANA TANA TUANCUS, new subspecies.

Type-locality.—Pulo Tuangku, Banjak Islands, west of Sumatra.

Type-specimen.—In United States National Museum, Cat. No. 114412, skin and skull of adult male, collected on Pulo Tuangku, Banjak Islands, January 29, 1905, by Dr. W. L. Abbott; original number, 1489; in good condition.

Geographic distribution.—Known only from Pulo Tuangku, but probably occurring on other islands of the Banjak group. See No. 8 on map on page 143.

Diagnosis.—Most like *Tana tana sirhassenensis*, but body colors rather brighter and redder, underparts darker and redder, especially underside of tail; light elements on either side of dorsal stripe, more ochraceous-buff; in *T. t. sirhassenensis*, buff; in *T. t. tana*, cream buff.

Measurements.—Type: Head and body, 215 mm.; tail, 160; hind foot, 46; condylo-basal length, 53; zygomatic width, 26.5; width of braincase, 20.5; maxillary tooth row, 20.5. See table, page 149.

Remarks.—This is a rather well-marked subspecies, easily distinguished by its rich dark colorings, and the ochraceous elements on either side of the dorsal stripe. The specimens on which this form is based were regarded as true *T. tana tana* in 1903.[1]

Specimens examined.—Two, both from Pulo Tuangku.

TANA LINGÆ, new species.

Type-locality.—Linga Island, between Sumatra and Malay Peninsula.

Type-specimen.—In United States National Museum, Cat. No 101597, skin and skull of adult male, collected at 2,000 feet altitude on the peak of Linga Island, July 16, 1899, by Dr. W. L. Abbott; in good condition.

Geographic distribution.—Known only from Linga Island. See No. 11 on map on page 143.

Diagnosis.—Almost identical in color with *Tana tana sirhassenensis*, the only noticeable difference being the greater narrowness and less conspicuousness of the dorsal stripe, but as the only specimen has a small albinistic spot at about the middle of the dorsal stripe, that difference may be more apparent than real. The species is at once distinguished from other members of the genus by its small-size, hind foot 40 mm., condylo-basal length of skull 50.5. In addition to its small size the skull is further distinguished by its slender attenuate rostrum, having a rather abrupt origin from the rest of skull, and by its smaller more rounded bullæ. (Plate 11, fig. 2.)

Measurements.—Type and only known specimen: Head and body, 191 mm.; tail, 133; hind foot, 40; condylo-basal length, 50.5; zygomatic width, 25; width of brain case, 19.5; maxillary tooth row, 19.5.

Remarks.—Owing to the absence of specimens of the genus *Tana* from Sumatra until within the last year, this specimen from Linga

[1] See Miller, Proc. U. S. Nat. Mus., vol. 26, p. 472, February 3, 1903.

has previously been identified [1] with *Tana tana*. While it is clearly related to that species, yet its small size and narrow rostrum serve to distinguish it very clearly. Additional material, however, may show that it grades in with the smaller subspecies of *Tana tana*.

Specimen examined.—One, the type.

Measurements of Tana tana utara and T. t. besara.

Name.	Locality.	Number.	Sex.	Molar teeth worn.	Head and body.	Tail.	Hind foot.	Condylo-basal length.	Zygomatic width.	Width of brain case.	Maxillary tooth row.	Number of mammæ.
					mm	*mm*	*mm*	*mm*	*mm*	*mm*	*mm*	
T tana utara	British North Borneo.	[2]	Female.	Moderately.	.....	.....	42	....	26±	22	20.5	2-2
Do	do	19225	do		.....	.....	42±	([2])	....	....	....	2-2
Do	British North Borneo, Kinabatangan River.	[2]	Male	Moderately.	.....	.....	45	57	28	21.5	21	....
Do	British North Borneo.	34943	.....	Slightly	.....	.....	([3])	56	26.5	20.5	22	....
Do	do	34944	.....	Unworn	.....	.....	([3])	53	25	21	20.5	....
Do	British North Borneo, Suanalamba River.	[2]	.....	Moderately.	.....	.....	([3])	....	....	....	21	....
Do	Sandakan, Northwest Borneo.	78.4.26.2	.....	None	.....	.....	51	....	26.5	20.5	22.5	....
Do	Borneo, Sarawak.	83938	Female.	Slightly	.....	.....	47	58	23.5	....	21	2-2
Do	Mount Dulit, 1,000 feet, North Borneo.	99.12.9.4	Male	Much	.....	.....	48	56	28	21	20.5	....
Do	Mount Dulit, 3,000 feet, North Borneo.	99.12.9.5 [4]	do	Moderately.	.....	.....	50	55.5	28	20	21	....
Do	Mount Dulit, 4,000 feet, North Borneo.	92.2.7.4	do	do	.....	.....	47	54	27	21	20.5	....
Do	Mount Mulu, 1,000 feet, North Borneo.	94.6.2.1	do	Slightly	.....	.....	50	60	29	21	22	....
Do	Mount Penrisen, Borneo.	90.6.25.2	.....	do	.....	.....	51	....	28	21	22	....
Do	Base of Mount Song, Borneo.	92.9.6.30	.....	None [5]	.....	.....	46	....	....	19.5	19	....
Do	Bukit Sebau, Sarawak, Borneo.	5.3.1.4	Male	None [6]	.....	.....	50	47.5	....	20	....	....
Do	Borneo, Mount Dulit.	[7], Geneva.	Female.	None [7]	225±	170±	50±	56.5	26	22	21	2-2
Do	Borneo, Sarawak.	Berlin, 4453.[8]	Male	.....	225	175	53	....	....	....	....	....
Do	do	Berlin, 7283.	.....	([9])	230±	160±	49	....	....	....	....	....
Do	do	Genoa [8]	Female.	Adult	230	175	49	....	....	....	....	2-2
Do	do	do [8]	Male	None [6]	155	140	47	43.5	23	20.5	....	....
Do	do	do [8]	Female.	Adult	240	160	51	....	....	....	....	2-2
Do	do	Genoa 5a	Male	.....	205±	155±	52±	....	....	....	....	....
Do	do	do 5c	do	.....	230±	165±	50±	....	....	....	....	....
Do	do	Genoa 6a	.....	None [6]	170±	155±	45±	44	....	20	....	....
T. tana besara.	Borneo, Kapuas River, Tyan District.	142246	Male	do	190	155	50	47	23.5	20	....	....
Do	Borneo, Kapuas River, opposite Pulo Jambu.	142247 [4]	do	Slightly	229	196	53	59.5	29	21	23	....

[1] Miller, Proc. Wash. Acad. Sci., vol. 2, p. 229, August 20, 1900.
Miller, Proc. U. S. Nat. Mus., vol. 31, p. 271, September 11, 1906.
Lyon, Proc. U. S. Nat. Mus., vol. 36, p. 490, June 1, 1909.
[2] Skin only, no skull.
[3] Skull only, no skin.
[4] Type.
[5] m^3 just appearing.
[6] m^1 last tooth in place.
[7] pm^4 half way through alveolus.
[8] Preserved in alcohol.
[9] Skull in skin.

TANA CERVICALIS (Miller).

(Synonymy, type-specimens, etc., under the subspecies.)

Geographic distribution.—The Batu Islands off the west coast of Sumatra. See Nos. 9 and 10 on map on page 143.

Diagnosis.—The two members of this species differing considerably from each other are distinguished from *Tana tana* by their bright ruddy style of coloration accompanied with a large and well defined brilliant black area on the lower back; mammæ, 2–2=4.

Color.—Sides of body, tail, outer side of legs dark, rich ferruginous, washed or lined with black about base of tail, middle of sides and thighs, the black becoming conspicuous on the lower back where it may form a well defined black patch of moderate area or spread over almost the entire posterior portion of body in a brilliant black pattern, underparts of body including inner side of legs bright cinnamon rufous; underside of tail rich ferruginous, darkening to burnt sienna along the edges; light area on either side of the dorsal stripe varying from a grizzled mixture of blackish and cream-buff to a mixture of blackish and tawny ochraceous; shoulder stripe cream buff to ochraceous.

Skull and teeth.—There are no characters by which the skull and teeth of *Tana cervicalis* may be distinguished from those of related species, nor the different forms from each other.

Measurements.—Head and body, 205–215 mm.; tail, 155–165; hind foot, 43–47; condylo-basal length, 53–54; zygomatic width, 25–26; width of brain case, 19.5–20; maxillary tooth row, 20–21.5.

Subspecies.—Two subspecies of *Tana cervicalis* may be recognized: *T. cervicalis cervicalis*, Tana Bala; *T. cervicalis masæ*, Tana Masa, Batu Islands.

Remarks.—*Tana cervicalis* is not distantly removed from *T. tana*, but is immediately distinguishable by the large, conspicuous brilliant black area of the lower back. This character, however, is only one of degree, for in *T. tana* many examples are seen where a darkened or even black area exists on the lower back, but it is never so intense in color, or so large, extending so far on the sides, or so far anteriorly.

TANA CERVICALIS CERVICALIS (Miller).

1903. *Tupaia cervicalis* MILLER, Smiths. Misc. Coll., vol. 45, p. 59, November 6, 1903.

Type-locality.—Tana Bala, Batu Islands, off west coast of Sumatra.

Type-specimen.—In United States National Museum, Cat. No. 121754, skin and skull of adult male collected on Tana Bala, Batu Islands, February 14, 1903, by Dr. W. L. Abbott; original number, 2294; in good condition.

Geographic distribution.—Tana Bala Island. See No. 9 on map on page 143.

Diagnosis.—Distinguished by the great extent and intensity of the black area of the lower back, extending forward to meet in striking contrast the light area beside the dorsal stripe, and also well down on the sides of body and on base of tail; light areas beside the dorsal stripe very light and conspicuous, a mixture of buff and black, the former in excess; shoulder stripe cream buff. (Plate 11, fig. 7).

Measurements.—Type: Head and body, 210 mm.; tail, 165; hind foot, 47; condylo-basal length, 54.5; zygomatic width, 25; width of braincase, 20; maxillary tooth row, 21.5. For measurements of a second specimen see table, page 149.

Remarks.—*Tana cervicalis cervicalis* is a very well marked form, and conspicuous animal. The rich ferruginous tones of the sides and tail, the brilliant black of the lower back, and the light areas of the neck and bordering the dorsal stripe, make *T. cervicalis cervicalis* the handsomest animal in the family Tupaiidæ.

Specimens examined.—Two, both from Tana Bala.

TANA CERVICALIS MASÆ, new subspecies,

Type-locality.—Tana Masa, Batu Islands, west of Sumatra.

Type-specimen.—In United States National Museum, Cat. No. 121835, skin and skull of adult female, collected on Tana Masa, Batu Islands, February 18, 1903, by Dr. W. L. Abbott; original number, 2302; in good condition.

Geographic distribution.—Tana Masa Island. See No. 10 on map on page 143.

Diagnosis.—A member of the species *Tana cervicalis*, characterized by having the light areas on either side of the dorsal stripe tawny ochraceous slightly mixed with blackish, the black area of the back not quite so well developed, nor extending so far forward, and the reddish colors of maximum intensity, head relatively dark.

Remarks.—This race appears to be a well-defined one and quite different in appearance from *Tana cervicalis cervicalis* on the nearby island of Tana Bala so far as the anterior portions of the body are concerned, but the posterior halves of the two animals are essentially alike except that *T. c. masæ* has the darker coloration of the two. Anteriorly *T. c. masæ* more closely resembles the form from the Banjak Islands. This form was identified by me in 1908 as identical with the Tana Bala form.[1]

Specimens examined.—Two, both from Tana Masa.

[1] Ann. Mag. Nat. Hist., ser. 8, vol. 1, p. 138, February, 1908.

Measurements of insular forms of the genus Tana.

Name.	Locality.	Number.	Sex.	Molar teeth worn.	Head and body.	Tail.	Hind foot.	Condylo-basal length.	Zygomatic width.	Width of brain case.	Maxillary tooth row.	Number of mammæ.
					mm	*mm*	*mm*	*mm*	*mm*	*mm*	*mm*	
T. cervicalis cervicalis.	Batu Islands, Tana Bala.	121753	Female.		215	150	46	....	....	....	....	2–2
Do	do	121754 [1]	Male	Slightly	210	165	47	54.5	25	20	21.5	....
T. cervicalis masæ.	Batu Islands, Tana Masa.	121835 [1]	Female.	Much	216	154	46	54	26	19.5	20	2–2
Do	do	7.6.18.6	do	Moderately	.....	.....	47	54	26	20	21	2–2
T. lingæ	Linga Island	101597 [1]	Male	do	191	133	40	50.5	25	19.5	19.5	....
T. tana bunoæ.	Tambelan Islands, Bunoa.	101640 [1]	Female.	Slightly	210	152	45	53.5	26	20	19.5	2–2
Do	do	101641	Male	Moderately	203	152	43	53	26.5	20	20	....
Do	Tambelan Islands, Big Tambelan.	101653	Female.	Slightly	184	.....	44	....	25±	19.5	19.5	....
Do	do	101654	Male	Moderately	178	152	43	51	25	19.5	19	....
T. tana tuancus.	Banjak Islands, Tuanku.	114412 [1]	do	Slightly	215	160	46	53	26.5	20.5	20.5	....
Do	do	114413	Female.	Much	205	160	43	53.5	26	21	20.5	2–2
T. tana sirhassenis.	Natuna Islands, Sirhassen.	104709	Male	None [2]	178	146	45	47	23	20	19.5	....
Do	do	104710	do	Slightly	203	162	47	51.5	25	19.5	20	....
Do	do	104711	Female.	do	203	158	46	53	26	19	20.5	2–2
Do	do	104712 [1]	Male	do	203	152	47	51.5	25	19.5	20	....
Do	do	104713	Female.	Moderately	203	162	45	52.5	25.5	19	20	2–2
Do	do	94.9.28.5	.....	None [3]	.....	.....	45	....	....	19	19	....
Do	do	94.9.28.4	Female.	Moderately	.....	.....	45	....	25	19	20	2–2
Do	do	Paris 15 B	.....	.....	220±	140±	46	....	....	....	....	....

[1] Type. [2] *m* [2] just through alveolus. [3] *m* [3] just appearing.

TANA CHRYSURA (Günther).

1876. *Tupaia tana* var. *chrysura* GÜNTHER, Proc. Zool. Soc. London, 1876, p. 427; pl. 36, entire animal in colors, fairly good.

Type-locality.—Mainland of Borneo, opposite the island of Labuan.

Type-specimen.—In British Museum, Reg. No. 76.5.2.19, collected by Mr. Hugh Low on Borneo, opposite the island of Labuan; in good condition except that occipital region of skull has been cut away.

Geographic distribution.—Known only from the region of the type-locality. See No. 1 on map on page 143.

Diagnosis.—Color pattern generally similar to that of *Tana tana*, but tail instead of being concolor with body is uniformly buffy, and very different in color from rest of animal. Mammæ unknown.

Color.—Much like the color of *Tana tana*, but the gray of the head, neck, shoulders, and area bordering the dorsal stripe more pronounced and clear; general body color, including outer side of legs, less reddish than in *T. tana*, of a color between mars and mummy brown, inclining to blackish on the lower back; underparts, including inner side of legs, dull orange rufous; entire tail, above and below, buff, tinged with clay color in places; shoulder stripe, whitish.

Skull and teeth.—They do not differ materially from those of *Tana tana;* the rostrum is, perhaps, a little wider in *T. chrysura* than in species commonly seen on Borneo.

Measurements.—Type: Head and body (from dried skin), 240± mm; tail (from dried skin), 160±; hind foot, 52; zygomatic width, 29; width of brain case, 21.5; maxillary tooth row, 22. For individual measurements see table, page 151.

Remarks.—*Tana chrysura* is a well-marked form. Its buff-colored tail serves at once to distinguish it from other members of the genus. In addition to the difference in color of the tail, it also differs in its general color from *T. tana.* This to my mind shows it to be no mere color phase of *T. tana,* but a perfectly distinct species. This view is further advanced by the fact that *Tana chrysura* has not yet been secured in Borneo other than in the vicinity of the type-locality, and that no specimens of *T. tana* have been taken at the type-locality of *T. chrysura.* Its analogy with *Tupaia demissa,* page 58, is interesting.

Specimen examined.—Seven, all from the vicinity of the type-locality.

TANA PAITANA, new species.

Type-locality.—Paitan River, northeastern Borneo.

Type-specimen.—In British Museum, Reg. No. 93.4.1.1, skin and skull of adult, collected along the Paitan River, northeastern Borneo, July, 1892, by A. Everett; in good condition, but skull somewhat damaged posteriorly.

Geographic distribution.—Known only with certainty from the type-locality, but represented on Banguey Island by the same or a closely allied form. See No. 2 on map on page 143.

Diagnosis.—Differs conspicuously from *Tana tana* in the greater development of yellowish gray light areas on either side of the dorsal line so as to embrace the area of the shoulder stripe, instead of having it embraced by the reddish brown color of the sides. Mammæ unknown.

Color.—Much brighter and "redder" than is *Tana tana* on the sides, legs, and lower back; the lower back without any evident black patch and nearly as clear ferruginous as are the sides; the light areas on anterior half of back more extensive and lighter than in any other form, with the general effect of a yellowish gray instead of the rather clear gray seen in *Tana tana utara,* the light shoulder stripe being entirely surrounded by this yellow gray area, and not bordered above and below by a forward extension of the ferruginous color of the sides, underparts not essentially different from those of *Tana tana.*

Skull and teeth.—These show no special distinguishing features and are apparently indistinguishable from those of *Tana tana.*

Measurements.—Type: Head and body (dried skin), 260 mm.; tail (dried skin), 160; hindfoot, 50; zygomatic width, 28; width of brain case, 21; maxillary tooth row 22.

Remarks.—*Tana paitana* appears to be a very distinct species, nearly as much so as *T. chrysura,* the surrounding of the shoulder stripe by the grayish of the anterior back being a feature unknown in other species; the distinct ferruginous instead of blackish color of the lower back is also distinctive. It appears to be more nearly related to *Tana chrysura* than to *T. tana* as far as its general coloration is concerned, excepting of course the tail. *T. chrysura* has rather large grayish areas on the anterior back, but they do not embrace the shoulder stripe. The specimen from Banguey Island is provisionally referred to *T. paitana.* The specimen is immature, and it does not appear advisable to found a new name on its smaller size and more blackish lower back.

Specimens examined.—Two, the type, and one from Banguey Island, off northeastern Borneo.

Measurements of Tana chrysura and paitana.

Name.	Locality.	Number.	Sex.	Molar teeth worn.	Head and body.	Tail.	Hind foot.	Condylo-basal length.	Zygomatic width.	Width of brain case.	Maxillary tooth row.	Number of mammæ.
					mm	*mm*	*mm*	*mm*	*mm*	*mm*	*mm*	
T chrysura	Borneo, Lumbidan [1].	63023 [2]	.....	Moderately.	.....	.....	50±	54	26	20.5	20.5	....
Do.....	Borneo, opposite Labuan.	76.5.2.19 [3]	Male .	.....do.....	240±	160±	52	....	29	21.5	22	....
Do.....	Borneo, Lumbidan [1].	93.4.1.2	.....	Much	255±	155±	49	56	29	20	21	....
Do.....	.....do.....	94.7.2.6	.....	None [4].....	220±	160±	48	....	....	18.5	....	....
Do.....	Borneo, opposite Labuan.	76.5.2.20 ...	.....	.....do. [5]....	.....	.....	47	....	23.5	20.5	21	....
Do.....	Borneo, Lumbidan [1].	94.7.2.54 [6]..	Male .	.....	230	185	52	....	....	....	....	....
Do.....	.....do	Paris, 2229.	.....	Slightly	250±	160±	51±	....	....	20.5	21.5	....
T. paitana .	Borneo, Paitan River	93.4.1.1 [3] ...	.....	Moderately.	260±	160±	50	....	28	21	22	....
Do.....	Banguey Island, Borneo.	94.7.2.8	Male .	None [7]	230±	140±	45	....	....	20	21	....

[1] Lumbidan directly opposite Labuan. See Everett, Journ. Straits Branch Royal Aslat. Soc., vol. 20, 1889, p. 93.
[2] Has two small supernumerary *pm*s on left side.
[3] Type.
[4] m^1 last tooth in place.
[5] m^2 last in place.
[6] Preserved in alcohol.
[7] Deciduous incisors still in place.

TANA DORSALIS (Schlegel).

1857. *Tupaja dorsalis* SCHLEGEL, Handl. Beoef. Dierk., p. 59, pl. 3, fig. 31, two-fifths nat. size, in black and white, 1857.

1890. *Typaia dorsalis*, JENTINK, Notes Leyden Museum, vol. 12, p. 228, 1890.

Type-locality.—Lower Kapuas River, western Borneo.[1]

Type-specimens.—Cotypes in Leyden Museum,[2] mounted skins "*b*" and "*g*," under *Tupaja tana* of Jentink's Catalogues, of which they are there considered young examples, and skull "*f*" under *T. tana*. Skin "*g*" was collected by M. Schwaner in Borneo, along the Kapuas River. I have not seen these cotypes.

Geographic distribution.—Known from western and northern Borneo, but probably occurring elsewhere in the island. See No. 12 on map on page 143.

Diagnosis.—A very well-marked species of the genus *Tana* characterized by its small size, short claws, narrow dorsal stripe extending from nape almost to base of tail. Mammæ 2–2=4.

Color.—Upper parts and sides of anterior parts of body, with the general effect of olive, produced by a fine grizzling of blackish and buffy, upper parts and sides of posterior parts of body, with the general effect of burnt umber, produced by a fine grizzling of blackish and tawny. The line of demarcation between the two colors is not sharp, but they gradually blend one with the other; the olive color in most specimens occupies more than the anterior half of body, but in some the olive and burnt umber are about equally divided. Extending through the middle of both colors from the nape almost to the root of tail is the narrow (2–3 mm.) black dorsal line, slightly wider at the middle than at the ends. Top and sides of head, intermediate in color between the olive of the anterior parts of body and the burnt umber wash of the posterior parts. Outer side of hind legs similar to adjacent parts of body; outer side of fore legs intermediate in color between the head and the anterior parts of body. Tail above the same color as the lower back, at base, becoming dark brownish toward the end; underside of tail similar to the color above for the outer half of hairs, russet for the inner half of hairs; underparts, including innerside of legs, dull buffy to ochraceous buff, clearest in the region of the throat, elsewhere obscured by the slaty bases of the hairs showing through; shoulder stripe fairly conspicuous, cream buff or buff. (Plate 6, fig. 2.)

Skull and teeth.—The skull of *Tana dorsalis* is mainly distinguished by its smaller size, but the rostrum is relatively less slender and attenuate. The difference in size between *Tana dorsalis* and the smallest member of the *tana* group, *T. lingæ*, is not greater than

[1] See Jentink, Notes Leyden Museum, vol. 12, 1890, p. 228, and also Cat. Syst. Mamm. Mus. Hist. Nat. Pays-Bas, vol. 12, 1888, p. 116.

[2] See Jentink, Notes Leyden Museum, vol. 12, 1890, p. 228, and also Cat. Ost. Mamm. Mus. Hist. Nat. Pays-Bas, vol. 9, 1887, p. 240.

between the largest, *T. tana besara*, and the smallest members of the *tana* group. The first and second upper molars of *T. dorsalis* are more quadrate in outline than they are in the *tana* group and have relatively better developed hypocones; the last upper molar is relatively larger and with a better developed metacone, and the hypocone of pm^3 is better developed, resembling that of pm^2 on a small scale. (Plate 11, fig. 1.)

Measurements.—Usual measurements of adults: Head and body, 175–200 mm.; tail, 140–150; hindfoot, 42–45; condylo-basal length, 45–46.5; zygomatic width, 22–24; width of brain case, 18–19; maxillary toothrow, 17–18. See table below.

Remarks.—*Tana dorsalis* is one of the best marked forms in the subfamily Tupaiinæ, and needs no comparison with any other species. It is so different from the members of the *tana* group in the genus *Tana* that it might almost be made the type of a distinct subgenus, mainly on the basis of the small size of the claws, as well as upon the tooth differences, but the latter are relatively slight. Nothing appears to be published regarding its habits, but judged by the structure of its feet, it probably leads a rather different life than does the *tana* group.

Its association with the long-snouted treeshrews was pointed out by Jentink in 1890.[1]

Specimens examined.—Fifteen, from various localities in western and northern Borneo.

Measurements of Tana dorsalis.

Locality.	Number.	Sex.	Molar teeth worn.	Head and body.	Tail.	Hind foot.	Condylo-basal length.	Zygomatic width.	Width of brain case.	Maxillary tooth row.	Number of mammæ.
BORNEO.				*mm*	*mm*	*mm*	*mm*	*mm*	*mm*	*mm*	
Sarawak, Baram	83939	Female	None	.....	.....	45±	....	22±	18	18	2–2
Sarawak, Mount Dulit	84505	Male	.....do.[2]	.....	.....	43	45	22.5	19	18.5	....
Kapuas River, Pulo Saparo	142245	Female	Slightly	175	145	42	45±	23	18.5	17	2–2
Trusan, opposite Labuan	87.7.14.1	Male	.....do	.....	.....	45	....	23.5	18.5	17.5	....
Mount Penrisen, Sarawak	90.6.25.3	Female	[3]	185±	140±	44	....	....	....	....	2–2
Do	90.6.25.4	.....	[3]	180±	145±	43	....	....	....	....	....
Balingean	5.3.1.6	Male	None [4]	190±	145±	45	45.5	....	19.5	....	....
Mount Dulit, 1,000 feet	99.12.9.10	Female	.....do.[5]	.....	.....	40	45±	20.5	18	17.5	2–2
Baram, Apoh	92.2.8.2	...do	Moderately	.....	.....	40	....	....	....	18	2–2
Mount Batu Song, 4,000 feet	92.11.8.2	...do	Much	.....	.....	41	....	....	....	17	....
Mount Mulu, 1,000 feet	94.5.2.4	Male	Slightly	.....	.....	44	46.5	23	18.5	18	....
Mount Dulit, 3,000 feet	Genoa	...do	[3]	220±	150±	44	....	....	....	....	....
Baram River, Sarawak	Berlin	Female	[3]	210±	150±	40	....	....	....	....	2–2
Baram, Sarawak	Paris, 901	.....	.....	200±	155±	44	46	24	19	....	....
Mount Kaulong, Sarawak	Paris, 286	.....	.....	195±	150±	43	....	....	....	....	....

[1] Notes Leyden Museum, vol. 12, 1890, p. 228.
[2] dpm^4 still in place.
[3] Skulls in the skins.
[4] di^1 and di^2 still in place.
[5] m^3 halfway through.

Genus UROGALE Mearns.

1905. *Urogale* MEARNS, Proc. U. S. Nat. Mus., vol. 28, p. 435, May 13, 1905.

Type.—*Urogale cylindrura* Mearns = *U. everetti* (Thomas).

Diagnostic characters.—A large member of the family Tupaiidæ, easily distinguished externally by its elongated snout and close-haired rounded tail, and cranially by its long rostrum, small zygomatic fenestra, and dentally by the large size and canine-like appearance of i^2 and the small rudimentary condition of i_3.

External characters.—*Urogale*, externally, is like the genus *Tana*, with the exception that the tail is not bushy or distichous, but rather close haired. The tail has the same relative length to the head and body that it has in *Tana*, but because of the shorter hairs appears much smaller. The naked area on the nose, the ear, the shoulder stripe, and the arrangement of footpads show no differences in the genera *Tana* and *Urogale*. The claws, especially those of the fore feet, are particularly long and sharp like those of *Tana tana*. The color pattern does not show a dorsal stripe. The mammæ are 2–2 = 4. (Plate 6, fig. 3.)

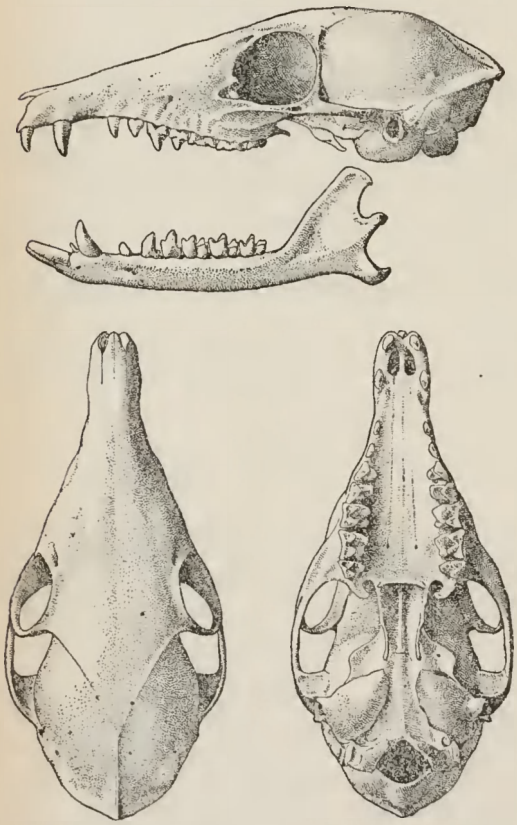


FIG. 12.—UROGALE EVERETTI; TYPE × 1; REG. NO. 79.5.3.11, BRITISH MUSEUM, ZAMBOANGA, MINDANAO, PHILIPPINE ISLANDS.

Cranial characters.—The skull of *Urogale* is built on the same general plan as that of *Tana*, but differs in many important features. The skull of *Urogale* on the whole is heavier and more angular, although it is scarcely larger than that of *Tana;* the rostrum is relatively heavier, has a more abrupt origin from the skull, and is enlarged just back of the extremity to accommodate the canine-like incisors; the temporal ridges are more prominent, but shorter, so that they

meet at a more anterior point, forming a sagittal crest or ridge quite as long as each temporal ridge. In *Tana* the sagittal ridge is much lower and only about a third or a fourth the length of the less conspicuous temporal ridges. The surface for the attachment of the temporal muscles is thus much greater in *Urogale* than in *Tana* or *Tupaia*. The coronoid process of the mandible is correspondingly increased in size. In *Urogale* the lambdoid region of the skull projects further posteriorly than in *Tana* or *Tupaia*, and when viewed from behind, the two ridges make a more acute angle than they do in the the other genera. The fenestra in the zygoma of *Urogale* is reduced to an almost invisible slit. A rather conspicuous grooved surface is found on the underside of the maxillary zygomatic root. In *Tana* this surface is much smaller and less conspicuous. The zygomata are more spreading in *Urogale* than in *Tana* or *Tupaia*. The bony palate is more ossified in *Urogale* and without the vacuities more often seen than not in *Tana* and *Tupaia;* the interpterygoid space is slightly narrower; the external plate larger and plate-like instead of forming a short wide hook, as in *Tana*. The greatest width of the brain case is about the same in *Urogale* and the large species group of *Tana*, but it rapidly narrows anteriorly, so that the postorbital constriction is distinctly less than the preorbital; in *Tana* the reverse condition holds. The orbit is relatively and absolutely slightly smaller in *Urogale* than in *Tana*. When the skulls of the two genera are looked at from above, the posterior bar of the orbit divides the space between the zygoma and the rest of the skull into two approximately equal parts, one anterior and one posterior, in *Urogale;* in *Tana* the anterior portion is distinctly the larger of the two. The mandible of *Urogale* is distinctly heavier and more massive than that of *Tana* or *Tupaia* and the ascending ramus larger and more upright, especially seen in the coronoid and angular processes; the condyle is also somewhat larger. See figure 12, page 154. (Plate 11, fig. 6.)

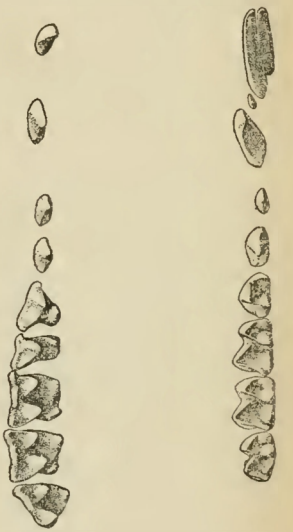


FIG. 13.—UPPER AND LOWER TOOTH-ROWS OF UROGALE EVERETTI; TYPE, × 2; REG. NO. 79.5.3.11, BRITISH MUSEUM, ZAMBOANGA, MINDANAO, PHILIPPINE ISLANDS.

Dental characters.—*Urogale* differs more in respect to its teeth from the other members of the subfamily Tupaiinæ than in respect to its skull. The second pair of upper incisors are enormously developed and are rather canine-like in form, but straighter than the ordinary canine tooth, so that instead of having a backward curving fang the axis

of this large tooth is so placed that the straight fang is directed downward and backward. The canine tooth itself is slightly better developed than it is in *Tana* or *Tupaia*, but owing to the great size of the incisor just in front it is scarcely noticed. In the mandible the first two incisors are essentially as they are in *Tana* or *Tupaia*, but the third lower incisor is very small, functionless, and sometimes deciduous. The lower canine is well developed, to match with the canine-like second upper incisor. While the lower canine and the second upper incisor undoubtedly perform the functions of upper and lower canines, yet it is interesting to notice that the positions of the two teeth are reversed, the lower canine being placed posterior to the tooth that functions as the upper canine, whereas in the case of true canines the lower tooth cuts in front of the upper tooth.

The upper and lower series of premolars in *Urogale* are essentially as they are in *Tupaia* or *Tana*, but both of the last premolars are relatively better developed in *Urogale* and apparently of better service to the animal. This is particularly well shown in the protocone of pm^4, which is quite large and has nearly the same relative degree of development as is found in that tooth in *Anathana*. The lower molar series of *Urogale* and *Tupaia* are indistinguishable. The upper series are nearly alike in the two genera, but the hypocones of m^1 and m^2 are much better developed in *Urogale* than they are in *Tupaia* or *Tana*, being nearly as large as in *Anathana*. (See figure 13, page 155.)

Geographic distribution.—So far as known *Urogale* occurs on only one island, Mindanao, of the Philippines. See E on map on page 143.

Number of forms.—*Urogale* contains but a single species, *U. everetti*.

Remarks.—*Urogale*, while clearly belonging to the subfamily with *Tupaia*, *Tana*, *Anathana*, and *Dendrogale*, is more different from them than any of them differs among themselves. With which one it has the closest affinity it is hardly possible to say. In most respects it has many points of real resemblance to the genus *Tana* and in some ways may be looked upon as the *Tana* type carried to an extreme. My own view is that both have been derived from some common ancestor different from *Tupaia*, and that owing to its isolation and smallness of the land area on which it is found, *Urogale* went farther than did *Tana*. The habits and food of *Urogale* probably differ considerably from those of the rest of the subfamily. From the development of its teeth, elongated rostrum, generally heavy build, one would suppose it to be a more predatory and carnivorous animal than any other member of the subfamily.

The two specimens collected by Dr. E. A. Mearns on Mount Apo were snared in trees by natives, and the one from Mount Malindang was shot on a tree stump. It had been observed several days before, and in its actions resembled a chipmunk.

UROGALE EVERETTI (Thomas).

1892. *Tupaia everetti* THOMAS, Ann. Mag. Nat. Hist., ser. 6, vol. 9, p. 250, March, 1892.

1905. *Urogale cylindrura* MEARNS, Proc. U. S. Nat. Mus., vol. 28, p. 435, May 13, 1905. (Type-specimen, in United States National Museum, Cat. No. 125287, collected by Doctor E. A. Mearns at 4,000 feet on Mount Apo, Mindanao, July 12, 1904; original number, 5727; skin and skull in good condition.)

Type-locality.—Zamboanga, Mindanao, Philippine Islands.

Type-specimen.—In British Museum, Reg. No. 79.5.3.11, adult male, collected at Zamboanga, Mindanao, Philippine Islands. The original entry in the Register says "in spirit," but the specimen has for some time been made into a modern study skin in good condition. Aside from some cracks about braincase, the skull is in good condition. With the principal exception of the pelvis, most of the skeleton exists.

Geographic distribution.—Mindanao, Philippine Islands. Specimens from Mount Apo, Zamboanga, and Mount Malindang. See E, on map on page 143.

Diagnosis.—As for the genus above.

Color.—General effect of upper parts of head, neck, body, and tail and outer side of legs a color between mummy and seal brown, produced by a fine grizzling of blackish and tawny, the blackish brown in excess, about nose and sides of head, the tawny color replaced by raw sienna and more of it; feet similar to legs but darker, and with almost none of the lighter color; underparts, including inner side of legs, varying from ochraceous to ochraceous rufous brightest in region of the chest, the slaty bases of the hairs showing through in places to a considerable extent; underside of tail similar to upperside, but the light and dark color elements about equally mixed; shoulder stripe rather poorly defined, ochraceous. The type-specimen is dull and rusty in comparison with the modern skins, the difference probably being due to its original preservation in alcohol; its underparts are dull brown and tail quite rusty.

Skull and teeth.—Skull large and angular, with relatively heavy rostrum rising abruptly from rest of skull, enlarged just back of extremity to accommodate roots of the large second pair of incisors; temporal ridges short but prominent, sagittal crest rather long and high; fenestra in zygoma reduced to a minute slit; bony palate well ossified, usually without vacuities; postorbital constriction less than preorbital constriction. Second pair of upper incisors enormously developed, functioning as canines, third lower incisors, small, functionless and sometimes deciduous; last upper and lower premolars well developed, especially protocones on upper tooth; lower canine conspicuously developed. (See fig. 12, p. 154; fig. 13, p. 155; also plate 11, fig. 6.)

Measurements.—Type of *U. everetti* and of *U. cylindrura:* Head and body, 235 mm. (dried skin), 182; tail, 170 (dried skin), 163; hind-

foot, 51, 50; condylobasal length, 58, 58.5; zygomatic width, 29, 29; width of braincase, 21, 20.5; maxillary toothrow, 22, 21. For individual measurements see table below.

Remarks.—There can be but little doubt that *Urogale cylindrura* is perfectly synonymous with *U. everetti*. The relatively slight difference in color between the type of *U. everetti* and the Mount Apo specimens is due only to the fact that the former is an old specimen skinned out of alcohol,[1] while the latter are modern freshly prepared skins. There is almost as much difference between members of the Apo series as there is between the type of *U. everetti* and the Apo series as a whole. The skull and teeth of Zamboanga specimen are essentially like those from Mount Apo. The Mount Malindang specimen is represented by a skin brought back by Doctor Mearns in 1906. The information on the label reads: "Malindang Mts., summit of Mt. Bliss, 5,750 ft., June 3, 1906. Shot on trunk of an oak tree by Private D. W. West, Co. B, 19th Infantry, U. S. A." It has every appearance of having been preserved in alcohol or formalin at some time. Apparently the skull was not saved. A hind foot and tibia removed from the skin show it to be a young individual. It has the general color characters of *Urogale everetti* combined with the long sharp claws and *Tana*-like style of nose. The entire pelage, however, including that of the tail, is much longer and softer than it is in Mount Apo specimens. It is barely possible that it represents an entirely distinct species of *Urogale* or even another genus.

Specimens examined.—Nine. Seven from Mount Apo, one from Zamboanga, and one from Mount Malindang, the last doubtfully referable to the genus and species.

Measurements of Urogale everetti.

Locality.	Number.	Sex.	Molar teeth worn.	Head and body.	Tail.	Hind foot.	Condylobasal length.	Zygomatic width.	Width of brain case.	Maxillary tooth row.	Number of mammæ.
MINDANAO.				*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	
Mount Apo, 4,000 feet	125287 [2]	Male	Moderately	182	163	50	58.5	29	20.5	21	....
Do	125288	do	do	185	155	49	56.5	29	20	21	....
Mount Apo, 3,000 feet	7.2.2.1	do	Slightly	214	165	51	58	29	21	21.5	....
Do	7.2.2.2	do	do	197	148	49	58	30	21.5	21.5	....
Mount Apo, 4,000 feet	7.2.2.3	Female	None [3]	165	142	48	49.5	.....	20	20	....
Mount Apo, 3,000 feet	7.2.2.4	do	Slightly	202	150	48	55	27.5	20	20.5	2-2
Do	7.2.2.5	do	Moderately	200	147	49	58	29	21	21	2-2
Zamboanga	79.5.3.11 [4]	Male	do	235±	170±	51	58	29	21	22	....
Mount Malindang	144825	.....	.....	170±	115±	44	.....	.....	.....	.....	.....

[1] See Thomas, Proc. Zool. Soc. London, 1907, p. 149.
[2] Type of *Urogale cylindrura* Mearns.
[3] m^3 just appearing.
[4] Type.

Genus PTILOCERCUS Gray.

1848. *Ptilocercus* GRAY, Proc. Zool. Soc. London, 1848, p. 23.
1864. *Ptilocerus*, BREHM, Ill. Thierl., vol. 1, pp. 663-665. A misspelling of *Ptilocercus*.
1876. *Ptilocerus*, WALLACE, Geographical Distribution of Animals, vol. 1, p. 337. A misspelling of *Ptilocercus*.

Type.—Ptilocercus lowii Gray,[1] the only species included in the genus.

Diagnosis.—An aberrant member of the family Tupaiidæ, forming the subfamily Ptilocercinæ, distinguished externally by its large thin ears, naked tail basally, distichously tufted distally, cranially by absence of supraorbital foramen, and approximately parallel temporal ridges; dentally by the relatively larger size of the first upper incisors over the second pair, double-rooted upper canine, without conspicuous diastema between second upper incisor and upper canine, and absence of mesostyles on upper molars.

External characters.—Ptilocercus differs very strikingly from any other members of the family Tupaiidæ in the form of its tail, which is naked and scaly for about its proximal half or a little more, and distichously tufted for a trifle less than the distal half. The extreme basal eighth of the tail is covered with soft furry hair like the adjacent parts of the body. Each scale of the naked portion of the tail is subtended by three short hairs about equal to a scale and a quarter or a scale and a half in length. The hands and feet of *Ptilocercus* are relatively larger than in the other genera of the family, and the footpads relatively larger, with an appearance of greater softness. The fifth finger is as large as the second, and relatively much larger than it is in *Tupaia*. The four interdigital pads are larger and more rounded; the thenar and hypothenar are relatively larger and situated at about the same anteroposterior level; posteriorly the two pads are connected by a slight bridge. Of the toes, the third, fourth, and fifth are equal and the second nearly as large. The first toe is well developed but much shorter than the others. Of the pads of hind foot, the interdigitals are large and rounded; the small pad accessory to the fourth interdigital is wanting. Corresponding to the relatively shorter foot the proximal external pad is relatively shorter than in *Tupaia*, and the proximal internal is much shorter and wider and perfectly distinct from the first interdigital pad. Mammæ, 2–2=4.

The ear of *Ptilocercus* is large, thin, and membranaceous in contrast to the small thick ear of *Tupaia*, with a fairly well developed tragus and a ridgelike antitragus. Viewed by the unaided eye, both inside and outside of the ear is essentially naked, but under a glass a few scattered hairs are found interiorly, and slightly more

[1] Proc. Zool. Soc. London, 1848, p. 23.

on the outer surface, gradually increasing in quantity toward the base, where the ear is as well furred as the body.

No shoulder stripe is present on *Ptilocercus*, but distinct markings are found on sides of head, consisting of a distinct black patch, almost a stripe, extending from near the tip of the nose, posteriorly through the eye a little more than half way to base of ear. This black patch is bordered above and below not by distinct light stripes, but by the rather light color of top of head and the distinctly light color of the underparts. At the beginning of the black face stripe arise well developed vibrissæ lacking in the Tupaiinæ. (Plate 7.)

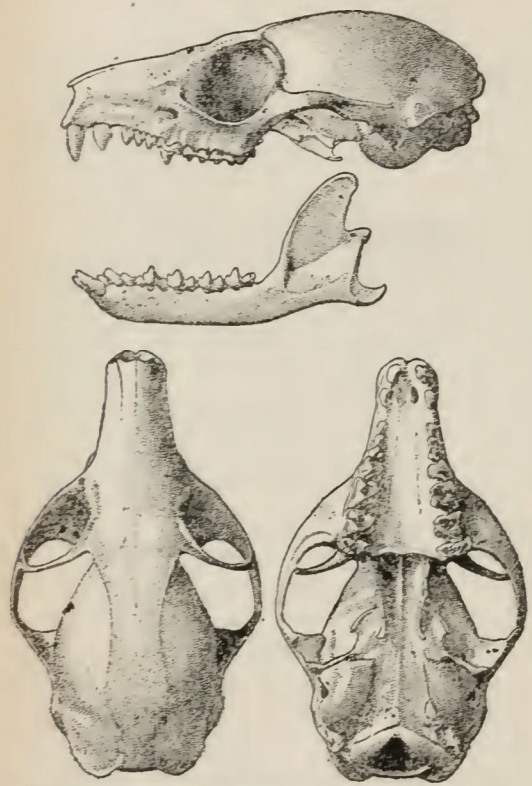


FIG. 14.—PTILOCERCUS LOWII CONTINENTIS, × 1½; CAT. NO. 112611, U.S.N.M., SEMBEONG RIVER, JOHORE, MALAY PENINSULA.

Cranial characters.—Some of the most fundamental differences between *Ptilocercus* and the other Tupaiidæ are found in the region of the orbit, certain structures in one having no direct counterpart in the other. *Tupaia* has a distinct supraorbital foramen, which is continued backward as a well-marked groove on the underside of the upper rim of the orbit. There is no counterpart of this foramen or groove in *Ptilocercus*. The infraorbital is a long canal in *Tupaia*, the proximal end in the orbit and the distal end of the canal over the penultinate upper premolar; in *Ptilocercus* the canal is much shorter and is situated over the middle of the last upper premolar. In the most anterior corner of the orbit is the posterior opening of another foramen leading into the nasal fossa. In *Tupaia* this opening is situated in a distinct notch, 2 mm. or so in size, and the upper end of this notch forms a distinct blunt spine. This notch and spine are entirely lacking in *Ptilocercus*. The position of the orbits in *Ptilocercus* is quite different from that in the Tupaiinæ. They are relatively larger, and placed relatively farther forward; the posterior

edge of the orbit is placed only a trifle behind the level of the union of olfactory bulb with the cerebrum, whereas in Tupaiinæ the posterior edge of the orbit is placed very much behind the level of the point of union of olfactory bulb and cerebrum. The general plane of the orbits in *Ptilocercus* looks more to the front of the animal, the plane of each orbit making with the long axis of the skull an angle of about 40°. In the case of Tupaiinæ the orbits look more to the side, each making with the long axis of the skull an angle of about 20°. Other conspicuous features about the skull of *Ptilocercus* are the wide spreading zygomata, temporal fossa larger than orbit, approximately parallel temporal ridges, a better ossified palate and simpler audital bullæ; that is, not divided by internal septa, as is frequently the case in the Tupaiinæ. The comparatively small antero-external segment of the bulla in *Tupaia* is very much reduced in *Ptilocercus*. At the apex of the orbital cavity in both *Tupaia* and *Ptilocercus* are two foramina, (1) the optic and (2) sphenoid fissure. In *Tupaia*, just below and external to these is the foramen rotundum, situated at the base of the external pterygoid plate, communicating with the cranial cavity as well as with a canal, the alisphenoid, running lengthwise in the base of the external pterygoid plate. In *Ptilocercus* the foramen rotundum is confluent with the sphenoidal fissure. Posterior to the external pterygoid plate in *Ptilocercus*, near the bulla, is a distinct oval foramen leading into the cranial cavity; this foramen is almost entirely overlapped by the bulla in *Tupaia*.

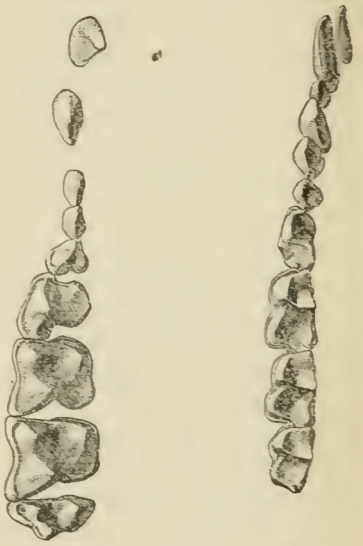


FIG. 15.—UPPER AND LOWER TOOTHROWS OF PTILOCERCUS LOWII CONTINENTIS, × 4; CAT. NO. 112611, U.S.N.M., SEMBRONG RIVER, JOHORE, MALAY PENINSULA.

The postorbital constriction in *Ptilocercus* is slightly less than the interorbital, being similar in this respect to *Urogale*. In *Tupaia* the postorbital constriction is greater than the interorbital. The two limbs of the lambdoid crest in *Ptilocercus* do not meet in a backwardly projecting obtuse angle as in Tupaiinæ, but each limb runs up to meet its corresponding temporal ridge. Between the posterior extremities of the temporal ridges the lambdoid exists as a slightly convex (backwardly) ridge.

The coronoid process of the mandible is relatively larger and wider in *Ptilocercus* than in *Tupaia*, and the notch between the condyle and coronoid shallower. See figure 14, page 160.

Dental characters.—There are not so many fundamental differences between the teeth of *Ptilocercus* and *Tupaia* as there are between the skulls, perhaps no more than generic differences. The upper canine is distinctly two-rooted and premolariform in shape. At times the upper canine in *Tupaia* is also two-rooted, but is not premolariform in shape. The first upper incisors are very much larger than the second pair, usually disproportionately more so than is usual in *Tupaia*. Both pairs of upper incisors are somewhat differently shaped in *Ptilocercus* and *Tupaia*. In the latter they are simple cone-like recurved teeth; in *Ptilocercus* these teeth are more trenchant with a moderately well-developed posterior cutting edge, and the second incisor almost has a distinct posterior cusp. Owing to the shortness of the rostrum, the incisor-canine-premolar series of teeth stand closer in the tooth row than they do in Tupaiinæ. The second upper premolar is three-rooted, as is usually the case in Tupaiinæ, and also is more triangular and more like the last upper premolar in shape. The last upper molar is more compressed antero-posteriorly in *Ptilocercus* than in *Tupaia*. The upper molars of *Ptilocercus* lack the mesostyle, which is quite conspicuous in Tupaiinæ; the cusps on the teeth appear blunter and more rounded. The molars are surrounded by a distinct cingulum, absent in *Tupaia*. In the lower jaw the first and third incisors are relatively smaller with respect to the second incisor in *Ptilocercus* than in *Tupaia*. The lower canines are about the same relative sizes in the two genera, but in *Ptilocercus* they are less canine-like in shape and look like enlarged first premolars. In *Ptilocercus* the middle lower premolar is much smaller than either of the two other premolars and is below the general level of the lower tooth row, while in *Tupaia* it is the first which is the smallest of the premolar series and which stands below the level of the tooth row. The lower molar teeth have a well-defined cingulum on their outer aspect, lacking in Tupaiinæ, but otherwise no essential differences are found in the two genera. See figure 15, page 161.

Geographic distribution.—*Ptilocercus* is found in Borneo, Banka, Sumatra, and Pulo Pinie of the Batu Islands, and in the southern part of the Malay Peninsula. It is said to exist on Sirhassen of the Natuna Islands.[1] See Nos. 2 and 3 on map, page 133.

Number of forms.—*Ptilocercus* contains but a single species group, *lowii*, of which one geographic race has been described.

Remarks.—*Ptilocercus* differs in external and particularly in cranial characters from any of the other genera of the Tupaiidæ more than any of them differs from each other, and seems well worthy of subfamily rank. The most striking differences are found in the ears, tail, feet, supraorbital foramen, and certain foramina at base of skull,

[1] See Thomas and Hartert, Nov. Zool., vol. 1, p. 656, September, 1894.

some of them having no counterpart in the other genera. Dentally it differs conspicuously from the other genera in lacking mesostyles on the upper molars and in having distinct cingula on both upper and lower molars.

PTILOCERCUS LOWII Gray.

(Synonymy, type-specimens, etc., under the subspecies.)

Geographic distribution.—The same as that of the genus, page 162.

Diagnosis.—The same as for the genus, page 159.

Color.—General color of upper part of head, neck, and body and outerside of legs, isabella color variously shaded with drab or drab-gray, top of head usually lighter, sides of body with a more or less distinct buff wash; underparts including innerside of legs varying from gray to a rather dark buff, the latter more conspicuous anteriorly; a black or blackish mark extending posteriorly through the eye, but not reaching base of ear, the black mark contrasting strongly with the lighter colors of the head; distal portion (75–80 mm.) of plume of tail, white or cream color, proximal portion (about 10 mm.) blackish brown; the well-haired basal portion of the tail colored like adjacent parts of body. (See Plate 7.)

Skull and teeth.—The same as for the genus, pages 160 to 162.

Remarks.—*Ptilocercus lowii* is one of the most strongly characterized of mammals and can be instantly identified by its external as well as cranial characters. It is quite rare in collections. Dr. W. L. Abbott has collected over 6,000 mammals in regions where it is known or supposed to occur, and has only encountered it twice. I have seen 10 examples of the pentailed treeshrew, and know of two others in the Leyden Museum which I have not seen. *Ptilocercus* and *Dendrogale* seem to be of about equal rarity, at least in collections. This probably is due not so much as an actual rarity in nature as to some peculiarity of habit, rendering them seldom observed and difficult to trap. Observations on the habits of this animal are scarce. Both of Doctor Abbott's specimens were caught in traps in heavily forested hills. The Selangor [1] specimen was "captured in its nest in a hollow bough. * * * The nest was merely a tunnel about 3 inches in diameter and 18 inches in length, roughly lined with fibrous material and green leaves." The original representative was caught in a house. Schneider's [2] remarks are interesting and worth quoting in full:

> The natives did not know this little animal and simply called it, in response to my questions, Tikuskaju—that is, Treemouse. The male of this pentailed treeshrew happened to be brought alive to me by a Battak man employed in the vicinity in woodcutting. Thereupon I hastened at once with the man to the exact spot where he had obtained it, in the hope of perhaps yet capturing the female, and my joy was

[1] Robinson, Journ. Straits Brit. Royal Asiat. Soc., No. 44, 1905, p. 225.

[2] Zool. Jahrb., vol. 23. pt. 1, 1905, p. 84.

indescribable when after a quarter hour I had the luck to discover the female in the leafy summit of a large tree lying on the ground, amongst the parasitic vegetation which thickly covered the tree, and to capture it with the help of the woodcutters. I then kept the pair alive for several hours in order to observe them. The long pentail they carried hanging or lightly outstretched, and at the same time they constantly moved it to and fro like the pendulum of a clock. It appeared to me as if they used the tail as an organ of touch. If I merely touched lightly the hairs of the plume with my finger, they moved away, but they permitted themselves to be gently stroked and handled without making an attempt to bite. They sniffed the bananas which I laid before them, but they did not eat any. As I feared through some accident these rare and interesting little animals might escape from me, I chloroformed them at evening, measured them at once, and preserved them in alcohol.

Of this pair the male is preserved in the Natural History Museum at Basel and the female at Strassburg.

Subspecies.—Two forms of *Ptilocercus lowii* have thus far been recognized, true *lowii* on Borneo, and *continentis* from the Malay Peninsula. The specimen from Banka is probably the same form as the Bornean one. The Sumatran and Batu specimens are here regarded as the same as the peninsular form. The two subspecies are not highly differentiated from one another, and it would be well if their distinctness could be established by the examination of more material or the examination of all the known examples together. The only material that I have carefully examined is that in the United States National and British Museums.

KEY TO THE SUBSPECIES OF PTILOCERCUS LOWII.

Toes not different in color from rest of hind foot; muzzle and palate slightly broader. Borneo, Banka; *P. lowii lowii*, p. 164.

Toes distinctly lighter in color than rest of hind foot; muzzle and palate slightly narrower. Malay Peninsula, Sumatra, Batu Islands ----*P. lowii continentis*, p. 165.

PTILOCERCUS LOWII LOWII Gray.

1848. *Ptilocercus lowii* GRAY, Proc. Zool. Soc. London, 1848, p. 23, pl., mammalia, 2, entire animal in colors, very good.

1848. *Ptilocercus lowii*, GRAY, Ann. Mag. Nat. Hist., ser. 2, vol. 2, p. 212, September, 1848. The same account as appeared in Proc. Zool. Soc. London, 1848.

1850. *Ptilocercus lowii*, GRAY, Zool. Voy. Samarang, p. 18, pl. 5, entire animal in colors, and views of skull and teeth.

Type-locality.—Sarawak (the town), northern Borneo.

Type-specimen.—In British Museum, mounted skin, Reg. No. 47.12.30.1, and skull, Reg. No. 48.5.12.3, collected in the Rajah's house, Sarawak, Borneo, by Mr. Hugh Low. The mounted skin is very old and exhibition worn, and was probably made from an alcoholic specimen; considerable patches of hair have slipped from the left side and from belly. The skull is perfect and in good condition, but is not fully adult, as the deciduous incisors are still retained.

Geographic distribution.—Northern Borneo, Sarawak, Baram River, Lawas Mountains,[1] islands of Banka, and Sirhassen.[2] See No. 2 on map on page 133.

Diagnosis.—Toes not distinctly lighter than rest of hind foot, and skull with broader muzzle and palate, teeth slightly larger, general coloration a clearer isabella color, with less tendency to drab or drab gray.

Measurements.—Type: Head and body (from mounted skin) 140 mm., tail (from mounted skin) 160; hind foot, 27; condylo-basal length, 35; zygomatic width, 20.5; width of braincase, 14.5; maxillary toothrow, 14. Usual measurements of adults: Head and body, 135–150; tail, 160–180; hind foot, 27–28; condylo-basal length, 37–38; zygomatic width, 22–23; width of braincase, 14.5–15; maxillary toothrow, 13–14.

Remarks.—Jentink[3] records in the Leyden Museum a specimen of *Ptilocercus* from Banka, a mounted skin and incomplete skull of a nearly adult animal. Owing to the general similarity of the mammals of Banka and Borneo, this specimen is here regarded as belonging to the typical subspecies.

Specimens examined.—Five. See table, page 166.

PTILOCERCUS LOWII CONTINENTIS Thomas.

1910. *Ptilocercus lowi continentis* THOMAS, Ann. Mag. Nat. Hist., ser. 8, vol. 5, May, 1910.

Type-locality.—Vicinity of Kwala Lumpur, Selangor, Malay Peninsula.

Type-specimen.—In British Museum, Reg. No. 10.4.17.1, skin and skull of an adult male, collected 10 miles from Kwala Lumpur, Selangor, December 27, 1903, by a Dyak collector employed by Selangor Museum; in good condition.

Geographic distribution.—At present known from Selangor and Johore of the Malay Peninsula, Deli-Lankat region of Sumatra, and Pulo Pinie of the Batu Islands off west coast of Sumatra. See No. 3 on map on page 133.

Diagnosis.—Differs from *Ptilocercus lowii lowii* in having more drab in the colors of the upper parts, the metatarsal region of hind feet brown in contrast with the lighter toes, and in the possession of a somewhat narrower rostrum and palate, and slightly smaller teeth. (See Plate 10, fig. 5.)

Measurements.—Type: Head and body, 133 mm.; tail, 167; hind foot, 28; condylo-basal length, 27; zygomatic width, 22.5; width of brain case, 15; maxillary tooth row, 12.5. For individual measurements see table, page 166.

[1] See Hose, Mammals of Borneo, 1893, p. 34.

[2] See Thomas and Hartert, Nov. Zool., vol. 1, 1894, p. 656.

[3] Cat. Mus. Hist. Nat. Pays-Bas, Osteol. Mamm. vol. 9, 1887, p. 242; Cat. Mus. Hist. Nat. Pays-Bas, Mamm., vol. 12, 1888, p. 118.

Remarks.—The chief distinguishing mark of this subspecies is the brown color of the metatarsal region of the foot in contrast with the buff-colored toes. The differences pointed out by Mr. Thomas in regard to the "naked portion" of the tail is simply due to the manner in which the skin of the tail of the type is stretched. This animal was first recorded on the Malay Peninsula by Mr. Robinson in 1905.[1] Although the Selangor specimen was the first to be recorded in the literature, Dr. W. L. Abbott was the first person to take *Ptilocercus* on the Asiatic Continent, his Johore specimen being collected July 5, 1901, about two and a half years before the Selangor animal was secured.

Specimens examined.—Two from the Malay Peninsula, one from Pulo Pinie. The two Sumatran specimens I merely saw in their exhibition cases without critically examining them. See table below. In addition to these a skeleton of a specimen collected at Deli Sumatra is recorded by Jentink.[2]

Measurements of Ptilocercus lowii.

Name.	Locality.	Number.	Sex.	Molar teeth worn.	Head and body.	Tail.	Hind foot.	Condylo-basal length.	Zygomatic width.	Width of brain case.	Maxillary tooth row.	Number of mammæ.
					mm	*mm*	*mm*	*mm*	*mm*	*mm*	*mm*	
Ptl. lowii continentis.	Johore, Sembrong River.	112611	Male	Moderately	143	165	28	36	22	15	12.5	....
Do	Selangore, Kuala Lumpur.	10.4.17.1 [3]	...do	Slightly	133	167	28	37	22.5	15	12.5	....
Do	Batu Islands, Pulo Pinie.	121855	...do	Moderately	140	170	29	35.5	21.5	14	13	....
Do	Sumatra, Lower Langkat.	Basel, 1246	...do	Adult [4]	120	170	30	....	....	....	....	....
Do	....do	Strassburg.	Female.	...do.[5]	120	170	30	....	....	....	....	....
Ptl. lowii lowii	Borneo	Paris, 1225 [6]	.....	.....	170±	150±	34±	....	....	....	....	....
Do	....do	Berlin, 3992	.....	Very slightly.	150±	180±	28±	38	22	15	13.5	....
Do	Borneo, Sarawak.	11.12.29.1 [7] 11.12.29.3	.....	None [8]	140	160	27	35	20.5	14.5	14.0	....
Do	Borneo, opposite Labuan.	76.5.2.8	Male	Slightly	135±	180±	28	37.5	23	15	13	....
Do	Borneo, Labuan [9]	89.1.9.1 [10]	Female.	...do	140	180	28	37.5	22.5	14.5	13	2–2

[1] Journ. Straits Branch Royal Asiat. Soc., No. 44, 1905, p. 225.
[2] Notes Leyden Museum, vol. 7, 1885, p. 38, and Cat. Mus. Hist. Nat. Pays-Bas. Osteol. Mamm., vol. 9, 1887, p. 242.
[3] Type.
[4] Entire specimen in alcohol on exhibit; measurements furnished by collector.
[5] Skin, mounted from alcoholic, and entire body in alcohol, on exhibit; measurements furnished by collector.
[6] Mounted.
[7] Type, mounted.
[8] Deciduous incisors still in place.
[9] Although labeled Labuan I suspect the specimen came from the mainland opposite.
[10] Preserved in alcohol.

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A republication of preceding account.

——— Vertebrata. Zool. Voyage H. M. S. *Samarang*, pp. 18–20, 1850.

Detailed account of *Ptilocercus*, and summary of the other genera and species, *Tupaia javanica, ferruginea, tana, Dendrogale murina*, and *Ptilocercus lowii.* Entire animal in colors, and skull and teeth on plate 5.

——— Early notice of the *Tupaia* (sic) found in Pulo Condore. Ann. Mag. Nat. Hist., ser. 3, vol. 5, 1860, p. 71.

Original publication of W. Ellis's account of "*Sciurus dissimilis*" (= *Tupaia dissimilis*).

——— Ann. Mag. Nat. Hist., ser. 3, vol. 6, p. 217, August, 1860.

Original description of *Tupaia frenata.*

——— Notice of a species of *Tupaia* from Borneo in the collection of the British Museum. Proc. Zool. Soc. London, 1865, p. 322, pl. 12.

Original description of *Tupaia splendidula*, and a fairly good colored plate.

GREGORY, W. K. The Orders of Mammals. Bull. Amer. Mus. Nat. Hist., vol. 27. 1910.

Pages 269–280, a detailed consideration of the family Tupaiidæ. Two genera recognized: *Tupaia, Ptilocercus*, illustrations of the feet and skeleton of *Tupaia*, and of skull of *Ptilocercus.* Special attention is paid to affinities of the family, structure of teeth, and anatomy of skull.

GRIFFITH, E. Animal Kingdom, vol. 2, 1827, pp. 211–216.

A rather vague account of the genus *Tupaia* and the species *tana, javanica*, and *ferruginea;* a better account, vol. 5, p. 106, and there occurs this combination, *Tupaia Tanaia Tana*, ascribed to Raffles. Evidently a misprint, as the combination is not found in Raffles.

GÜNTHER, A. Remarks on some Indian and more especially Bornean Mammals. Proc. Zool. Soc. London, 1876, pp. 424–428, pl. 36, *Tupaia tana* var. *chrysura* in colors.

A review of the genus based on the specimens in the British Museum; 12 forms recognized, and *Tana chrysura* characterized for first time.

HAECKEL, ERNST. Systematische Phylogenie der Wirbelthiere, vol. 3, 1895.

On p. 582 uses *Cladobatida* as a group name for the treeshrews.

HARDWICKE, THOMAS. [Introductory Remarks.] On the *Sorex Glis*. Trans. Asiat. Soc. Bengal, vol. 14, 1822, pp. 471–472. See Diard and Duvaucel, on page 169.

Observations on habits.

HEILPRIN, ANGELO. The Geographical and Geological Distribution of Animals, 1887.

On p. 345, Tupaiidæ (genera *Tupaia, Ptilocercus*) briefly mentioned as inhabitants of Oriental Region.

HOLLISTER, N. A List of the Mammals of the Philippine Islands, exclusive of the Cetacea. Philippine Journ. Sci., vol. 7, No. 1, pp. 1–64, February, 1912.

A list of the Tupaiidæ in the Philippine Islands, pp. 6–7.

HORSFIELD, THOMAS. Zoological Researches in Java and the neighboring islands, 1824.

An account of the members of the genus *Tupaia* known at that time: *T. ferruginea, T. tana*, and *T. javanica* new. Rather poorly colored illustrations of the latter two, and a plate in black and white showing head and teeth of the three forms, and feet *T. tana* and *javanica*.

———. Plantæ Javanicæ Rariores, 1838–1842.

Contains an excellent old-time map of Java, showing Horsfield's journeys in Java, and map with p. v of postscript enables one to determine location of type-locality of *Tupaia javanica*.

———. Catalogue of Mammalia in the Museum of the Hon. East India Company, 1851.

On pp. 130–134 lists all the then known species of *Tupaia: javanica, ferruginea, tana, murina, peguana, belangeri*, and gives a very clear summary of the history, discovery, and habits of the animals. Examples only of the first two in the museum.

HOSE, CHARLES. Mammals of Borneo, 1893.

A good list of all of the Bornean forms of the family Tupaiidæ, the descriptive matter mostly compiled, but some good original notes. Forms mentioned: *T. javanica, longipes, tana, minor, dorsalis, splendidula, picta, montana, melanura, gracilis, D. murina, P. lowii*.

HUBRECHT, A. A. W. Ueber die Entwicklelung der Placenta von Tarsius und Tupaja nebst Bermerkungen ueber deren Bedeutung als haematopoietische Organe. Proc. Fourth Internat. Cong. Zool., 1899, pp. 343–382, pls. 4–15.

HUSCHKE. Ueber die Zähne von Cladobates. Isis, vol. 20, 1827, pp. 758–759. pl. 10.

A rather good description of the teeth of *Tupaia* and in comparison with *Sorex, Talpa, Erinaceus*, and *Chrysochloris*.

HUXLEY, THOMAS H. A Manual of the Anatomy of Vertebrated Animals, 1872.

On pp. 383, 384, a few facts about anatomy and osteology of the treeshrews, which are designated Tupayæ.

INGERSOLL, E. Life of Animals (Mammals), 1906, p. 75.

Barely mentions *Tupaias* and their distribution, but referring to their resemblance to squirrels says: "This has often been adduced as a case of 'mimicry,' which is very rare among mammals; but it seems to me rather an instance of 'convergence'—that is, the result of two animals coming to be like one another, because they have followed the same manner of life under identical circumstances."

JENTINK, F. A. On some rare and interesting mammals. Notes Leyden Museum, vol. 7, p. 37, 1885.

Mentions occurrence of *Ptilocercus* on Sumatra and Banka and makes a few remarks on the skeleton.

———. Catalogue Ostéologique de Mammifères. Mus. Hist. Nat. Pays-Bas., vol. 9, 1887.

List of the osteological material of the family Tupaiidæ in the Leyden Museum, pp. 240–242.

JENTINK, F. A. Catalogue Systématique des Mammifères. Mus. Hist. Nat. Pays-Bas., vol. 12, 1888.

List of the skins, all mounted, and specimens preserved in alcohol of the family Tupaiidæ in the Leyden Museum, pp. 116–118. Contains the new generic term *Glipora* and the new specific names *leucogaster* and *rufescens*.

———. On a collection of Mammals from East Sumatra. Notes Leyden Museum, vol. 11, pp. 17–30, 1889.

Records *Tupaia javanica* (probably= *T. minor malaccana*), Tandjong Morawa, *T. tana* Deli, *T. ferruginea* Deli, *T. ferruginea* var. *chrysura* (= *T. demissa*), and *Ptilocercus lowii*, Tandjong Morawa.

———. On a collection of Mammals from Billiton. Notes Leyden Museum, vol. 12, pp. 149–154, 1890.

Records *Tupaja javanica* from Billiton; it is probably an example of *T. gracilis inflata*.

———. On two very rare, nearly forgotten and often misunderstood mammals from the Malayan Archipelago. Notes Leyden Museum, vol. 12, 1890, pp. 222–230.

Considers in detail the cotypes of *Tupaia dorsalis* Schlegel, and points out the similarity in form of the skulls of that species with those of *Tupaia tana*, both now in the genus *Tana*.

JERDON, T. C. Mammals of India, 1867, pp. 64–66.

Gives characters of the family and of *T. elliotti* and *T. chinensis*, remarks on food.

KLOSS, C. BODEN. In the Andamans and Nicobars, 1903.

An account of Abbott and Kloss's visit to those islands in 1901. Describes habits of *Tupaia nicobarica*, pp. 122, 136.

———. A Provisional List of the Mammals of the Peninsula Region. Journ. Fed. Malay States Mus., vol. 2, No. 3, pp. 147–150, September, 1908.

Tupaia ferruginea, *T. f. belangeri*, *T. sordida*, *T. pulonis*, *T. malaccana*, *Ptilocercus lowi*.

———. Diagnoses of new Mammals from the Trengganu Archipelago, east coast of Malay Peninsula. Ann. Mag. Nat. Hist., ser. 8, vol. 7, pp. 115–119, January, 1911.

Original descriptions of *Tupaia obscura* and *T. ferruginea longicauda*.

———. On Mammals and Birds from Trengganu. Journ. Fed. Malay States. Mus., vol. 4, No. 2, pp. 135–143, April, 1911.

Tupaia ferruginea recorded.

———. On Mammals and Birds from the lowlands of Pahang. Journ. Fed. Malay States Mus., vol. 4, No. 2, pp. 144–166, April, 1911.

Tupaia ferruginea and *T. malaccana* mentioned.

———. On a Collection of Mammals and other Vertebrates from the Trengganu Archipelago. Journ. Fed. Malay States Mus., vol. 4, pp. 175–212, November, 1911.

Detailed descriptions and measurements of *Tupaia obscura*, and *T. longicauda*; remarks on habits.

———. On Mammals and Birds from the Hills of Negri Sembilan. Journ. Fed. Malay States Mus., vol. 4, pp. 219–229, November, 1911.

Tupaia ferruginea recorded from Bukit Tangga.

KOHLBRUGGE, J. H. F. Bijdragen tot de natuurlijke Geschiedenis van Menschen en Dieren, III. Zoogdieren van Zuid-Oost Borneo. Nat. Tijdschr. Ned.-Ind., vol. 55, ser. 9, vol. 4, pp. 176–200, 1896.

Original description of *Tupaja Mülleri* (p. 196)= *T. splendidula*.

LECHE, W. Zur Anatomie der Beckenregion bei Insectivora, mit besonderer Berücksichtigung ihrer morphologischen Beziehungen zu derjenigen anderer Säugethiere. Kongl. Svenska Vet.-Akad. Handl., vol. 20, No. 4, 1883, pp. 1–113, pls. 1–10.

Descriptions and illustrations of the bony pelvis, the pelvic nerves, and muscles of Insectivora, among them a male *Tupaia ferruginea* and a female *T. javanica*.

———. Zur Morphologie des Zahnsystems der Insectivoren. Anat. Anzeiger, vol. 13, 1897, pp. 528–529.

Brief account of milk and permanent teeth of Tupaiidæ (*Tupaia tana*, *belangevi* (sic), and *melanura*).

LESSON, RÉNÉ-PRIMEVERRE. Manuel de Mammalogie, 1827, pp. 122–123.
Cladobates ferrugineus, tana, javanica.

———. Nouveau Tableau de Règne Animal, Mammifères, 1842, p. 93.
Tupaia ferruginea, T. javanica, T. tana T. peguanus, original description of latter.

LEWIS, CAPT. Observations of in E. Blyth. Journ. Asiat. Soc. Bengal, vol. 15, p. 368.
Mentions squirrels on the Nicobar Islands, probably = *Tupaia nicobarica.*

LICHTENSTEIN, H. Uber die Verwandtschaft der Kleinen (Insectenfressenden) Raubthiere mit den Nagern. Abhandl. kön Akad. Wissensch, Berlin (1831), 1832, pp. 345–360.
On p. 356 mere mention of resemblance between *Tupaya* and *Sciurus.*

LYDEKKER, RICHARD. The Tree-Shrews, or Tupaias. Royal Natural History, vol. 1, 1893–94, pp. 312–315.
A good popular account of the family with woodcuts of *Tana* and *Ptilocercus.*

———. A Geographical History of Mammals, 1896, pp. i–xii, 1–400.
On p. 270 gives distribution of family and a rather poor woodcut on p. 271, "*Tupaia tana,*" apparently taken from Günther's plate of *Tana chrysura.*

———. Insectivora (pp. 638–644), Encyl. Brit., ed. 11, vol. 14, 1910.
Brief account of the Tupaiidæ, genera *Tupaia, Ptilocercus,* and *Urogale. U. everetti* erroneously referred to Borneo.

LYON, MARCUS WARD Jr. Mammals of Banka Mendanau, and Billiton, islands between Borneo and Sumatra. Proc. U. S. Nat. Mus., vol. 31, pp. 575–612, December 18, 1906.
Original descriptions of *Tupaia inflata* and *T. discolor.*

———. Mammals of Batam Island, Rhio Archipelago. Proc. U. S. Nat. Mus., vol. 31, pp. 653–657, January 16, 1907.
Original description of *Tupaia ferruginea batamana.*

———. Mammals collected in western Borneo by Dr. W. L. Abbott. Proc. U. S. Nat. Mus., vol. 33, pp. 547–572, December 24, 1907.
Records *Tupaia dorsalis* and *T. spcciosa* from Lower Kapuas River (both nowi n genus *Tana* and the latter= *T. t. bcsara*).

———. On a collection of mammals from the Batu Islands, west of Sumatra. Ann. Mag. Nat. Hist., ser. 8, vol. 1, pp. 137–140, February, 1908.
Records *Tupaia cervicalis* from Tana Masa Island (now *Tana cervicalis masæ*).

———. Mammals collected in eastern Sumatra by Dr. W. L. Abbott during 1903, 1906, and 1907, with descriptions of new species and subspecies. Proc. U. S. Nat. Mus., vol. 34, pp. 619–679, September 17, 1908.
Original description of *Tupaia siaca; T. ferruginea* recorded from Aru Bay.

———. Additional Notes on Mammals of the Rhio-Linga Archipelago, with descriptions of new species and a revised list. Proc. U. S. Nat. Mus., vol. 36, pp. 479–491, June 1, 1909.
List of treeshrews occurring in the Archipelago.

———. Mammals collected by Dr. W. L. Abbott on Borneo and some of the small adjacent Islands. Proc. U. S. Nat. Mus., vol. 40, pp. 53–146, April 25, 1911.
Records *Tupaia speciosa* (now *Tana tana besara*) and *T. t. tana* from Kapuas River and southern Borneo; *T. dorsalis,* Kapuas River; *T. splendidula,* southern Borneo; *T. longipes* (now *T. l. salatana*), southern Borneo; *T. carimatæ,* Karimata Island; *T. inflata* (now *T. gracilis edarata*), Karimata Island; *T. grocilis* Kendawangan River; *T. minor,* southern Borneo and Pulo Laut.

———. Descriptions of four new treeshrews. Proc. Biol. Soc. Wash., vol. 24, pp. 167–170, June 16, 1911.
Original descriptions of *T. raviana, T. pemangilis, T. natunæ, T. sincipis,*

LYON, MARCUS WARD, Jr., and OSGOOD, WILFRED HUDSON. Catalogue of the Type-specimens of Mammals in the United States National Museum, including the Biological Survey Collection. Bull. U. S. Nat. Mus. 62, January 28, 1909.
The type-specimens of species in the family Tupaiidæ in the U. S. National Museum, listed, pp. 251–254.

MASON, Rev. FRANCIS. The natural productions of Burmah, 1850.
On p. 224 mentions *Tupaia javanica* and *peguana* (=*chinensis* and *belangeri*).

MATSCHIE, PAUL. Über Säugethiere von der Philippinen. Sitz-Ber. Ges. nat. Freunde, Berlin, 1898, pp. 38, 43.
Original description of *Tupaia möllendorffi*.

MEARNS, EDGAR A. Descriptions of new Genera and Species of Mammals from the Philippine Islands. Proc. U. S. Nat. Mus., vol. 28, pp. 425–460, May 13, 1905.
Original description of genus *Urogale* and species *cylindrura* (=*everetti*).

MEIJERE, J. C. H. DE. Über die Haare der Säugethiere, besonders über ihre Anordnung, pp. 312–424. Morph. Jahrb., vol. 21, 1894.
On p. 398, the arrangement of the hairs of *Tupaia javanica* and of *Ptilocercus lowii*, and schematic figure of the scales and hairs of tail of *Ptilocercus* (fig. 3, p. 319). Hairs arise, singly, and not in definite groups, 3 hairs to a scale in *Ptilocercus*. Hairs of *Tupaia* have a thickness of 0.016 to 0.020 mm., occasionally 0.065 mm. Hairs of *Ptilocercus* 0.012 mm. in diameter.

MILLER, GERRIT S., Jr. Mammals collected by Dr. W. L. Abbott on Islands in the South China Sea. Proc. Wash. Acad. Sci., vol. 2, pp. 203–246, August 20, 1900.
Original descriptions of *Tupaia bunoæ*, *T. sordida*, *T. chrysomalla*. *T. tana* (now *Tana lingæ*) recorded from Linga Island, *T. malaccana*, from Linga, with illustrations of skull of latter.

———. Mammals collected by Dr. W. L. Abbott on Pulo Lankawi and the Butang Islands. Proc. Biol. Soc. Wash., vol. 13, pp. 187–193, December 21, 1900.
Records *Tupaia ferruginea* on Pulo Lankawi and Butang Islands, and also at Trong, Lower Siam. At present these represent 3 forms of *Tupaia laccrnata*. At the time of Miller's paper examples of true *Tupaia glis ferruginea* were not in the United States National Museum collection.

———. Mammals collected by Dr. W. L. Abbott on the Natuna Islands. Proc. Wash. Acad. Sci., vol. 3, pp. 111–138, March 26, 1901.
Original description of *Tupaia* (now *Tana*) *sirhassenensis*. *T. splendidula* (now *natunæ*) recorded on Bunguran, and *T. lucida* on Laut.

———. The Mammals of the Andaman and Nicobar Islands. Proc. U. S. Nat. Mus., vol. 24, pp. 751–795, May 28, 1902.
Original description of *Tupaia nicobarica surda*, Little Nicobar, and record of *T. n. nicobarica* on Great Nicobar.

———. Mammals collected by Dr. W. L. Abbott in the region of the Indragiri River, Sumatra. Proc. Acad. Nat. Sci. Phila., 1902, pp. 143–159, June 11, 1902.
Original description of *Tupaia phæura*, Sinkep Island. *T. malaccana* recorded from Linga Island and Indragiri River, and from Sinkep (now *T. minor sincipis*), and *T. tana* from Linga (now *Tana lingæ*).

———. Mammals collected by Dr. W. L. Abbott on the coast and islands of northwest Sumatra. Proc. U. S. Nat. Mus., vol. 26, pp. 437–484, February 3, 1903.
Records *Tupaia ferruginea*, Loh Sidoh and Tapanuli Bays; *T. tana* (now *Tana tana tuancus*) from Tuangku Island, *T. malaccana* from Tapanuli Bay.

———. Seventy New Malayan Mammals. Smiths. Misc. Coll., vol. 45, No. 1420, pp. 1–73, pls. 1–19, text fig. 1, November 6, 1903.
Original descriptions of *Tupaia castanea*, Bintang Island; *T. pulonis*, Pulo Aor; *T. tephrura*, Tana Bala Island; *T. chrysogaster*, Pagi Islands (skull, fig. 1, pl. 10); *T. cervicalis*, Tana Bala Island. Views of skull of *Tupaia ferruginea* from Tringanu, fig. 2, pl. 10. Key to species of *splendicula* group=*T. lucida*, *T. splendidula*, *T. chrysomalla*, and *T. castanea*.

———. Mammals collected by Dr. W. L. Abbott in the Karimata Islands, Dutch East Indies. Proc. U. S. Nat. Mus., vol. 31, pp. 55–66, July 23, 1906.
Original description of *Tupaia carimatæ*.

MILLER, GERRIT S., JR. The Mammals collected by Dr. W. L. Abbott in the Rhio-Linga Archipelago. Proc. U. S. Nat. Mus., vol. 31, pp. 247–286, September 11, 1906.
Records *Tupaia castanea* from Pulo Bintang; *T. tana* (now *Tana lingæ*) from Linga; *T. phæura* from Sinkep; *T. ferruginea* (now *T. glis batamana*) from Batam; *T. malaccana* from Linga and Sinkep (now part *T. minor sincipis*).

———. Descriptions of two new genera and sixteen new species of mammals from the Philippine Islands. Proc. U. S. Nat. Mus., vol. 38, pp. 391–404, August 19, 1910.
Original description of *Tupaia cuyonis*, p. 393.

MIVART, ST. GEORGE. Notes on the Osteology of the Insectivora, Journ. Anat. Physiol., vol. 1, 1867, pp. 292–295, and vol. 2, 1868, pp. 145–146.
Describes skull, osteology, and teeth of *Tupaia*, and illustrates trunk vertebræ, and grinding surface of upper molars of *Tupaia* and *Ptilocercus* and lower of *Tupaia*.

———. Notes sur l'ostéologie des insectivores. Ann. Sci. Nat., Paris, ser. 5, vol. 8, 1867, pp. 221–284, and vol. 9, 1868, pp. 311–372.
A publication in French of the above.

———. On Hemicentetes, a new genus of Insectivora, with some additional remarks on the osteology of that order. Proc. Zool. Soc. London, 1871, pp. 67–79.
A general account of the families and genera of Insectivora. Osteological characters of Tupaiidæ well set forth. Three genera recognized in family, *Tupaia*, *Ptilocercus*, *Hylomys*.

MODIGLIANI, E. Appunti intorno ai mammiferi dell' isola Nias. Ann. Mus. Civ. Stor. Nat. Genoa, ser. 2, vol. 7 (27), 1889, pp. 238–245.
Records *Tupaia javanica* on Nias.

MURRAY, A. Geographical Distribution of Mammals, 1866, p. 233, map 65.
Briefly gives distribution, not mentioning Ceylon, but the colored area of distribution on the map includes Ceylon.

NEHRING, ALFRED. Über Säugethiere von den Philippinen, namentlich von der Palawan-Gruppe. Sitz.-Ber. Ges. naturf. Freunde, Berlin, 1894, pp. 179–193.
On p. 184 records *Tupaia ferruginea* from the Calamines (= *T. palawanesis*) and probably came from Palawan.

OSBORN, HENRY FAIRFIELD. The Age of Mammals in Europe, Asia, and North America, 1910.
On p. 522, under classification of Mammals: Suborder Menotyphla, Family Tupaiidæ, genera *Tupaia*, *Ptilocercus*, and family Macroscelididæ.

OWEN, RICHARD. Odontography, vol. 1, p. 419, vol. 2, pl. 111, fig. 3, 1840–1845.
Illustrations and descriptions of teeth of *Tana*.

PALMER, T. S. Index Genera Mammalium=North American Fauna, No. 23, 1904.
On page 875 are gathered together the family, subfamily names, genera, and subgenera, the latter fully discussed in the body of the work. The only omission I have noticed is *Glipora* Jentink.

PARKER, W. K. Development of the skull in the Mammalia; a few remarks on an adult skull of *Tupaia javanica*. Philos. Trans. Royal Soc. London, vol. 176, year 1885, pp. 267–8, pl. 1, 1886.
A rather brief account, showing *Tupaia* rather primitive, with certain marsupial affinities, but in brain capacity approaching lemurs.

PAULLI, SIMON. Über die Pneumaticität des Schädels bei den Säugethieren, Morph. Jahrb., vol. 28, pp. 483–564.
On p. 486, endo and ecto turbinals of *Cladobates* discussed, peculiar among the Insectivora in having only 2 ecto-turbinals instead of 3.

PECHUEL-LOESCHE. Brehms Tierleben, 1890, vol. 2, pp. 382–383.
Brief account of Tupaiidæ, but *Ptilocercus* omitted.
Woodcut of *Tana*.

PELZELN, AUGUST VON. Über die malayische Säugethier-Fauna, K. k. zool. bot. Ges. Wien, 1876, pp. 53–74, and map.
Tupaia mentioned as occurring in his "tibetanische hinterindien and sundaishe Unterabteilung."

PETERS, WILHELM. Über die Säugethier-Gattung Solenodon. Abh. kön Akad. Wiss., Berlin, 1863, p. 20.
Outline classification of Insectivora, under Tupayæ: 1. Cladobates; 2. Ptilocercus; 3. Hylogale.

POMEL, A. Études sur les carnassiers insectivores (extrait), Seconde-Partie.—Classification des insectivores. Arch. Sci. Phys. Nat. Genève, vol. 9, 1848, pp. 244–251.
On p. 250 the treeshrews, called Hylogaliens (one genus *Sorexglis*), the first type of the tribe Glisoriciens (Glisoricina), the second type being Dipogaliens with the genera *Macroscelis* and *Petrodromus*.

POUSARGUES, E. DE. Mammifères de l'Indo-Chine. Mission Pavie Indo-Chine, 1879–1895, Études diverses, III, Recherches sur l'Histoire Naturelle de l'Indo-Chine orientale, pp. 510–549.
Mentions as occurring in Indo-China *Tupaia chinensis*, *T. belangeri*, *T. ferruginea*, *Dendrogale frenata* (p. 520).

RAFFLES, Sir THOMAS STAMFORD. Descriptive Catalogue of a zoological collection made on the account of the Honourable East India Company, in the Island of Sumatra and its vicinity, etc. Trans. Linn. Soc. London, vol. 13 (1822), pp. 239–274 (mammals), May, 1821.
Original description of the genus *Tupaia* and species *ferruginea* and *tana;* remarks on habits.

RIDLEY, H. N. On the Dispersal of Seeds by Mammals. Journ. Straits Branch Royal Asiat. Soc., No. 25, pp. 11–32, 1894.
On p. 21 mentions eating of fruits by *Tupaia ferruginea*.

———. List of Mammals recorded from Pahang. Journ. Straits Branch Royal Asiat. Soc., No. 25, pp. 57–60, 1894.
Tupaia ferruginea and *T. javanica* (probably = *T. minor malaccana*.)

———. The Mammals of the Malay Peninsula. Natural Science, vol. 6, January, 1895, pp. 23–29.
Excellent remarks on the habits of *Tupaia glis ferruginea*.

ROBINSON, H. C. A List of a Small Collection of Mammals and Birds from the Mountains of Ulu Langat, Selangor. Journ. Fed. Malay States Mus., vol. 4, November, 1911, pp. 235–241.
Records *Tupaia ferruginea ferruginea*.

H. C. R[OBINSON] and C. B[ODEN] K[LOSS]. In Thomas and Wroughton, Journ. Fed. Malay States Mus., vol. 4, No. 1, December, 1909, pp. 111–112.
Notes on the habits of *Tupaia ferruginea*.

———. On Six New Mammals from the Malay Peninsula and Adjacent Islands. Journ. Fed. Malay States Mus., vol. 4, No. 2, pp. 169–174, April, 1911.
Original description of *Tupaia ferruginea wilkinsoni*.

———. On New Mammals from the Malay Peninsula and Adjacent Islands. Journ. Fed. Malay States Mus., vol. 4, pp. 241–246, November, 1911.
Original description of *Tupaia ferruginea penangensis* = *Tupaia glis glis*, Penang Island.

SCHINZ, H. R. Naturgeschichte und Abbildungen der Menschen und der Säugethiere, p. 54
Brief description of "*Gladobates* (sic) *ferrugineus*." "It lives in Java." Black and white figure on plate 11. Evidently compiled from Cuvier.

———. Naturgeschichte und Abbildungen der Säugethiere, 1824, pp. 87–88, pl. 62.
Brief description and black and white illustration of "*Chladobates* (sic) *javanicus*." Evidently compiled from Cuvier. Among the known species in the genus are "Der gestreifte Tupaja. *Cladob. vittatus*, in Sumatra. Der Tana, *Cladob. tana*, in Sumatra. Der rostfarbe Tupaja. *Cladob. ferrugineus*, in Java."

SCHLEGEL, HERMANN. Handleiding to de Beoefening der Dierkunde, 1857, vol. 1, pp. 58–59, pl. 3, fig. 31 (⅔).
Describes the genus *Tupaia* and mentions in it *javanica*, *tana*, *dorsalis* (new), black and white figure of latter.

SCHLEGEL, HERMANN. Die Dierentuin van het Kon. Zool. Gen. Natura Artis Magistra, Mammalium, 1872.

Rather poor woodcut of *Tana dorsalis* on page 62; short description of genus; species mentioned, *javanica, tana, dorsalis.*

SCHLEGEL, HERMANN, and MÜLLER, SAL. Over de op de oostindische eilanden levende soorten van het geslacht *Hylogalea*. Verh. Nat. Gesch. Nederl overz. Bezitt., 1843, pp. 159–168, pls. 26 and 27.

Descriptions of the 4 then known Malayan species, *tana, ferruginea, javanica, murina* (new); colored illustrations of the heads of the others, and entire animal of *murina;* drawing of skulls and bones of feet of all; original publication of *Hylogalea* as the generic term for the treeshrews.

SCHNEIDER, GUSTAV. Ergebnisse zoologischer Forschungsreisen in Sumatra O. K. Zool. Anzeiger, vol. 27, pp. 722–724, July 12, 1904.

Contains original description of *Tupaia ferruginea demissa.* See Oldfield Thomas.

——— Ergebnisse zoologischer Forschungsreisen in Sumatra. Säugetiere (Mammalia). Zool. Jahrb., vol. 23, 1905, pp. 1–172.

Records specimens collected in the Deli and Indragiri regions, enumerating *Ptilocercus lowii, Tupaia ferruginea, T. f. demissa, T. splendidula* (probably *T. siaca*), *T. castanea* (= *T. siaca*), *T. javanica, T. malaccana, T. tana,* and *T. tana* var. *speciosa* (the latter two probably represent the same form, *tana*). Interesting remarks on living specimens of *Ptilocercus.* Illustrations in colors, plates 1 and 2 of *Ptilocercus* and *Tupaia demissa.*

SCLATER, W. L. and P. L. Geography of Mammals, 1899, p. 145.

Mentions *Tupaia* and *Ptilocercus* as being very characteristic of the Malayan Subregion of the Oriental Region.

SCUDDER, SAMUEL H. Nomenclator Zoologicus. Bull. U. S. Nat. Mus., No. 19, 1882.

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STERNDALE, R. A. Natural History of the Mammalia of India and Ceylon, 1884, pp. 99–104.

Describes the mainland and Nicobar species and includes *Ptilocercus,* thinking it may be found in Tenasserim. Remarks on habits, etc., mostly quoted.

STONE, WITMER, and REHN, J. A. G. A collection of Mammals from Sumatra, with a Review of the genera Nycticebus and Tragulus. Proc. Acad. Nat. Sci. Phila., 1902, pp. 127–142.

Tupaia tana recorded from Gunong Sugi, Lampong District, Sumatra.

TEMMINCK, C. J. Monographies de Mammalogie, vol. 1, 1827.

On p. 19 first use of *Hylogale* for the "barbarous" *Tupaia.*

THOMAS, OLDFIELD. On the Mammals presented by Allan O. Hume, Esq., C. B., to the Natural History Museum. Proc. Zool. Soc. London, 1886, pp. 54–79.

Records *Tupaia belangeri* (now called *chinensis*) from Aimole and Machi Manipur; *T. belangeri* and *T. ferruginea* from Tenasserim; *T. ferruginea* from Malacca and Selangor; *T. javanica* (probably *T. malaccana*) from Selangor and Johore.

———. On the Mammals of Mount Kina Balu, North Borneo. Proc. Zool. Soc. London, 1889, pp. 228–236.

On p. 229 records 3 specimens of *Tupaia ferruginea* from Mount Kina Balu, collected by John Whitehead. They were probably examples of *T. montana baluensis.*

———. On a Collection of Mammals obtained by Dr. Emin Pasha in Central and Eastern Africa. Proc. Zool. Soc. London, 1890, pp. 443–450.

Remarks on the teeth of the Macroscelididæ and figure of the milk dentition of *Petrodromus.*

———. On some new Mammalia from the East Indian Archipelago. Ann. Mag. Nat. Hist., March, 1892.

Original description of *Tupaia everetti* (now *Urogale everetti*) and *T. picta, T. montana, T. malanura* (now *Dendrogale melanura*).

———. On some Mammals from Mount Dulit, North Borneo. Proc. Zool. Soc. London, 1892, pp. 221–227.

Among them *Tupaia tana, montana, minor, melanura,* and on p. 227, *T. dorsalis.*

THOMAS, OLDFIELD. On the Mammalia collected by Signor Leonardo Fea in Burma and Tenasserim. Ann. Mus. Civ. Stor. Nat. Genoa, ser. 2, vol. 10 (1890–91), pp. 913–949, 1892.

On p. 920 records *Tupaia ferruginea belangeri* (embracing both *belangeri* and *chinensis* of the present paper). Discusses number of mammæ in *T. ferruginea, tana, ellioti,* and *javanica.*

———. On some new Bornean Mammalia. Ann. Mag. Nat. Hist., ser. 6, vol. 11, pp. 341–347, May, 1893.

Original description of *Tupaia ferruginea longipes.*

———. Description of a new Bornean Tupaia. Ann. Mag. Nat. Hist., ser. 6, vol. 12, pp. 53, 54, July, 1893.

Original description of *Tupaia gracilis.*

———. On the Palawan Representative of *Tupaia ferruginea.* Ann. Mag. Nat. Hist., ser. 6, vol. 13, p. 367, April, 1894.

Original description of *Tupaia ferruginea palawanensis.*

———. On some Mammals collected by Dr. E. Modigliani in Sipora, Mentawei Islands. Ann. Mus. Civ. Stor. Nat. Genoa, ser. 2, vol. 14, pp. 661–672, January, 1895.

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———. In Schneider, Gustav. Ergebnisse zoologischer Forschungsreisen in Sumatra, O. K. Zool. Anzeiger, vol. 27, pp. 722–724, July 12, 1904.

Original description of *Tupaia ferruginea demissa.*

———. The Duke of Bedford's Zoological Exploration in Eastern Asia.—III. On Mammals obtained by Mr. M. P. Anderson in the Philippine Islands. Proc. Zool. Soc. London, 1907, pp. 140–142, June 12, 1907.

Remarks on status of *Urogale everetti* and *U. cylindrura,* p. 140.

———. On Mammals collected by Mr. H. C. Robinson on Tioman and Aor Islands, S. China Sea. Journ. Fed. Malay States Mus., vol. 2, No. 3, pp. 101–106, 1908.

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———. Two new Mammals from the Malay Peninsula. Ann. Mag. Nat. Hist., ser. 8, vol. 5, pp. 424–426, May, 1910.

Original description of *Ptilocercus lowi continentis.*

THOMAS, OLDFIELD, and HARTERT, ERNST. List of the first collection of Mammals from the Natuna Islands. Nov. Zool., vol. 1, pp. 652–660, September, 1894.

Record *Ptilocercus lowi* on Sirhassen and *Tupaia splendidula* (now *natunæ*) on Bunguran and *T. tana* (now *sirhassenensis*) on Sirhassen.

———. On a second collection of Mammals from the Natuna Islands. Nov. Zool., vol. 2, December, 1895, pp. 489–492.

Tupaia splendidula typica recorded from Bunguran (now *T. natunæ*) and original description of *Tupaia splendidula lucida.*

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Original description of *Tupaia lacernata.*

———. On Mammals from the Rhio Archipelago and Malay Peninsula collected by Messrs. H. C. Robinson, C. Boden Kloss, and E. Seimund, and presented to the National Museum by the Government of the Federated Malay States. Journ. Fed. Malay States Mus., vol. 4, No. 1, pp. 99–129, December, 1909.

Tupaia castanea on Bintang *T. ferruginea,* S. E. Johore and Singapore; *T. f. batamana* on Batam. Notes by Robinson and Kloss on *T. ferruginea.*

TROUESSART, E.-L. Catalogus Mammalium tam viventium quam fossilium, vol. 1, 1897, pp. 167–169.

Ptilocercus, 1 form; *Tupaia*, subgenus *Dendrogale*, 2 forms; subgenus *Tupaia*, 20 forms.

Vol. 2, 1899, appendix, pp. 1286, 1287. Two additional species of *Tupaia*.

Quinquennale Supplementum Anno 1904, pp. 120–123. The species and subspecies of subgenus *Tupaia* now 28.

[VIGORS.] Catalogue of Zoological Specimens. Memoir of the Life and Public Services of Sir Thomas Stamford Raffles, etc., by Sophia Raffles, London, 1830.

Pages 637–638, genus *Tupaia*. *Tup. Tana*, Sumatra. *Tup. Javanica*, Java. *Tup. ferruginea*, Sumatra.

VOGT, CARL, and SPECHT, FRIEDERICH. Die Säugetiere in Wort und Bild, 1883.

On p. 87 a short account of treeshrews and wood cut. *Cladobates*, *Ptilocercus*, (*Hylomys* also included), family Tupajæ.

WAGLER, J. G. Naturliches System der Amphibien mit vorangehender Classification der Säugthiere und Vögel, 1830.

On p. 15, genus 9, *Hylogale*, with the species *ferruginea*, *tana*, *javanica*.

WAGNER, J. A. Schreber's Säugthiere, Supplementband, 2. Abtheilung, 1841, pp. 37–44, p. 553.

Systematic account of the known Tupaiidæ, *Cladobates tana*, p. 40; *C. ferrugineus*, p. 41; *C. belangeri* (new), p. 42; *C. speciosus* (new), p. 43; *C. javanicus*, p. 44; *C. murinus*, p. 553.

———. Schreber's Säugthiere, Supplementband, 5. Abth. 1856, pp. 524–529, and pls. 34 and 35, in colors.

Descriptions of *Cladobates tana*, p. 525; *Cl. ferrugineus*, p. 526, pl. 34; *Cl. ellioti*, p. 526; *Cl. javanicus*, p. 527; *Cl. belangeri*, p. 527; *Cl. murinus* (subgenus *Dendrogale*), p. 528; *Ptilocercus lowii*, pl. 35.

WALLACE, A. R. Geographical Distribution of Animals, 1876, vol. 1, p. 337, pl. 8, vol. 2, p. 187.

Mentions in a very general way the distribution of the family. *Hylomys* is regarded as a member of the Tupaiidæ.

———. Island Life, 1881.

On p. 345, list of the then known Bornean Tupaiidæ, *Tupaia*, *Dendrogale*, *Ptilocerus* (sic).

WATERHOUSE, G. R. Catalogue of the Mammalia preserved in the Museum of the Zoological Society of London, 1838.

On page 19 four specimens listed, *Tupaia tana* (probably the original specimen), *T. javanica*, *T. ferruginea*.

———. Description of a new species of *Tupaia* discovered in Continent of India by Walter Elliot, Esq. Proc. Zool. Soc. London, 1849, pp. 106–108, pl. 13.

Original description of *Tupaia ellioti* in comparison with *T. tana*, *ferruginea*, and *javanica*; very good plate in colors.

WEBER, MAX. Die Säugethiere, 1904.

Pages 376 and 377, family Tupaiidæ defined; two genera recognized, *Tupaia*, *Ptilocercus*.

WILLINK, T. Mammalia voorkomende in Nederlandsch-Indië. Nat. Tijdschr. Ned.-Ind., vol. 65, pp. 296–300, 1905.

A list of Tupaiidæ known up to 1905 and occurring in the Dutch East Indies, compiled and non-critical.

WINGE, HERLUF. Jordfundne og nulevende Flagermus (Chiroptera) fra Lagoa Santa, Minas Geraes, Brasilien.

Pages 41–51, various osteological and anatomical observations on treeshrews, usually designated as *Cladobates*, sometimes as *Tupaia*.

ZELEBOR, JOHANN. Säugethiere. Reise der österreichischen Fregatte *Novara* um die Erde in den Jahren 1857, 1858, 1859. Zool. Theil, vol. 1, 1869, pp. 1–42, pls. 1–3.

Original description of *Tupaia nicobarica*, with a plate in colors of entire animal and a plate illustrating skeleton, skull, and teeth.

EXPLANATION OF PLATES.

Plate 1.

Tupaia dissimilis, Pulo Condore. Reproduction of the original figure of William Ellis' *Sciurus dissimilis*, in his natural history journal, written during Capt. Cook's third voyage, 1776–1780; now in the British Museum (Natural History). Reproduced by the permission of the authorities of the British Museum. A scale of 100 mm. was laid on the page when photograph was made.

Plate 2.

Skeleton of *Tupaia lacernata wilkinsoni;* Cat. No. 49468, U.S.N.M., Tarang, Lower Siam; collected by Dr. W. L. Abbott. About one-half natural size.

Plate 3.

External appearance of *Tupaia nicobarica*, *T. javanica*, *T. minor*, and *T. glis*. About one-third natural size.

Fig. 1. *Tupaia nicobarica surda;* Type; Cat. No. 111757, U.S.N.M., Little Nicobar Island; Dr. W. L. Abbott, collector.

2. *Tupaia javanica;* Cat. No. 154598, U.S.N.M., Mount Salak, Java; Bryant and Palmer, collectors.
3. *Tupaia minor minor;* Cat. No. 145575, U.S.N.M., Sempang River, western Borneo; Dr. W. L. Abbott, collector.
4. *Tupaia glis ferruginea;* Cat. No. 114548, U.S.N.M., Tapanuli Bay, west coast of Sumatra; Dr. W. L. Abbott, collector.

Plate 4.

External appearance of *Anathana ellioti* (Waterhouse). After the original plate in colors by Waterhouse in the Proceedings of the Zoological Society of London for 1849.

Plate 5.

External appearance of *Dendrogale murina* (Schlegel and Müller). After the original figure in Verhandelingen over de Natuurlijke Geschiedenis der Nederlandsche Overzeesche Bezittingen, 1843.

Plate 6.

External appearance of *Tana cervicalis*, *T. dorsalis*, *Urogale everetti*. About one-third natural size.

Fig. 1. *Tana cervicalis cervicalis;* Type; Cat. No. 121754, U.S.N.M., Tana Bala, Batu Islands, off west coast of Sumatra; Dr. W. L. Abbott, collector.

2. *Tana dorsalis;* Cat. No. 142245, U.S.N.M., Kapuas River, western Borneo; Dr. W. L. Abbott, collector.
3. *Urogale everetti;* Cat. No. 125287, U.S.N.M. (Type of *U. cylindrura*), Mount Apo, Mindanao, Philippine Islands; Dr. E. A. Mearns, collector.

Plate 7.

External appearance of *Ptilocercus lowii* Gray. After the original plate by Gray in the Proceedings of the Zoological Society of London for 1848.

PLATE 8.

Skulls of Treeshrews of the genus *Tupaia*. All figures natural size.

Fig. 1. *Tupaia chinensis;* Cat. No. 37384, U.S.N.M., Carin Hills, Burma; Leonardo Fea, collector.
2. *Tupaia belangeri;* Cat. No. 124284, U.S.N.M., Telok Besar, Tenasserim; Dr. W. L. Abbott, collector.
3. *Tupaia lacernata wilkinsoni;* Cat. No. 83254, U.S.N.M., Trong, or Tarang, Malay Peninsula; Dr. W. L. Abbott, collector.
4. *Tupaia lacernata raviana;* Type; Cat. No. 104355, U.S.N.M., Pulo Rawi, Butang Islands, west coast Malay Peninsula; Dr. W. L. Abbott, collector.
5. *Tupaia lacernata lacernata;* Cat. No. 123901, U.S.N.M., Pulo Lankawi, west coast Malay Peninsula; Dr. W. L. Abbott, collector.
6. *Tupaia glis ferruginea;* Cat. No. 141074, U.S.N.M., Tarussan Bay, west coast of Sumatra; Dr. W. L. Abbott, collector.
7. *Tupaia tephrura;* Type; Cat. No. 121752, U.S.N.M., Tana Bala, Batu Islands, southwest coast of Sumatra; Dr. W. L. Abbott, collector.
8. *Tupaia glis glis;* Cat. No. 1444/11, Selangor Museum, Penang Island, west coast Malay Peninsula.
9. *Tupaia glis batamana*; Type; Cat. No. 142151, U.S.N.M., Batam Island, Rhio Archipelago; Mr. C. Boden Kloss, collector.

PLATE 9.

Skulls of treeshrews of the genus *Tupaia*. All figures natural size.

Fig. 1. *Tupaia cuyonis;* Type; Cat. No. 26, Philippine Museum, Cuyo, Philippine Islands; McGregor and Celestino, collectors.
2. *Tupaia montana montana;* Cat. No. 84507, U.S.N.M., Mount Dulit, northern Borneo; Charles Hose, collector.
3. *Tupaia picta*; Cat. No. 84506, U.S.N.M., Baram District, northern Borneo; Charles Hose, collector.
4. *Tupaia discolor;* Type; Cat. No. 124703, U.S.N.M., Island of Banka; Dr. W. L. Abbott, collector.
5. *Tupaia longipes salatana;* Type; Cat. No. 151882, U.S.N.M., Pangkallahan River, Klumpang Bay, southeastern Borneo; Dr. W. L. Abbott, collector.
6. *Tupaia hypochrysa;* Cat. No. 154599, U.S.N.M., Mount Salak, western Java; Bryant and Palmer, collectors.
7. *Tupaia phæura;* Type; Cat. No. 113148, U.S.N.M., Sinkep Island; Dr. W. L. Abbott, collector.
8. *Tupaia glis sordida;* Type; Cat. No. 101747, U.S.N.M., Pulo Tioman, off southeast coast Malay Peninsula; Dr. W. L. Abbott, collector.
9. *Tupaia chrysogaster;* Type; Cat. No. 121572, U.S.N.M., North Pagi Island, southeast coast of Sumatra; Dr. W. L. Abbott, collector.

PLATE 10.

Skulls of treeshrews of the genera *Tupaia* and *Ptilocercus*. All figures natural size.

Fig. 1. *Tupaia javanica;* Cat. No. 121488, U.S.N.M., near Batavia, Java.
2. *Tupaia gracilis inflata;* Type; Cat. No. 124709, U.S.N.M., Island of Banka; Dr. W. L. Abbott, collector.
3. *Tupaia minor minor;* Cat. No. 153857, U.S.N.M., Kendawangan River, southwestern Borneo; Dr. W. L. Abbott, collector.
4. *Tupaia minor malaccana*; Cat. No. 112618, Sembrong River, Johore; Dr W. L. Abbott, collector.
5. *Ptilocercus lowii continentis;* Cat. No. 112611, U.S.N.M., Sembrong River, Johore; Dr. W. L. Abbott, collector.

Fig. 6. *Tupaia carimatæ;* Type; Cat. No. 125123, U.S.N.M., Karimata Island. Dr. W. L. Abbott, collector.

7. *Tupaia nicobarica surda;* Type; Cat. No. 111757, Little Nicobar, Nicobar Islands; Dr. W. L. Abbott, collector.

8. *Tupaia siaca;* Type; Cat. No. 144205, U.S.N.M., Little Siak River, eastern Sumatra; Dr. W. L. Abbott, collector.

9. *Tupaia castanea;* Type; Cat. No. 115608, U.S.N.M., Pulo Bintang, Rhio Archipelago; Dr. W. L. Abbott, collector.

10. *Tupaia chrysomalla;* Type; Cat. No. 101710, U.S.N.M., Pulo Siantan, Anamba Island, South China Sea; Dr. W. L. Abbott, collector.

11. *Tupaia splendidula;* Cat. No. 153856, U.S.N.M., Kendawangan River, southwestern Borneo; Dr. W. L. Abbott, collector.

12. *Tupaia natunæ;* Type; Cat. No. 104714, U.S.N.M., Bunguran, Natuna Islands; Dr. W. L. Abbott, collector.

PLATE 11.

Skulls of treeshrews of the genera *Tana* and *Urogale*. All figures natural size.

Fig. 1. *Tana dorsalis;* Cat. No. 142245, U.S.N.M., Kapuas River, western Borneo; Dr. W. L. Abbott, collector.

2. *Tana lingæ;* Type; Cat. No. 101597, U.S.N.M., Linga Island; Dr. W. L. Abbott, collector.

3. *Tana tana sirhassenensis;* Type; Cat. No. 101712, U.S.N.M., Sirhassen, Natuna Islands; Dr. W. L. Abbott, collector.

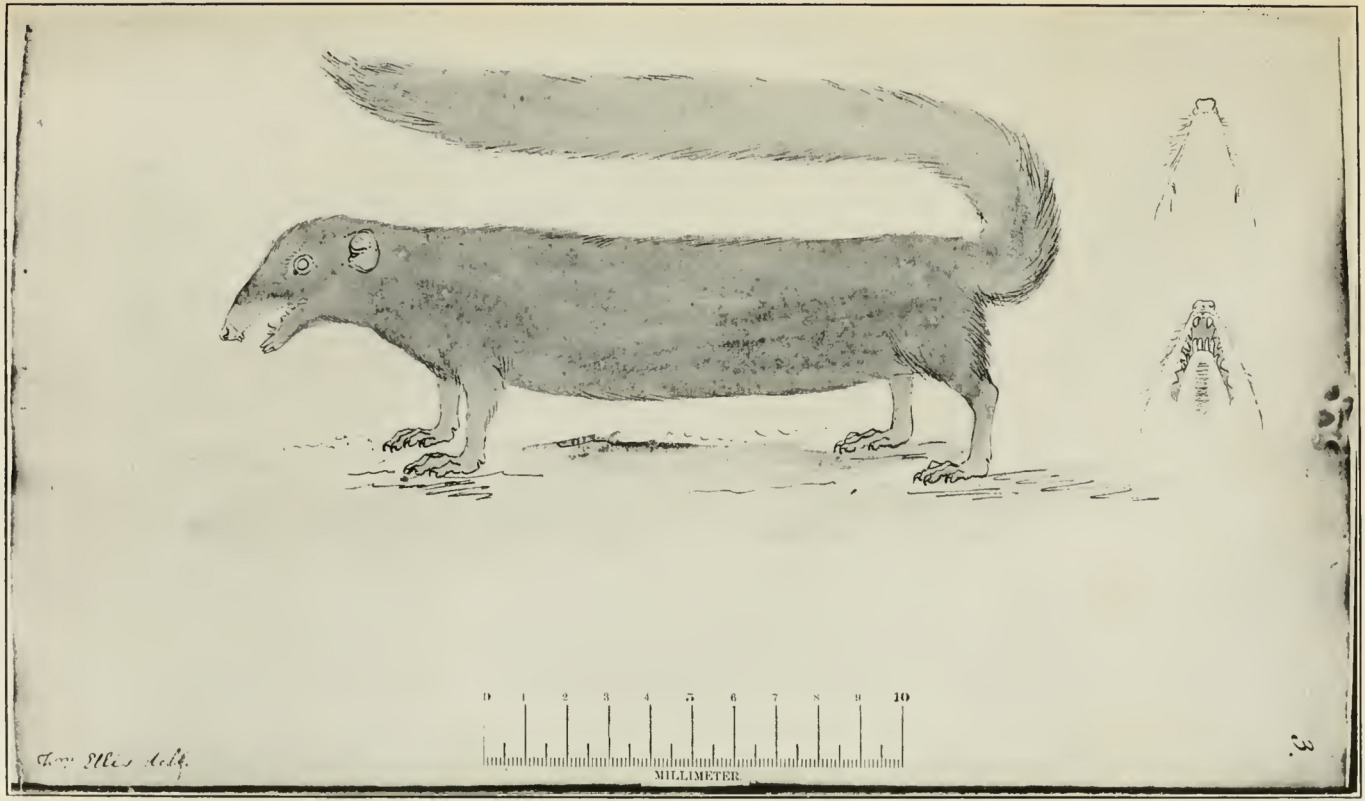
4. *Tana tana tana;* Cat. No. 174612, Landak region, Sumatra; Gustav Schneider, collector.

5. *Tana tana bunoæ;* Type; Cat. No. 101640, Bunoa, Tambelan Islands, South China Sea; Dr. W. L. Abbott, collector.

6. *Urogale everetti;* Cat. No. 125287, U.S.N.M. (type of *U. cylindrura*), Mount Apo, Mindanao, Philippine Islands; Dr. E. A. Mearns, collector.

7. *Tana cervicalis cervicalis;* Type; Cat. No. 121754, U.S.N.M., Tana Bala, Batu Islands, southwest coast of Sumatra; Dr. W. L. Abbott, collector.

8. *Tana tana besara;* Type; Cat. No. 142247, U.S.N.M., Kapuas River, western Borneo; Dr. W. L. Abbott, collector.



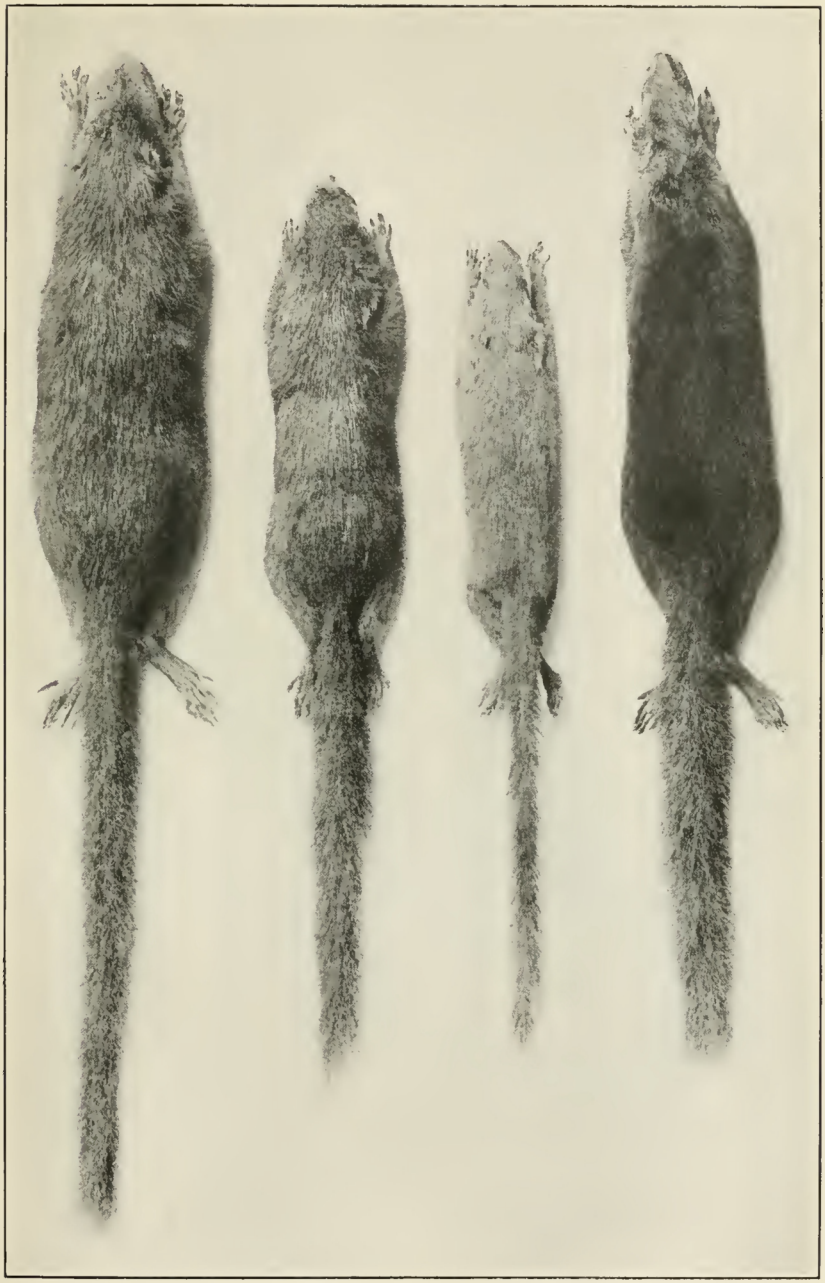
CONDORE ISLAND TREESHREW, TUPAIA DISSIMILIS FROM ELLIS' MANUSCRIPT JOURNAL, 1780.

FOR EXPLANATION OF PLATE SEE PAGE 181.



MALAY PENINSULA TREESHREW, TUPAIA LACERNATA WILKINSONI.

FOR EXPLANATION OF PLATE SEE PAGE 181.



NICOBARICA. JAVANICA. MINOR. GLIS.

SKINS OF TREESHREWS OF THE GENUS TUPAIA.

FOR EXPLANATION OF PLATE SEE PAGE 181.



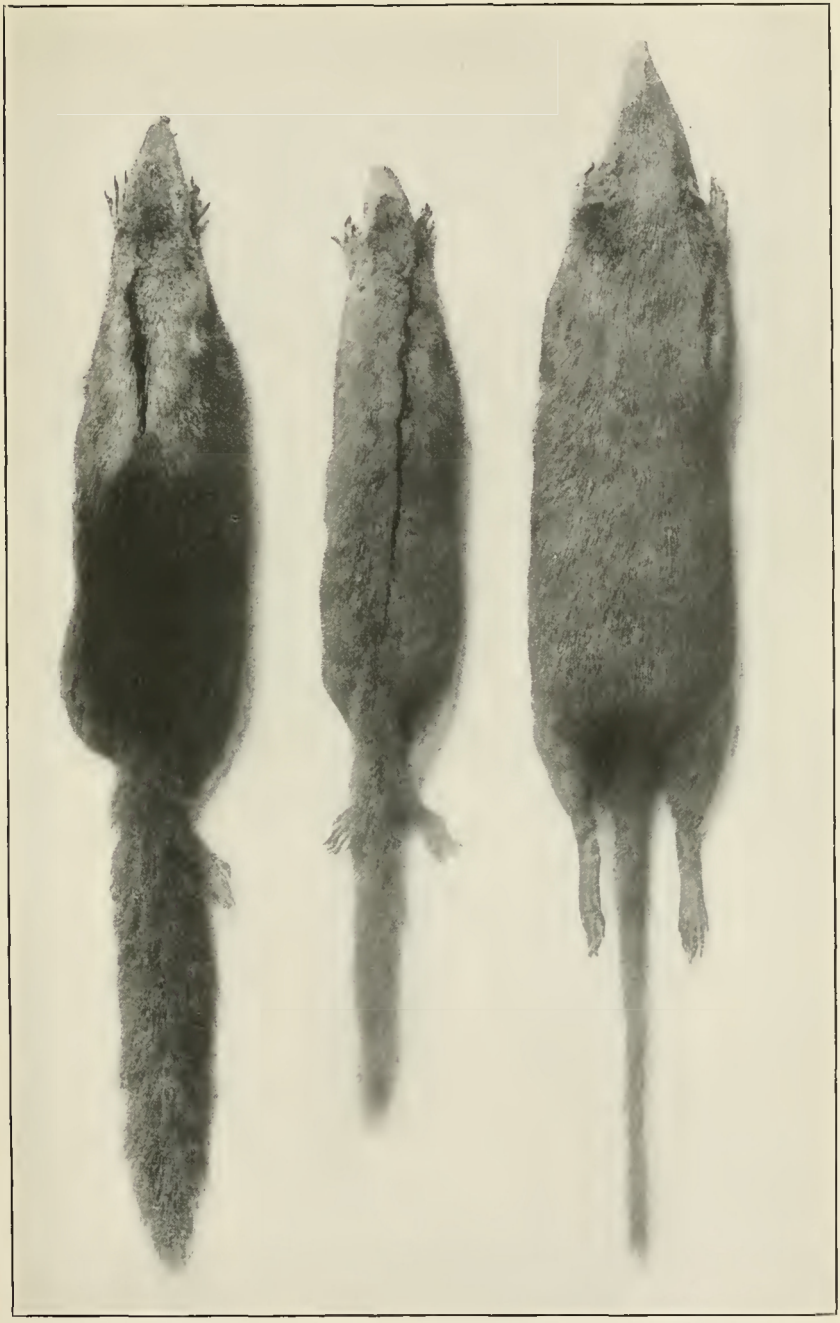
INDIAN TREESHREW, ANATHANA ELLIOTI FROM WATERHOUSE.

FOR EXPLANATION OF PLATE SEE PAGE 181.



PIGMY TREESHREW, DENDROGALE MURINA FROM SCHLEGEL AND MÜLLER.

FOR EXPLANATION OF PLATE SEE PAGE 181.



T. CERVICALIS. T. DORSALIS. U. EVERETTI.

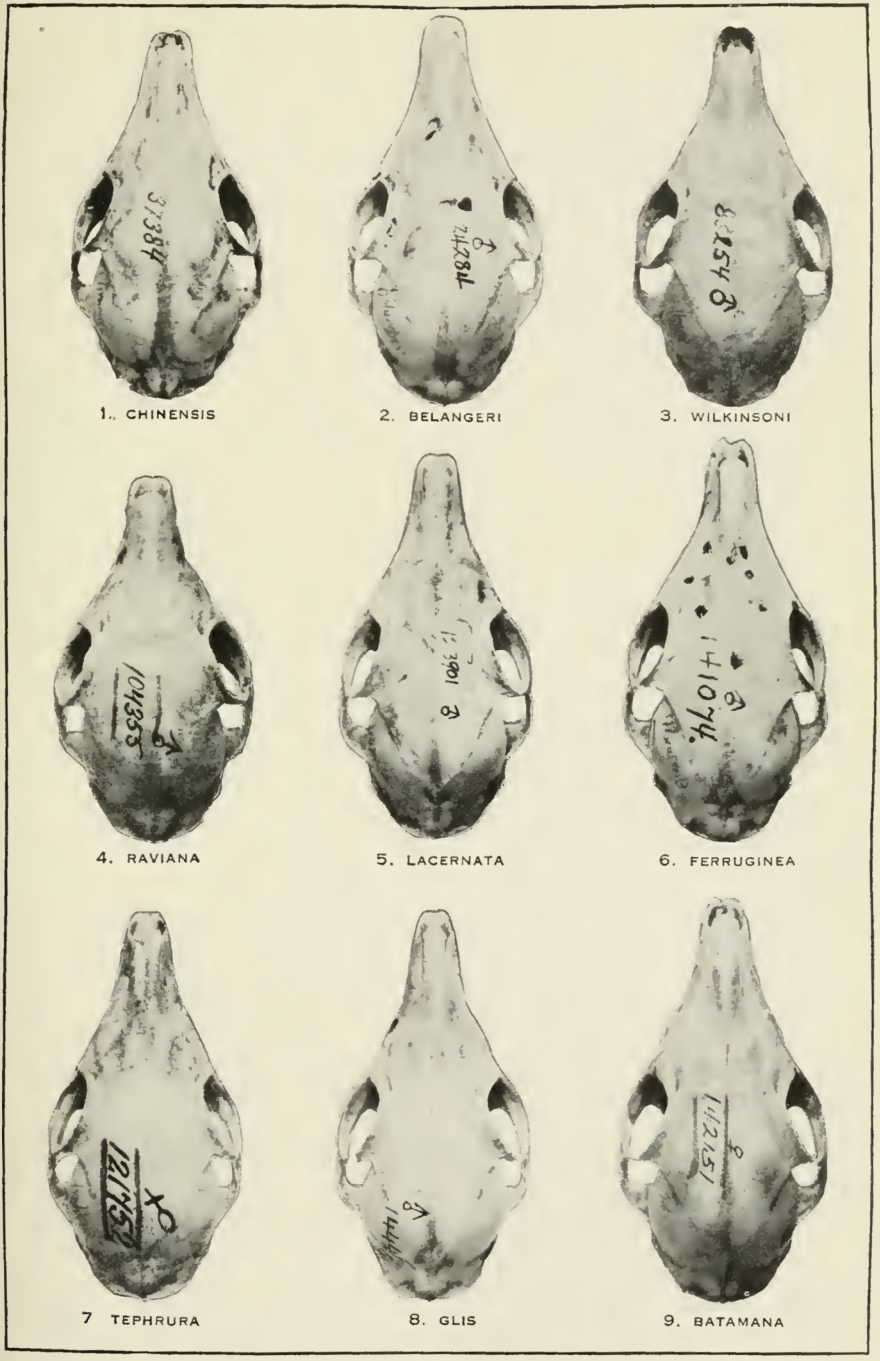
SKINS OF TREESHREWS OF THE GENERA TANA AND UROGALE.

FOR EXPLANATION OF PLATE SEE PAGE 181.



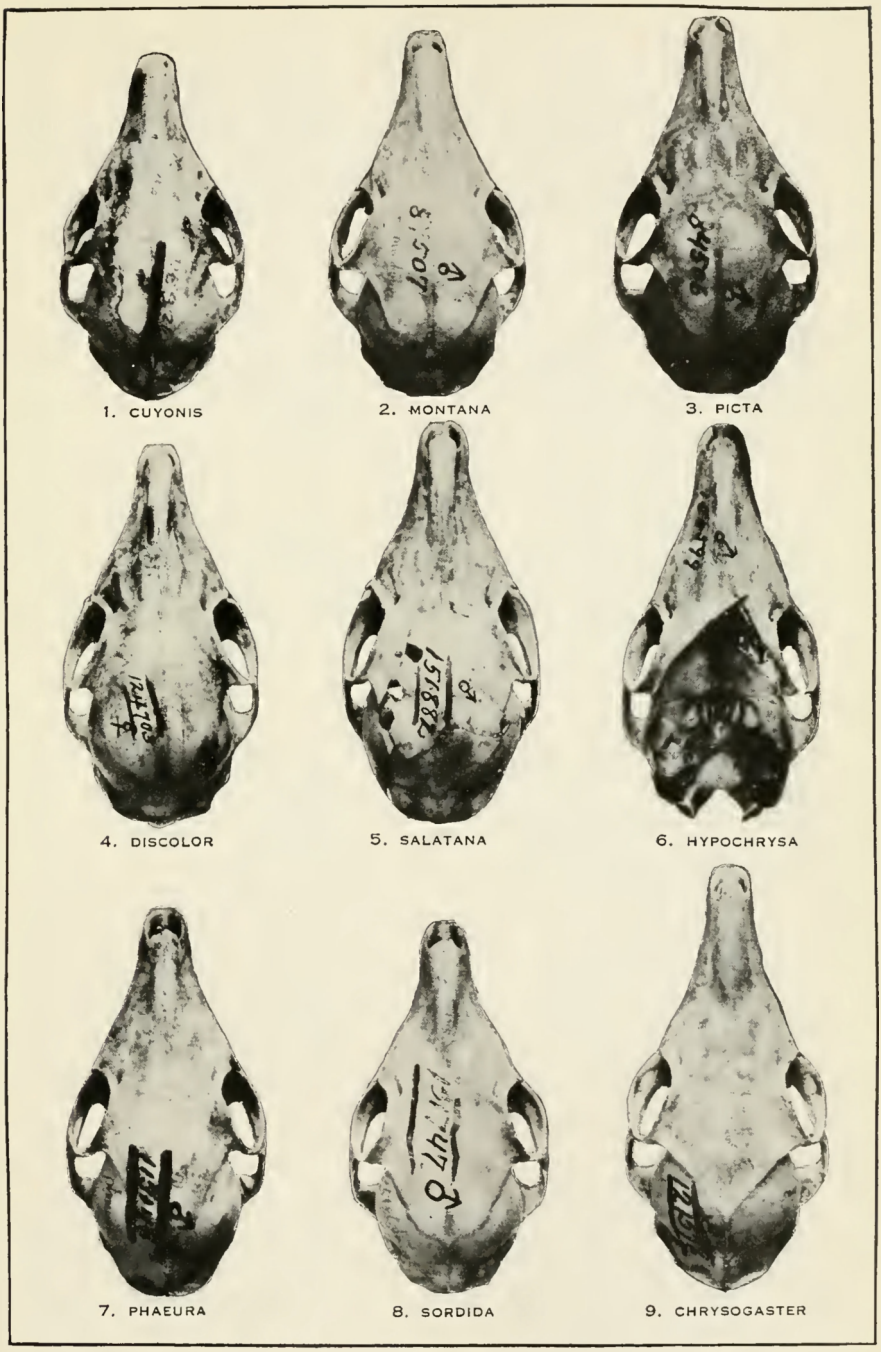
PENTAILED TREESHREW, PTILOCERCUS LOWII AFTER GRAY.

FOR EXPLANATION OF PLATE SEE PAGE 181.



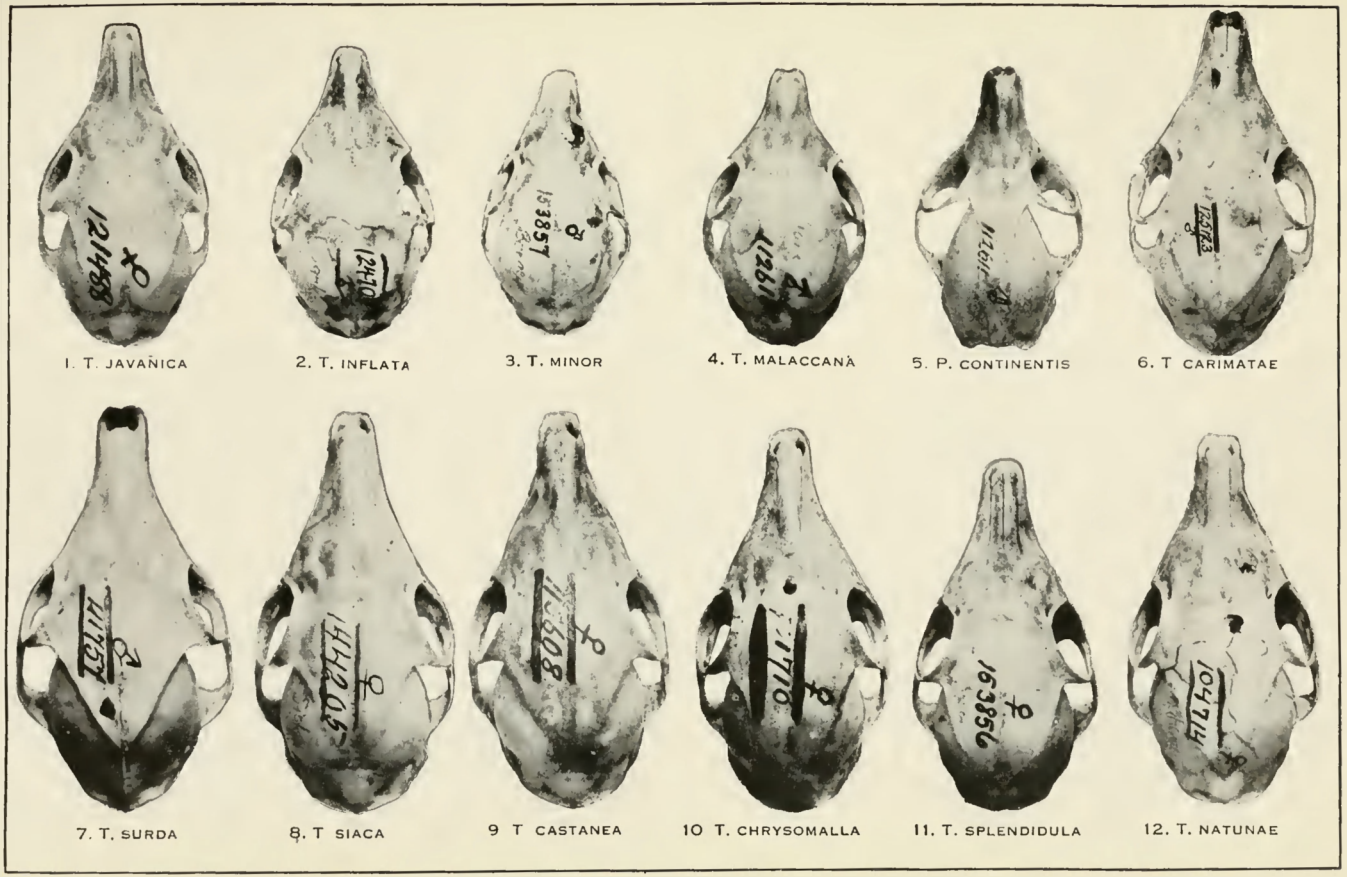
SKULLS OF TREESHREWS OF THE GENUS TUPAIA.

FOR EXPLANATION OF PLATE SEE PAGE 182.

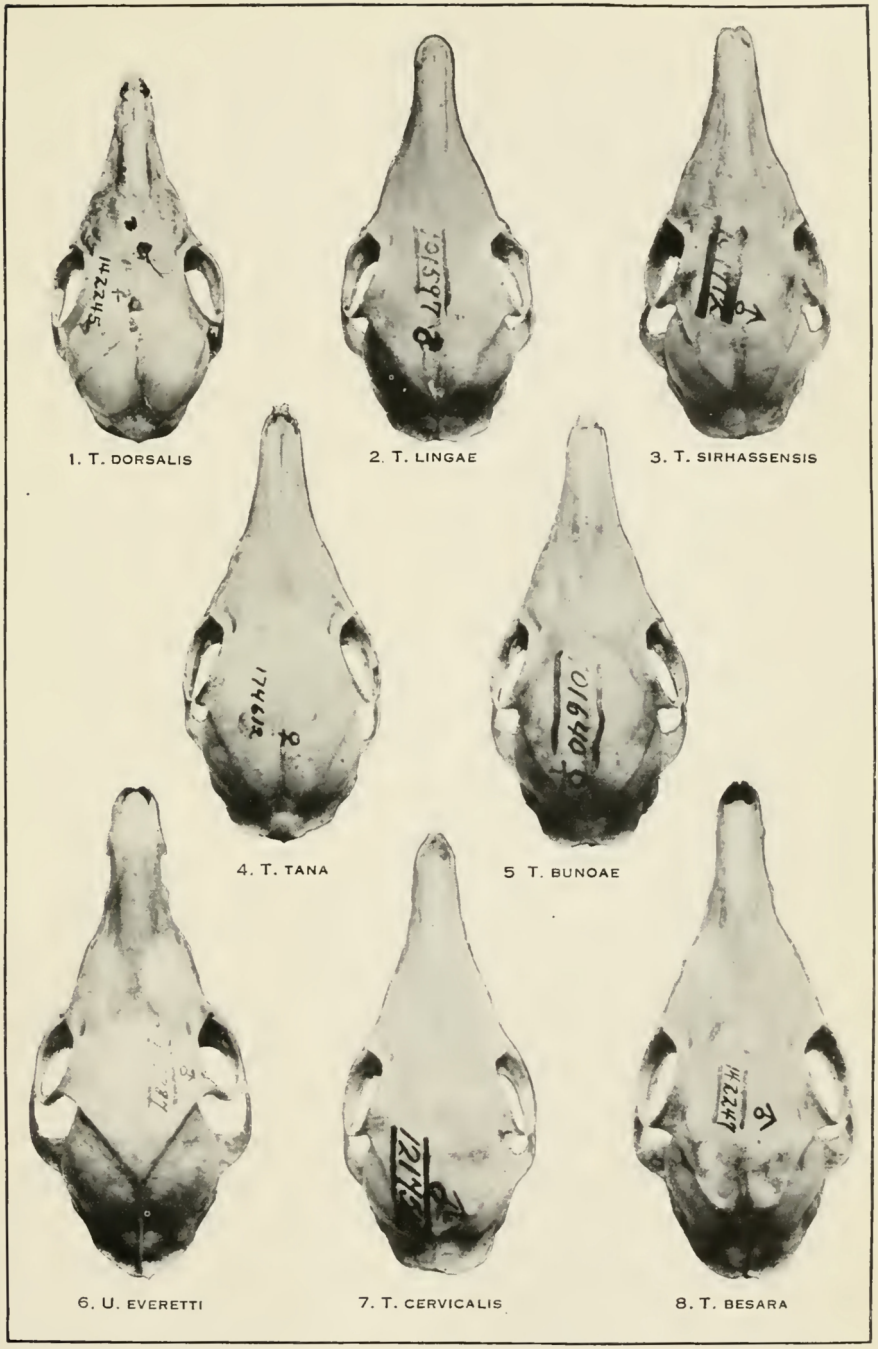


SKULLS OF TREESHREWS OF THE GENUS TUPAIA.

FOR EXPLANATION OF PLATE SEE PAGE 182.



SKULLS OF TREESHREWS OF THE GENERA TUPAIA AND PTILOCERCUS



SKULLS OF TREESHREWS OF THE GENERA TANA AND UROGALE

FOR EXPLANATION OF PLATE SEE PAGE 183.

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ADDENDA.

The following description appeared too late to be placed in the body of this paper. It should be read after the account of *Tupaia javanica* on page 107. (See also page 15.)

TUPAIA JAVANICA BALINA Thomas.

1913. *Tupaia javanica balina* Thomas, Ann. Mag. Nat. Hist., ser. 8, vol. 11, p. 505, May, 1913.

Type-locality.—Island of Bali, east of Java.

Type-specimen.—In British Museum, skin without skull, Reg. No. 13.3.6.12, collected at Gunong Bratan, Bali, 4,000 feet altitude, January 27, 1911, by Mr. E. Stresemann. Original number, 10.

Geographic distribution.—Island of Bali. (See map on page 111.)

Diagnostic characters.—Essentially like *Tupaia javanica javanica*, but smaller; hind foot shorter; color, browner.

Color.—Upper parts grizzled brown, nearest mummy brown; belly clay color, the hairs slaty basally, buffy on throat and axillæ; shoulder streak well marked; hands and feet brown, not so gray as in *javanica javanica;* inner side of hind limbs washed with buffy whitish; tail like body, middle of under surface suffused with cinnamon.

Measurements.—Type. Head and body, 117 mm.; tail, 153; hind foot (without claws), 34. Skull lost.

Specimens examined.—None. The above account is based on the original description. The type-specimen is unique.

The United States National Museum has received from the Kutei or Mahakkam River, eastern Borneo (see map on page 75), 30 specimens of treeshrews, too late to be incorporated with the preceding account. They are identified as follows:

TUPAIA MÜLLERI Kohlbrugge. (See page 83.)

1896. *Tupaja mülleri* Kohlbrugge, Natuur. Tijdschr. Nederl. Indië, vol. 55 (ser. 9, vol. 4), 1896, p. 196.

Type-locality.—Environs of Banjarmassin, southeastern Borneo.

Type-specimen.—I have not seen the type-specimen and do not know where it is. It may be in the Leyden Museum.

Geographic distribution.—Southeastern Borneo.

Diagnosis.—A member of the *splendidula* group, characterized by lighter neck and shoulders, and by a dark stripe extending from nape onto lower back much as in the case of *Tana tana;* tail with a distinct grizzle, resembling that of *Tupaia carimatæ;* mammæ, 2–3 = 5?

Color.—Based on two individuals from the Kutei River region. Upper parts and sides of neck and body, upper side of tail, and outer side of legs, a fine grizzled mixture of chestnut or dark cinnamon rufous and blackish, the reddish color slightly in excess except along middle line of neck and body where the blackish color forms a stripe about 2 millimeters wide anteriorly and nearly 20 millimeters wide over lower back. Anteriorly the reddish color inclines toward ochraceous. Under parts and inner side of legs varying from buffy to ochraceous with darker bases of the hairs showing through. Underside of tail similar to upper, but lighter color more tawny or tawny ochraceous and more conspicuous on either side of the middle line than is the brownish black color. Shoulder stripe well marked.

Skull and teeth.—Essentially as in *Tupaia splendidula,* but brain case slightly wider, approaching that of *T. picta.*

Measurements.—Female with moderately worn teeth and female with last molars appearing: Head and body 166, 169 mm.; tail, 143, 157; hind foot, 40, 41; condylobasal length, 46, 43.5; zygomatic width, 26, 23; width of braincase, 19, 19; maxillary toothrow, 18, 18.

Specimens examined.—Two, both from Loa Bamban, near Samarinda, Kutei River, eastern Borneo.

Remarks.—With the exception of the dark dorsal stripe, this species closely resembles *Tupaia carimatæ* (page 98) in color, but the skull is larger and wider. The presence of the dorsal stripe is somewhat suggestive of *T. picta,* but the stripe is not so pronounced or narrow, and the whole animal is much duller in color and apparently closely related to *T. spendidula.* I have not examined the type of *T. mülleri,* and the above identification is made with some reservation.

TUPAIA MINOR MINOR Günther. (See page 110.)

Twelve specimens; 2 from Batu Panggah, 2 from Segah River, and 8 from Birang River; Kutei River region.

TUPAIA GRACILIS GRACILIS Thomas. (See page 117.)

Four specimens; 1 each from Loa Bamban, Karang Tigau, Birang River, and Segah River; Kutei River region.

TANA TANA TANA (Raffles). (See page 139.)

Twelve specimens, 7 from Birang River, 3 from Segah River, 1 from Domering, and 1 from Talisaian Mountain; Kutei River region.

A SYSTEMATIC MONOGRAPH OF THE CHALCIDOID HYMENOPTERA OF THE SUBFAMILY SIGNIPHORINÆ.[1]

By A. Arsène Girault,

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INTRODUCTION.

About a year ago Dr. L. O. Howard, at my request, placed a collection of slide-mounted Encyrtidæ of the subfamily Signiphorinæ into my hands for study, sending me later all of the types and the specimens in the collections of the United States National Museum. This combined collection was unique in that it contained, I believe, all of the specimens of the subfamily known to exist in collections. I have received several other specimens from the collections of the Illinois State Laboratory of Natural History but without adding much of value; and have added also a few new species collected in Australia. Having types of all the species with but a single exception, together with a comparatively large miscellaneous collection drawn from all parts of their habitat, an opportunity was presented to make an adequate systematic study of the group.

The species of the single genus of the subfamily seem to be naturally segregated into about six species groups according to general coloration; four of these groups are easily separable but two of them present much difficulty, their coloration becoming variable and their structure nearly identical. However, of the 14 described species all have proved valid, so far as I was able to determine, with the exception of one. This exception proves to be a color variant of the type-species. The remaining 13 forms when divided into their color groups nearly always have some slight structural character which is correlated with their specific coloration. Many of these structural characteristics are marked, but others not so. In the two closely allied groups spoken of above, however, the only structural characteristic separating most of the species is the presence or absence of a bristle from the surface of the fore wing (called the

[1] It will be noticed in this paper that in connection with the data on the slides certain numbers are occasionally given in addition to the type numbers. Most of these refer to the series of biological notes in the Bureau of Entomology of the United States Department of Agriculture. Where these notes have given additional data which seemed of importance to this paper they have been mentioned in footnotes by the undersigned.—J. C. Crawford.

"discal bristle" in this paper). What value this possesses I have been unable to determine, but for the present it has served to make the validity of at least one species (*townsendi* as opposed to *flavopalliata*) To the 13 described species I add 14 others in the pages following, making in all a total of 27 species, all of which, with the possible exception of one or two, I believe are distinct. There are no well-marked varieties.

This paper will again emphasize the importance of either detailed or comparative description and will treat of a group of great interest from whatever standpoint it is viewed. Thus, from the systematic standpoint an isolated group of species may be seen, which, beginning at one end with deep black and at the other with yellow, converge toward each other, so much so as to cause confusion at the middle or therabouts. A genus is seen, the only representative of its subfamily, which has such a peculiar form and bears such peculiar characters that it has been a matter of dispute where to place it in the great complex of which it forms a part, though I consider its present position as nearly right as possible. For ecology, the host relations of these parasites should form a study of great value, since they seem to be entirely dependent for their existence upon one or two specialized groups of insects. The study of specific variation, it seems to me, could be made in this group with much profit and success; thus, the coloration is variable but of more interest is the fact that comparatively very slight structural variation becomes of specific value here, for instance, as mentioned about the isolated bristle arising from the fore wing.

From the systematic standpoint, this paper has significance (1) as showing the relative paucity of our knowledge of the existing specific forms in a previously explored insect group, (2) and as showing the inadequacy for recognition of specific forms of brief, noncomparative descriptions.

For a systematic monograph has several elementary functions: (1) To record every definite variety (species, varieties, and so on of systematic language) known to exist in nature; (2) to make the identification of each of these possible and to determine their proper names. Beyond these, other considerations become of secondary importance.

HISTORY OF THE SIGNIPHORINÆ.

Family ENCYRTIDÆ.

Subfamily SIGNIPHORINÆ.

Signiphorinæ HOWARD, 1894, p. 234.—ASHMEAD, 1899, pp. 236, 248; 1900, p. 324; 1904, pp. 286–287, 311, 497.
Signiphorini SCHMIEDEKNECHT, 1909, pp. 191, 261.

This subfamily was established 18 years ago by Howard (1894) in the following manner. It was in a paper describing *Signiphora*

occidentalis. Referring to the type species (*flavopalliata*) of the genus, after paraphrasing the original generic description, it was written:

In the Annual Report of the U. S. Department of Agriculture for 1880 (p. 371), we called attention to this remarkable insect and stated that Mr. Ashmead was probably in error in locating the "anomalous five-lobed appendage" upon the hind legs instead of upon the middle legs, since it is probably homologous with the apical spur upon the middle tibia so strongly developed in the Aphelininæ and Encyrtinæ.

Subsequent rearings of specimens from *Mytilaspis* [*Lepidosaphes*] *gloverii*, and *Aspidotus cydoniæ* [*lataniæ*] from Florida, from an Aleyrodes on oak from California, by Mr. Coquillett, and from *Aspidiotus aurantii* [Maskell] by the same gentleman, as well as the deposit of one of Mr. Ashmead's types in the collection of the U. S. National Museum, have enabled us to make a careful study of this peculiar genus. It differs so markedly from all other known Chalcididæ that it must be placed in a subfamily by itself, and we therefore propose for it the subfamily name *Signiphorinæ* . Several important points in the structure of the insect were not made out by Mr. Ashmead, and with more abundant material at our disposal we have drawn up a somewhat closer description of the genus and have characterized the subfamily, adding a description of the new species reared by Mr. Coquillett from the Red Scale.

SIGNIPHORINÆ, Subfam. nov.

Tarsi 5-jointed. Apical spur of middle tibia long and with *several long spines on inner edge*. Pronotum reaching nearly to tegulæ. Mesoscutum entire. *Mesoscutellum represented by a narrow transverse band.* Mesopleura short, sharply divided from metapleura. *Metascutum with a differentiated triangular central sclerite*, resembling the normal mesoscutellum. Antennæ at most 8-jointed. Ovipositor cleft of female abdomen extending back to 3d segment. (p. 234).

Five years later, Ashmead (1899) characterized the group exactly as quoted later for his paper of 1904. In 1900 the same author characterized it thus, quoting verbatim:

Family LXVII. ENCYRTIDÆ.[1]

The three subfamilies mentioned above, into which this family is divided, may be separated upon the following characters:

Mesonotum *not* entire, most frequently depressed or concave on disk, rarely convex, the parapsidal furrows distinct, or at least more or less present; marginal vein usually long..... Subfamily I. EUPELMINÆ.

Mesonotum entire, convex or subconvex, the parapsidal furrows always entirely wanting.

Marginal vein rarely very long, often punctiform, and always very much shorter than the subcostal vein; stigmal vein usually short but distinct, rarely very long; scutellum normal, the axillæ never closely united to form a transverse linear sclerite at base of scutellum; middle tibiæ without lateral spurs. Subfamily II. ENCYRTINÆ.

Marginal vein long, as long or nearly as long as the subcostal vein; scutellum abnormal, the axillæ closely united without suture between, forming a transverse linear sclerite at base of scutellum proper; middle tibiæ *with* lateral spurs, the lateral apical spur lobed..... Subfamily III. SIGNIPHORINÆ.

On a previous page (p. 323) Ashmead had written: "The subfamilies Eupelminæ, Encyrtinæ, and Signiphorinæ, the latter based upon

[1] The footnote is omitted as irrelevant.

my genus *Signiphora*, established in 1880, as I have already published elsewhere, constitute a distinct family in the subfamily [1] Chalcidoidea, to which the family name Encyrtidæ should be applied." He gives nothing further concerning it excepting a table of the species (quoted beyond), followed by a catalogue of the species, 12 of which are briefly described for the first time. However, four years later (Ashmead, 1904) the following synopsis of the subfamily was given, at first giving the table of the subfamilies of the Encyrtidæ quoted herewith:

TABLE OF SUBFAMILIES.

1. Mesonotum entire, convex or subconvex, the parapsidal furrows entirely absent.. 2. Mesonotum not entire, usually depressed or impressed, rarely convex, the parapsidal furrows distinct or at least more or less distinct, never entirely wanting; marginal vein usually long..... Subfamily I. EUPELMINÆ.
2. Marginal vein rarely very long, often punctiform, and always much shorter than the submarginal or subcostal vein; stigmal vein usually short, rarely long; scutellum never short or transversely linear; middle tibiæ without lateral spurs. Subfamily II. ENCYRTINÆ.

Marginal vein long, as long as the submarginal or subcostal vein; scutellum very short, transversely linear; middle tibiæ with lateral spurs, the apical spur lobed. Subfamily III. SIGNIPHORINÆ.

The synopsis follows:

Subfamily III. SIGNIPHORINÆ.

1894. *Signiphorinæ*, subfamily, HOWARD, Ins. Life, vol. 6, p. 234.
1899. *Signiphorinæ*, subfamily III, ASHMEAD, Proc. Ent. Soc. Washington, vol. 4, p. 248.

This subfamily was established by Dr. L. O. Howard, in 1894, and was based upon my genus *Signiphora*, described in 1880, from specimens bred in Florida from the purple scale, *Aspidiotus citricola* Packard. Many species have since been discovered from different parts of the world, and the group, although at present represented by a single genus, has evidently a wide distribution. The species destroy scale insects, Coccidæ, and the mealy-winged flies, Aleurodidæ.

Antennæ apparently three-jointed but in reality six-jointed, there being three minute ring-joints easily overlooked; wings with a long marginal fringe, the marginal vein long, about the length of the subcostal vein, the stigmal vein distinct but not long, the postmarginal vein absent; middle tibiæ with a large, lobed apical spur, and with lateral spurs or strong bristles. *Signiphora* Ashmead (type *S. flavopalliata* Ashm.). (p. 311.)

Schmiedeknecht's more recent treatment of the subfamily adds nothing. He gives the group tribal rank. At present, it does not seem advisable to add anything to the subfamily characters, thus tending to limit it.

This history is a brief one. The history of the genus is practically the same. *Signiphora* Ashmead was described 32 years ago (Ashmead, 1880) in the following manner:

[1] Superfamily.

SIGNIPHORA, nov. gen.[1]

Form robust, polished, or shining; head much wider than thorax, three ocelli, triangularly arranged, labial palpi three-jointed; antennæ inserted in front between the eyes, rather close together, three-jointed; first joint of scape long, second small and round, third large and fusiform, (Plate 2, fig. 3) thorax broad, not quite as long as abdomen; legs setaceous, with five-jointed tarsi, first joint longest; *hind tibia in place of the usual spine, furnished with an anomalous five-lobed appendage*, (Plate 2, fig. 15). In this respect, differing from any known chalcid. Abdomen somewhat sharply pointed and ending in rather a long ovipositor (Plate 2, fig. 5). Wings well rounded and strongly ciliated (Plate 2, figs. 6 and 8). Coxæ almost touching. (p. 30).

In the year following, Howard (1881), in concluding a discussion of coccid parasites in general, wrote concerning this genus as follows:

The new genus (*Signiphora*, founded for *S. flavopalliatus* Ashmead), we are not prepared to discuss at present, but would simply state that specimens of an insect corresponding very exactly with his description have been bred from the same scale (*Mytilaspis citricola* Packard), and that the "anomalous five-lobed appendage" which Mr. Ashmead locates upon the hind tibiæ of *Signiphora* is present upon the middle tibiæ, and is homologous with the middle tibial spine of the *Encyrtinæ* and *Aphelininæ*. The genus is also to be placed with the Mymarinæ.

A decade or so later, Howard (1894) redescribed the genus in this manner,[2] also redescribing the type species as new:

SIGNIPHORA Ashmead.

Type, *S. flavopalliata* Ashm., Orange Insects, 1880, p. 30.

Body robust; ocelli 3, situated in triangle. Antennæ inserted at border of clypeus, six-jointed; scape reaching nearly to top of head; pedicle large, nearly as long as scape; funicle joints 1, 2, and 3 very small; club very long, undivided. Face round; mandibles strong, bidentate; labial palpi rudimentary; maxillary palpi three-jointed. Fore-wings rather broad and short; submarginal and marginal veins subequal in length; marginal thick; stigmal thinner and curved; marginal and stigmal veins with several long, stiff bristles; no discal cilia; marginal cilia very long and delicate, beginning on costal margin just beyond stigmal, and extending around to a point opposite the stigmal. Hind-wings narrow and with very long and delicate cilia beginning beyond marginal vein and extending around nearly to hinder base of wing. Middle tibiæ with a number of stout bristles, apical spurs as long as first tarsal joint and furnished on inner edge with five or six long bristles at regular intervals; front and hind legs unarmed. Abdomen broadly sessile, rounded at tip; ovipositor of female somewhat extruded, apical spiracles facing ventrally; male penis long, cleft at tip.

Some generic characters to be noticed are: The entire absence of discal ciliation and the presence in some species of a bristle from the surface of the fore wing; the varying length of the marginal ciliation; the neckless stigmal vein; the many tined cephalic tibial spur; the bidentate mandibles; the long, solid antennal club.

[1] Immediately preceding this description it was written "Owing to the anomalous character of this fly I can find no genus to which it belongs. I therefore propose a new one, under the name of *Signiphora*, (the token bearer)" (p. 30).

[2] Insect Life, vol. 6, 1894, p. 235.

In 1896 Johnson recorded a *Signiphora nigrita* Howard MS. as a parasite of *Aspidiotus forbesi* Johnson; this species is a *nomen nudum* and is described beyond. Two years later, De Dalla Torre gave the following catalogue of the group:

21. Subfam. SIGNIPHORINÆ.

Howard, Insect Life, VI, 1894 p. 234.

SIGINPHORA.

Ashmead, Orange Insects, 1880 p. 30.
Signum; φέρω, fero.
(*flavopalliata* Ashm.[1])—Am.: Florida.
Signiphora flavopalliata Ashmead, Orange Insects, 1880 p. 31,
T. 2 F. 2, 3, 6, 8, 12 & 13.
Signiphora flavopalliata Howard, Comstock: Rep. Entomol. U. St. f. 1880, 1881 p. 371.
Signiphora flavopalliata Howard, Insect Life, VI. 1894 p. 235.
(*occidentalis* How.[2])—♀ ♂—Am.: California.

Signiphora Occidentalis Howard, Insect Life VI. 1894 p. 234, ♀ ♂.

Ashmead (1900) then made an important contribution to the knowledge of the group, describing 12 new forms and giving the following table of the species. Fourteen species were listed. I quote the table herewith, especially in order to allow a more ready and convenient comparison of it with my own, given later.

TABLE OF SPECIES.

Body *not* wholly black.....2
Body wholly black or blue-black.
Wings fuliginous on basal half; all tarsi white, the middle and anterior tibiæ brown, rest of legs black.....(1) *S. nigra* Ashmead, new species.
Wings fuscous with a hyaline band across the middle; legs black, a dot on knees and the tarsi whitish.....(2) *S. australiensis* Ashmead, new species.
Wings hyaline, with a fuscous band across the middle; tarsi alone white.
(3) *S. dactylopii* Ashmead, new species.
Wings entirely hyaline; all tarsi white.....(4) *S. noacki* Ashmead, new species.
2. Head, thorax, and most of the abdomen yellow.....4
Head anteriorly and a broad band between the wings ivory white.....3
Thorax black, with a single narrow yellowish-white band across the base of the scutellum and continued at sides along the posterior margin of the mesopleura and the mesosternal suture; wings hyaline.
(5) *S. unifasciata* Ashmead, new species.
Thorax black, with two transverse narrow bands between the tegulæ; wings hyaline.....(6) *S. bifasciata* Ashmead, new species.
Head and abdomen blue-black; thorax except the pronotum, bright yellow; wings hyaline with a dusky band beneath the marginal vein.
(7) *S. flavopalliata* Ashmead.
Head and thorax mostly brown.
Mesonotum lemon-yellow; abdomen brown-black; wings hyaline, with a broad fuscous band beneath the marginal vein.....(8) *S. occidentalis* Howard.
Mesonotum brown, the lateral margins narrowly yellow; abdomen aenous black; wings clear hyaline.....(9) *S. mexicana* Ashmead, new species.

[1] (*Rhynch.*: Aspidiotus citricola Pack.) ?[*Lepidosaphes beckii* Newman] (Ashmead).
[2] (*Rhynch.*: Aspidiotus aurantii var. citrinus) (Howard). p. 217.

3. Head anteriorly, a broad band between wings including the metathorax, and sutures between abdominal segments, ivory white; wings hyaline with a discoidal cloud beneath the marginal vein..(10) *S. rhizococci* Ashmead, new species.
4. Body mostly yellow; thorax at anterior apex, band across base of abdomen, ovipositor, and band across middle of front wings dark brown.
   Band at base of abdomen narrower, including hardly one-third of its length; club of antennæ entirely yellow.....(11) *S. aleyrodis* Ashmead, new species.
   Band at base of abdomen including more than one-third of its length; club wholly yellow; no distinct band between the eyes.
   (12) *S. coquilletti* Ashmead, new species.
   Club of antennæ with its apical half brown.(13) *S. aspidioti* Ashmead, new species.
   Band at base of abdomen including more than one-half of the abdomen, sometimes with only the tip yellow; club of antennæ shorter and wholly yellow.
   (14) *S. townsendi* Ashmead, new species.

Later, in his South American Chalcidoidea, Ashmead (1904, p. 497) included the two species then known to occur in South America. Finally, Schmiedeknecht (1909) gave the treatment of the genus implied already.

DISTRIBUTION OF THE SIGNIPHORINÆ.

The Signiphorinæ appear to be natives of the tropical or semitropical portions of the Western Hemisphere, as far as can be told from our present knowledge of them. Thus, of the 27 species now known 9 occur in Mexico, 8 in Brazil and Peru taken together, 5 in Florida, 5 in California, and 5 in the West Indies. Of the more northern and colder portions of the United States, 1 species occurs in Pennsylvania, 1 in Illinois, and 4 in the District of Columbia. Australia has 4 species and Hawaii 1, all probably introduced forms; the form occurring in Hawaii was described from specimens from the United States, probably California and occurs also in Florida, Brazil, and Mexico. The described Australian species has never been recorded from any other locality. The greatest differentiation of type, then, occurs, so far as yet known, in the tropical and semitropical portions of the Western Hemisphere, notably in Mexico and Brazil. The most common or abundant species, so far as can be told from the proportion of specimens occurring in the collection of this family are confined to the same regions. The most closely related forms occur in Mexico. The first record of a species was from Florida. The data concerning the distribution of their hosts is not available but all of them appear to be tropical or semitropical forms, occurring on plants growing in hot climates.

The genus is distributed from Pennsylvania, Maryland, District of Columbia and Illinois, in the United States in the north, south to Peru and Brazil and west to Australia (New South Wales and Queensland).

HABITS AND HOST RELATIONS.

Little or nothing is known about the habits of the Signiphorinæ other than the gross food habits of their young. The following table summarizes these habits. Ashmead wrote concerning *flavopalliata* in 1880:

> I have watched several through my pocket lens, as they are not at all timid. They would run up to a scale, tap it with their antennæ, and if not satisfied with their inspection, would run off to another, and so on until they were suited, then backing around they seemed to insert their ovipositor, probably at the same time depositing an egg into the scale. (p. 30.)

TABLE OF THE HOST RELATIONS OF THE SIGNIPHORINÆ.

On account of the fact that this list was made up later than the rest of the manuscript, I have been unable to bring the nomenclature of the hosts strictly up to date.

Species.	Hosts.
1. *flavopalliata*	*Lepidosaphes beckii.*
	Aspidiotus aurantii citrinus.
	Chionaspis sp. on magnolia.
	Aspidiotus camelliæ on *Acacia.*
	Aspidiotus sp. on *Hibiscus.*
	Aspidiotus sp. on *Celtis occidentalis.*
2. *nigra*	*Coccus hesperidum.*
3. *australiensis*	Acanthococcid on *Eucalyptus.*
4. *dactylopii*	*Pseudococcus ephedræ.*
5. *noacki*	A psyllid on a wild shrub.
6. *unifasciata*	*Ceropsylla sideroxyli.*
7. *bifasciata*	Unknown.
8. *mexicana*	*Aspidiotus hederæ.*
	Aspidiotus sp. on a wild shrub.
	Aspidiotus sp. on *Ciruela* and *Hibiscus.*
9. *rhizococci*	*Rhizococcus* sp. on a composite.
10. *aleyrodis*	*Alegrodes* sp. on orange.
	Lepidosaphes carinata.
	Chrysomphalus aonidum.
	Chrysomphalus dictyospermi?
11. *coquilletti*	*Aleyrodes* on *Quercus agrifolia.*
	Aleyrodes coronatus.
	Aleyrodes gelatinosus.
	Orthezia sp.
	Aspidiotus subrubrescens.
	Aspidiotus sp. on a wild shrub.
12. *aspidioti*	*Aspidiotus hederæ.*
13. *townsendi*	*Aleyrodes* on a coarse grass.
	Aspidiotus sp. on a soft-wooded tree.
	Aspidiotus on *Hibiscus.*
	Aspidiotus on *Celtis occidentalis.*
	Aspidiotus lataniæ.
	? Diaspis pentagona.
	? Aspidiotus perniciosus.
14. *flava*	*Aspidiotus camelliæ.*
15. *flavella*	*Aspidiotus lataniæ.*

Species.	Hosts.
16. *basilica*	*Aspidiotus lataniæ.*
17. *pulchra*	*Aspidiotus uvæ.*
	Diaspis pentagona.
	Aulacaspis rosæ.
	Chionaspis americana.
18. *maxima*	Unknown.
19. *melancholica*	Unknown.
20. *fasciata*	*Pulvinaria* sp. on ash.
	Inglisia sp. on cotton.
	Aleyrodes on *Hydroxylon.*
21. *hyalinipennis*	*Capulinia jaboticabæ.*
22. *maculata*	*Lepidosaphes alba.*
23. *nigrella*	*Chrysomphalus tenebricosus.*
24. *fax*	*Chrysomphalus personatus.*

From the above it is readily seen that the species do not confine themselves to a single host but may attack many of them. The hosts of any one species are usually closely related, though in some cases a species attacks one or two hosts in a different family from that of most of its hosts which are usually of the same genus. The hosts of the new Australian species are not known.

Three closely related families in the Hemiptera-Homoptera furnish food for the young of this subfamily, the Coccidæ, however, supplying most of it.

SYSTEMATIC TREATMENT.

Genus SIGNIPHORA Ashmead.

Signiphora Ashmead, 1880, p. 30, pl. 2, figs. 2–3, 6, 8, 12, and 15.—Howard, 1881, p. 371; 1894, p. 235.—Dalla Torre, 1898, p. 217 and footnote.—Ashmead, 1900, pp. 409–412; 1904, pp. 311, 388, 497.—Schmiedeknecht, 1909, p. 261.

No synonyms.

Type.—S. flavopalliata Ashmead.

1. SIGNIPHORA FLAVOPALLIATA Ashmead.

Signiphora flavopalliatus Ashmead, 1880, pp. 29–31, pl. 2, figs. 2–3, 6, 8, 12, and 15.—Howard, 1881, p. 371.

Signiphora flavopalliata Ashmead, Howard, 1894, pp. 233, 235.—Dalla Torre, 1898, p. 217 and footnote 1.—Ashmead, 1900, pp. 409, 411; 1904, pp. 311, 388.

Signiphora occidentalis Howard, 1894, pp. 233–235, fig. 10.—Dalla Torre, 1898, p. 217 and footnote 2.—Ashmead, 1900, pp. 409, 411.

The original description of this species is quoted forthwith:

The Blue Yellow-cloaked Chalcid.
(*Signiphora flavopalliatus*, N. Sp.)
[Ord., Hymenoptera. Fam., Chalcididæ.]

This is a very anomalous chalcid fly, discovered by me in September, running over the leaves of orange trees infested with the oval scale.[1]

[1] The next three paragraphs are omitted here, as they contain an account of habits and the generic description. In the paragraph immediately following this opening sentence, however, Ashmead wrote: The fly is a beautiful little creature, less than .02 of an inch long, robust, with head wider than thorax, three ocelli, three-jointed antennæ, first joint being long, second small and round, third long and wide, club-shaped; the abdomen is somewhat sharply pointed, with a rather long ovipositor in the end; the head and abdomen are bluish-black, while the thorax is orange yellow; the wings are clear, iridescent, and strongly fringed or ciliated with long hairs, with shorter ones on their surface; the legs are pale yellow, and the hinder pair is furnished with an anomalous five-lobed appendage, where usually is the tibial spur. (p. 30.)

DESCRIPTIVE.

Signiphora flavo-palliatus, n. sp.—Length 0.02 of an inch. Robust, polished; head bluish-black, much wider than thorax, three ocelli, black, two raised curved lines, one on each side of antennæ, eyes prominent, numerous facets; antennæ three jointed, first joint shorter than third, wider and rounded at apex, second joint very small and round; apical, or third joint, longer than first, six or seven times longer than second, and widening very much, claviform; thorax stout, nearly as wide as long, and of an orange-yellow, excepting a crescent-shaped space (collare) next to the head, which is bluish-black; abdomen longer than thorax, bluish-black, and decreasing sharply to a point, ending in a rather long ovipositor; under surface uniform bluish-black, with a few hairs on the different segments; wings hyaline, iridescent and strongly ciliated, well rounded at apex, with short setae on the surface; legs pale yellow, with five jointed tarsi, setaceous, femora somewhat swollen. Instead of a tibial spur on hinder legs, there is a singular anomalous apical five-lobed appendage (See Plate 2, fig. 15,) also two exterior spiny processes—coxæ not quite touching each other. Male not yet discovered. Inhabits Florida. Described from numerous specimens. (pp. 29–31, pl. II, figs. 2–3, 6, 8, 12 and 15).

From the unique type specimen in the United States National Museum collection I make the following corrections and additions to the specific description:

General color not blue-black but brown; a more or less obscure spot on each side of the abdomen at distal two-thirds and the dorsal thorax, lemon yellow, excepting the cephalic half or two-thirds of the mesoscutum and all of the pronotum. Wings not hyaline but distinctly embrowned out to a point slightly beyond (distad of) the venation and including most of the base of the wing; posterior wings with proximal half slightly embrowned; wings entirely without discal ciliation but the fore wing bears an isolated bristle under the distal three-fourths of the marginal vein, which is nearly as stout as some of the bristles borne by the venation but smaller than most of them. Distal half of the venation (marginal and stigmal veins) bearing seven stout bristles, one of which is at the extreme end or apex of the stigmal vein, the other six in pairs along the edges of the marginal vein; the submarginal vein bears a single, smaller bristle before its middle. Stigmal vein short, without a neck; marginal and submarginal veins subequal in length, but the former much broader. Marginal cilia of the fore wing long and slender, slightly longer than the greatest wing width, subequal to those of the posterior wings. Ovipositor slightly exserted. Middle tibial spur about subequal in length to the proximal joint of the intermediate tarsi, not large, with about six spines or lateral spurs. Cephalic tibial spur curved and divided distad into about six unequal tines which lengthen distad. Proximal tarsal joints of the intermediate legs not as long as the combined lengths of the three distal joints but twice the length of the same joint of the tarsi of the other legs. Mandibles bidentate, their tips nearly black. Antennal club slender, the antenna normal

for the genus. Fore wings long-ovate, very obtusely pointed, narrow. Two distal funicle joints each twice the length of the first one or else all gradually increasing in length, the second intermediate in size. Margins of the blade of the posterior wing parallel, the wing narrow, its marginal cilia very much longer than the greatest width of the blade.

These notes were taken from the single female type specimen, corrected and enlarged from the specimens as listed below.

I have studied the following specimens: (1) The type of *flavopalliata*, a single female mounted in balsam and labeled "Entomological Collection of Wm. H. Ashmead, Jacksonville, Florida. *Signiphora flavopalliata* Ashm. Type, female. No. 2801, U.S.N.M." (2) The original specimens—types but not so designated [1]—of *occidentalis*, comprising six slides all labeled, except the sixth, "From San Gabriel Red Scale," and as follows—one slide bearing a pair labeled in addition "*Signiphora occidentalis* How., male, female"; a second slide bearing a male and labeled "*Signiphora* male, *occidentalis*. June 3, 1887"; a third bearing a single female and labeled "*Signiphora* n. sp., June 1, 1887." A fourth bearing a single female and labeled "*Signiphora* n. sp., male, *occidentalis* How. May 30, 1887." A fifth bearing a female and a portion of another specimen, besides two specimens of *Prospaltella aurantii* (Howard), labeled "*Coccophagus aurantii* How. MS. *Signiphora* n. sp., female. May 9, 1887." And lastly, a slide bearing a single female, besides seven specimens of *Aspidiotiphagus citrinus* (Craw) and labeled "*Coccophagus citrinus*. *Signiphora*. From *Aspidiotus aurantii*. March 13, 1889. San Gabriel, Cal." All of these slides, except the sixth, were cut out by hand from window glass and were thick and short. (3) A slide bearing a single female and labeled "Morrill No. 2004. On orange leaf, Orlando, Florida, 6/24, 1907. A. W. Morrill." (4) A slide from the collections of the Bureau of Entomology, United States Department of Agriculture, bearing a single pair and labeled "From eggs of *Horiola arquata*. Tunapunta. F. W. Urich, Feb., 1911"; this host record must be considered a mistake until evidence is forthcoming; it is contrary to the host habits of the group. *Homotypes*. (5) A single female on a slide from the collections of the United States Department of Agriculture, labeled "7572[03]. *Chionaspis* on Magnolia, Savannah, Georgia. Issued June 15, '97." (6) A slide bearing the fragments of a single female specimen labeled "From *Aspidiotus camelliae* on *Acacia* sp. Mex. A. L. Herrara. XII. 15, 1905." (7) Another slide from the same collection, bearing three females with specimens of *mexicana* and *townsendi*, labeled "1768. *Aspidiotus*

[1] But for the convenience of future workers now marked as types, Cat. No. 1473, U. S. National Museum, the three slides as listed below, labeled "May 30, 1887" (1 male), "June 1, 1887" (1 female), and "June 3, 1887" (1 male), all evidently part of the material used in describing *occidentalis*.

on *Hibiscus*, Cuautla, Morelos, Mexico, May 29, '97. Koebele." (8) A final slide from the same source, bearing one male, nine females, together with specimens of *townsendi* and *flavella*, labeled "1744. *Aspidiotus* on *Celtis occidentalis*, Amecameca, Mexico, Mex., June 7, '97. Koebele."

Habitat.—United States of America—Florida (Jacksonville, Orlando); California (San Gabriel); Georgia (Savannah). Mexico—Morelos (Cuautla); Mexico (Amecameca). West Indies—Trinidad (Tunapunta).

Hosts.—*Lepidosaphes beckii* Newman (Florida); *Aspidiotus aurantii citrinus* Coquillett (California); *Chionaspis* sp., on Magnolia (Georgia); *Aspidiotus camelliæ* Signoret, on acacia (Mexico); *Aspidiotus* sp., on *Hibiscus* (Mexico); *Aspidiotus* on *Celtis occidentalis* (Mexico).

Type.—The single female specimen as indicated in foregoing. *Homotypes*—Accession No. 45089, Illinois State Laboratory of Natural History, Urbana, 1 male, 1 female on a single slide (Tunapunta, Trinidad). For types of the synonymic *occidentalis*, see before.

Some years after its original description the author [1] of this species amended his former description as follows: Head and abdomen blue-black; thorax, except the pronotum, bright yellow; wings hyaline, with a dusky band beneath the marginal vein.

As has been intimated, the species was redescribed as new to science by Howard (1894), under the name *occidentalis*. The original description of *occidentalis* agrees closely with the type specimen of *flavopalliata* Ashmead and because of the fact that the structural characters of the types of both are identical and that the difference in coloration between them is small, other specimens gradating between, it is quite evident that there is some color variation and that *occidentalis* represents the variation bearing a minimum amount of yellow on the thorax; also the brown of the body evidently varies, being very deep in some specimens, nearly, if not, black; usually, however, brown predominates. But it must be remembered that I have not seen specimens in nature. The fumated area of the fore wing may also vary, sometimes breaking into spots disto-cephalad.

I append the original description of *occidentalis* for completeness and convenience.[2]

SIGNIPHORA OCCIDENTALIS, n. sp.

Female.—Length, 0.53 mm.; expanse, 1.2 mm.; greatest width of fore wing, 0.09 mm. Antennal scape robust, reaching to middle of eyes; pedicel large, stout, rather more than one-third as long as scape; funicle joints 1, 2, and 3 subequal in diameter, very small, together only a little over one-third length of pedicel and considerably less than the tip width of the pedicel; increasing in length from 1 to 3; club nearly as long as scape and pedicel together, long oval when seen from side, twice as wide as pedicel, narrow with parallel sides when seen from above, scarcely wider than funicle joint 3.

[1] Ashmead, 1900, p. 409.

[2] Insect Life, vol. 6, 1894, p. 235.

Marginal vein with six strong bristles, stigmal with one, submarginal with one. Middle femora with a strong spine near inner side of tip, tibiæ with three strong external spines, two near base and one near tip. Color (from balsam-mounted specimens only): Head, pronotum, metanotum and abdomen, dark brown, nearly black, eyes dark red; mesonotum bright lemon-yellow; all legs and antennæ fuscous; mouth parts light-brown, mandibles tipped with black; wing veins fuscous; fore-wings with an indefinite fuscous patch occupying entire disk except at base and apical fourth.

Male.—Resembles female, except that it is rather larger and has the entire mesoscutum brown, leaving the yellow band to inclose mesoscutellum and metascutum.

Described from two females, three male specimens reared by D. W. Coquillett, from *Aspidiotus aurantii* var. *citrinus* Coquillett, from San Gabriel, Cal., May 30, June 1 and 3, 1887.

2. SIGNIPHORA NIGRA Ashmead.

Signiphora nigra ASHMEAD, 1900, pp. 409, 410.

Ashmead described this species as follows:

Female.—Length, about 0.55 mm. Polished black, impunctate, but with a decided æneous tinge in certain lights. Flagellum brown-black. Legs black, the anterior and middle tibæ brownish, their tips and all tarsi white. Wings with the basal half or more fuliginous, the apical half or less hyaline.

Type.—Cat. No. 4767, U.S.N.M. (Ashmead collection.)

Habitat.—District of Columbia: Washington.

It has never been mentioned in the literature since. I have the following notes concerning it, taken from the type and other specimens: Original description correct; the body is finely polygonally reticulated and opaque, not metallic; structurally it differs from *flavopalliata* as follows—The discal bristle of the fore wing is absent; the marginal cilia of the fore wing are very much shorter, moderately short, very much shorter than the wing's greatest width (the length about a fourth or less of the wing's greatest width) and slightly shorter than the longest marginal cilia of the posterior wings; the fuscous area of the fore wing extends less farther distad (proximal third of the wing clouded), only to the distal third of the marginal vein but, however, the apical third of the wing may be slightly embrowned; the bristles on the venation are more numerous, on the submarginal vein at least two, but on the marginal but six (not counting several very minute ones) and on the stigmal but one which is not apical; the venation differs—thus the stigmal vein makes but little angle with the marginal; its sides are parallel; it is narrow and straight or else conic, its inner (caudal) margin not forming a distinct concave curve with the inner margin of the marginal vein or but a very slight curve of that sort; the marginal vein is slightly longer and more slender, slightly longer than the submarginal and its caudal margin is less emarginated; the fuscous area of the fore wing is broken by a more or less irregular subquadrate to elongate clear area near the caudal margin under the base of the marginal vein. The distal tarsal joints are dusky; the cephalic tibial spur is long, slender and curved, at tip dividing into two slender tines. The

caudal wings are broad, nearly twice broader than in *flaviopalliata*. Excepting for the uniform blackness of the body, otherwise as in *flavopalliata*. The male is similar to the female.

Nothing was known concerning the hosts of this species, but I add a record beyond. I have studied the following specimens: The types from the United States National Museum collection remounted in balsam from tags labeled "*Signiphora nigra* Ashm., female, type No. 4767, U.S.N.M., Washington, D. C." The single type slide bears in reality three males and two females which comprise the types formerly by implication all females. A slide bearing a single male specimen remounted from a tag in the same collection labeled "Los Angeles, Calif. *Coccus hesperidum* L. 160°. Aug." And a third slide bearing two males remounted from tags in the same collection, labeled "Washington, D. C."

Habitat.—United States—Washington, District of Columbia; California (Los Angeles).

Host.—*Coccus hesperidum* Linnæus.

Types.—The three males, two females as indicated in foregoing.

Homotypes.—Accession No. 45087, Illinois State Laboratory of Natural History, Urbana, the two males from U.S.N.M. collection as noted above (Washington, District of Columbia).

3. SIGNIPHORA AUSTRALIENSIS Ashmead.

Signiphora australiensis ASHMEAD, 1900, pp. 409, 410.

The original description of this species is exactly as follows:

Female.—Length, 0.60 mm. Aeneous black, the mesonotum with a bronzy tinge, the scutellum with a slight bluish tinge; legs black, a spot on knees and tarsi white or yellowish-white, the anterior tibiæ yellowish beneath; wings fuscous with a hyaline band across the disk from apex of the marginal vein.

Type.—Cat. No. 4771, U.S.N.M.

Habitat.—Australia. (Albert Koebele, collector.)

Host.—Rhynch.: Sp. not identified.

By studying the types I am enabled to offer the following additional descriptive details: Like *nigra* but differing colorationally in that the head and thorax are metallic to some extent, the vertex and mesonotum distinctly metallic green (but not in balsam mounts), the latter finely transversely lined; body finely polygonally sculptured, including the abdomen (the sculpturing not distinct in balsam mounts); the fore wings differ as described—they are embrowned throughout, but somewhat distad of the middle there is a broad clear band, subcrescentic in shape and touching the costal margin at the apex of the stigmal vein. This area is broader at the caudal margin than at the cephalic one, barely reaching the latter; the stigmal vein differs in that it is like a short conical prolongation bending off slightly from the marginal; thus it is short and much broader at its point of origin than is the case with that of *nigra*.

Like *nigra*, there is also a clear area proximad, but this is somewhat more prominent with this species. (See beyond.) The male is like the female.

The species has not been mentioned again in the literature; it is variable, as will be shown later.

I have studied the following specimens: The tag-mounted types now remounted in xylol-balsam; these were and are labeled "*Signiphora australiensis* Ashmead, female. Type No. 4771, U.S.N.M. Australia. Koebele. 12." The type consists of three females. Also a slide from the collections of the United States Department of Agriculture, Washington, District of Columbia, bearing 2 males and 12 females and labeled "1849. Acanthococcid on *Eucalyptus*. Gosford, N. S. W., Nov. 1899. A. Koebele." These specimens varied considerably in the fumation of the fore wing and in the length of the marginal fringes. In all of them the latter were distinctly shorter than in the type specimens, while the majority of the specimens showed the clear, subhyaline band at the middle very indistinctly, not clear cut as in the type specimens excepting with several of them. Casually, in most of these specimens, the fore wings appeared to be fumated throughout, the cloudiness gradually fading out distad. I have since captured a female specimen of this species on a window of a barn at Roma, Queensland, October 6, 1911.

Habitat.—Australia—New South Wales (Gosford); Queensland (Roma).

Host.—Acanthococcid on *Eucalyptus*.

Types.—The three females as indicated in foregoing.

4. SIGNIPHORA DACTYLOPII Ashmead.

Signiphora dactylopii Ashmead, 1900, pp. 409, 410.

The original description runs as follows:

Female.—Length, 0.58 mm. Blue-black, the mesonotum with an aeneous tinge anteriorly; legs concolorous with the body, except the tarsi, which are white; wings hyaline, with a fuscous band across the middle from beneath marginal vein to the hind margin.

Type.—Cat. No. 4772, U.S.N.M.

Habitat.—District of Columbia.

Host.—Rhynch. *Pseudococcus ephedræ* (Coquillett). Bred at Department of Agriculture.

The following descriptive notes are added, taken from the types and the specimens mentioned beyond: Like *nigra* but differing in that the vertex and mesonotum are metallic green, the former smooth and shining but with scattered pin-punctures; the mesonotum is finely transversely lined; the proximal joint of the posterior tibiæ is as long as the same joint of the intermediate tibiæ; the fore wings are hyaline with the exception of a broad band across them somewhat before the middle, from the marginal vein; the proximal margin of

this band is irregularly concaved and consequently it is narrower near the middle than at either end; the marginal cilia of the fore wing somewhat shorter than in *nigra;* caudal wings broad; submarginal vein with three bristles; stigmal vein intermediate between *nigra* and *australensis;* otherwise like the latter. Cephalic tibial spur 2-tined at apex. Male like the female. Mandibles bidentate, the teeth subequal, small, acute and black at their tips.

These notes from the following specimens: The types, 1 male, 3 females, formerly on tags, now remounted in xylol-balsam (1 slide). They are labeled "*Signiphora dactylopii* Ashm., females. Type No. 4772. 4713°.[1] Par: on *Pseudococcus ephedræ* Coq." Also in the United States National Museum collection, three females in xylol-balsam (1 slide) remounted from tags and labeled "*Signiphora dactylopii* Ashm., female. Roswell, N. Mex. Cockerell," determined by Ashmead; and one female similarly remounted and bearing the label "3821^{xi}."

Habitat.—United States—District of Columbia; New Mexico (Roswell).

Host.—*Pseudococcus ephedræ* Coquillett.

Types.—The one male, three females as indicated above.

Homotypes.—Accession No. 45086, Illinois State Laboratory of Natural History, Urbana, one female on a slide labeled "3821^{xi}" as mentioned above.

5. SIGNIPHORA NOACKI Ashmead.

Signiphora noacki ASHMEAD, 1900, pp. 409, 410; 1904, p. 497.

The original description is:

Female.—Length, 0.50 mm. Coal-black, except a whitish line on the hind margin of the mesopleura, along the suture separating it from the metapleura and the tarsi, which are white; wings wholly hyaline.

Type.—Cat. No. 4773, U.S.N.M.

Habitat.—Brazil: San Paulo. (F. Noack.)

Host.—Rhynch.: *Psylla* sp. on a wild shrub. Bred October, 1897, by F. Noack.

The species is based upon male specimens and is quite as described but the fore wings are not wholly hyaline, the proximal fourth smoky or fuscous, or from the base out as far as a point somewhat beyond the apex of the submarginal vein; the body is finely, polygonally sculptured, finely transversely lined at the mesoscutum. From *nigra, australensis,* and *dactylopii,* to which group of species it belongs, this species may be distinguished at once by reason of the fact that the marginal fringes of both wings are long and subequal, those of the fore wing nearly as long as that wing's greatest width (about two-thirds of the greatest width), those of the caudal wing slightly longer than the greatest width of that wing. Again, the venation

[1] The original note says the material came from Los Angeles, Cal., and this instead of the District of Columbia is the correct type locality.—J. C. CRAWFORD.

differs—the caudal margin of the stigmal vein and that of the marginal at apex unite in a distinct concave curve as in *flavopalliata* Ashmead; the discal bristle is absent, as is also the oblique crease.

The proximal tarsal joint of the intermediate legs is much longer than the same joint of the caudal legs, which, however is as long as in *nigra*. The middle tibial spur is long and slender and bears about 10 spines; *apparently* the cephalic tibial spur is many-tined as in *flavopalliata;* caudal tibial spur single, short, straight. The species may be distinguished from *flavopalliata* structurally through the fact that it is larger and more robust, the caudal wings are much broader, the broader fore wings and their somewhat shorter marginal cilia, the very much longer proximal tarsal joints of the last two pairs of legs and the longer stigmal vein. Colorationally, of course, easily distinguished from *flavopalliata*. Also allied with *maxima*, *pulchra*, and *nigrella*[1]; from these species it differs in those points brought out in the table of species given later. Its caudal wings are somewhat broader than those of both *pulchra* and *nigrella*. Female unknown.

The following specimens have been studied: The two type specimens (both males?) in the United States National Museum collection now remounted on a single slide in xylol-balsam; they were and are labeled "*Signiphora noacki* Ashm., female. Type No. 4773, U.S.N.M. 7760°. Par: in Psyllid on wild shrub. San Paulo, Brazil, Oct. 97."

Habitat.—South America—Brazil (Sao Paulo).

Host.—A psyllid on a wild shrub.

Types.—The two males as indicated above.

6. SIGNIPHORA UNIFASCIATA Ashmead.

Signiphora unifasciata ASHMEAD, 1900, pp. 409, 410, 411.

The original description is as follows:

Female.—Length, about 0.70 mm. Black, with a narrow yellowish-white band across base of scutellum and continued below on the hind margin of the mesopleura and along the mesosternal suture; tarsi white, wings hyaline.

Type.—Cat. No. 4774, U.S.N.M.

Habitat.—Florida: Georgiana. (Dr. Wittfield.)

Host.—Rhynch: *Ceropsylla sideroxyli* Riley.

This species also belongs to the *nigra* group but on account of its coloration is placed in a group of its own; it is correctly described but the wings are not hyaline; the body is opaque black and finely polygonally sculptured. Structurally it resembles *noacki* Ashmead but may be distinguished by these characters; the stigmal vein is shaped differently; its inner or caudal margin is convex rather than concave and does not form a regular concave curve with the inner margin of the marginal vein but only an obtuse angle; its cephalic

[1] All three described later on in this paper.

margin is concave not convex as in *noacki;* moreover its tip points disto-cephalad, not distad; the wings are more robust but the marginal cilia are the same relatively as in *noacki;* the cephalic tibial spur is slender, curved at apex and beneath fimbriate bearing about 16 tines which gradually increase in length distad; otherwise, except as already described for color, as in *noacki.* The fore wings are smoky out to the middle of the marginal vein (or proximal third) but the smoky area is fainter caudad.

I have studied the following specimens: Only the single female type specimen found remounted on a tag and placed with a female of *fasciata.*[1] Consequently it was remounted on a slide in xylol-balsam with the latter before the two were known to be distinct. The type bears the following label: "*Signiphora unifasciata* Ashmead. Type No. 4774, U.S.N.M. 350[01]. Iss. Dec. 19, '81." As stated it is mounted with a female of *fasciata.*

Nothing more can be added concerning it.

7. SIGNIPHORA BIFASCIATA Ashmead.

Signiphora bifasciata ASHMEAD, 1900, pp. 409, 411.

The original description is as follows:

Female.—Length, about 0.60 mm. Black with two transverse yellow bands on thorax above between the tegulæ, or on the hind border of the mesonotum, the other at the base of the scutellum, the latter also continued along the mesopleural suture; legs black or blackish, the knees yellowish, the tarsi whitish; wings hyaline.

Type.—Cat. No. 4775, U.S.N.M.

Habitat.—West Indies: St. Vincent. (H. H. Smith.)

I have not been able to see the type of this species, which is a unique in the collections of the United States National Museum, formerly mounted on a tag, now mounted in balsam. It should be easily recognized though it is perhaps needful to call attention here to the fact that the fore wings are probably infuscated in some manner, probably near base, this being overlooked by the describer (as in the case of some of the other species when the infuscation was proximal). Nothing is known concerning its habits.

After writing the foregoing, Mr. J. C. Crawford of the United States National Museum was kind enough to examine the type for me in regard to certain of its characters and I have learned from him that after remounting in balsam there is no noticeable metallic coloration; the fore wings are lightly fumated out to the end of the stigmal vein; the transverse thoracic bands are contiguous and yellowish white and distinct, more distinct in the tag-mounted specimen than after it was remounted in balsam; the inner margin of the stigmal vein is nearly straight; the marginal cilia of the fore wing are moderate in length, about a third of the wing's greatest width; the discal bristle is present; and that the posterior wing is broad, its margins not parallel but the wing broadening toward the apex.

[1] Described beyond.

8. SIGNIPHORA MEXICANA Ashmead.

Signiphora mexicana ASHMEAD, 1900, pp. 409, 411.

The original description is as follows:

Female.—Length, about 0.45 mm. Head, thorax, antennæ, and legs, except tarsi, brownish-yellow; abdomen æneous black; tarsi white; mesonotum margined with yellow at sides; wings hyaline.

Type.—Cat. No. 4776, U.S.N.M.

Habitat.—Mexico: San Luis.

Host.—Rhynch.: *Aspidiotus nerii* Bouché. (Tyler Townsend.)

On account of its obscure coloration I first thought that this species was synonymic with *flavopalliata* which it resembles, but the following characteristics separate it from that species, aside from coloration, which is more or less difficult to detect, in balsam specimens especially. The narrow fore and posterior wings are replaced in *mexicana* by broad ones; the posterior wings in *mexicana* are twice the width of those in the type species and the same statement is nearly true for the fore wings; the marginal ciliation is long and holds the following relations: The longest of the fore wing are not more than two-thirds as long as the fore wing's greatest width; the longest of the caudal wings are somewhat longer than the greatest width of those wings; thus, of the caudal wings especially, the marginal cilia are not very much longer than the greatest width of the wing as in *flavopalliata.* The discal bristle is present. Otherwise structurally, apparently like the type species; however, the submarginal vein bears two bristles. Coloration of the type specimen as described, excepting that the fore wing at least is not hyaline but distinctly embrowned, very much as in *flavopalliata*, sometimes, as in that species, mottled distad. The mesonotum is finely lined transversely; the color of body is variable; thus, in the specimens noted below, a few are present which had all of the thorax brown, while most of them had all of the mesonotum as dark as the abdomen; in one specimen nearly all of the abdomen was brown, suffused with dusky. A large robust species with broad wings; the antennal club is more roughly longitudinally striated than usual.

I have studied the following specimens: The single female type specimen, remounted in balsam from a tag, labeled "*Signiphora mexicana* Ashm., female. Type No. 4776, U.S.N.M. 470°.=13 Townsend. 12 Oct., '94. Par. on *Asp. nerii*, San Luis, Mex." The head is missing. Also the following from the collections of the United States Department of Agriculture: Seven females on a slide with *coquilletti* and other coccid parasites, labeled "1725. *Aspidiotus* on common wild shrub on streams: Calif.; Cuautla, Morelos, Mex., July 1, '97. Koebele." One male, seven females with a female of *flavella* and *Perissopterus mexicana* Howard, on a single slide labeled "1722. *Aspidiotus* on *Ciruela*, Cuautla, Morelos, Mex., July

1, '97. Koebele." Another slide bearing a pair together with *flavopalliata* and *townsendi* and several aphelinines labeled "1768. *Aspidiotus* on *Hibiscus*. Cuautla, Morelos, Mex., May 29, '97. Koebele."

Habitat.—Mexico (San Luis; Cuautla, Morelos). United States—California.

Hosts.—*Aspidiotus hederæ* Vall (Mexico); *Aspidiotus* sp. on common wild shrub (California and Mexico); *Aspidiotus* sp. on *Ciruela* and *Hibiscus* (Mexico).

Type.—The single female as indicated above.

Homotypes.—Accession No. 45092, Illinois State Laboratory of Natural History, Urbana, 1 male, 7 females (Cuautla, Mexico) on one slide with homotype female of *flavella*.

9. SIGNIPHORA RHIZOCOCCI Ashmead.

Signiphora rhizococci ASHMEAD, 1900, pp. 409, 411; 1904, p. 497.

This species was described 11 years ago by Ashmead exactly as follows:

Female.—Length, about 0.50 mm. Head anteriorly, a broad band on thorax between the wings and the sutures between abdominal segments, more or less, ivory white; club of antennæ and vertex faintly dusky; anterior orbits narrowly, rest of body and a broad band in middle of front wings, dark brown.

Type.—Cat. No. 4858, U.S.N.M.

Habitat.—Brazil: Minas Geras.

Host.—Rhynch.: *Rhizococcus* sp. on a composite plant. Bred by F. Noack, July, 1897. One specimen."

I have studied only the type of this species, probably a male mounted on a slide labeled "7902°.[1] Par: on *Rhizococcus* on composite plant from F. Noack, Bella Horizonte, Minas Geras, Brazil, July, 1897. *Signiphora* sp. *rhizococci* Ashm. Type 4858." The caudal half of the abdomen is missing.

The species appears to be a well-marked one and should be easily recognized; nevertheless, it is fortunate that its principal structural characteristics can be pointed out. Nothing is known of it excepting what is given with its original description. The following structural characteristics: Like *flavopalliata* excepting as pointed out later in the table of species. The mandibles are bidentate and black at tip; antennæ normal.

10. SIGNIPHORA ALEYRODIS Ashmead.

Signiphora aleyrodis ASHMEAD, 1900, pp. 409, 412.

This species was described at the same time as most of the others:

Female.—Length, about 0.50 mm. Body mostly golden-yellow; vertex of head faintly dusky; thorax anteriorly and very narrowly, and a band across base of abdomen

[1] The host has since been determined as *Eriococcus braziliensis* Cockerell.—J. C. CRAWFORD.

including hardly one-third its length, dark brown; wings hyaline, with a dusky band across the middle just beneath the marginal vein, which is a little narrower at the hind margin than at its origin; antennæ and legs entirely pale yellowish white.

Type.—Cat. No. 4855, U.S.N.M.

Habitat.—West Indies: Trinidad.

Host.—Rhynch.: *Aleyrodes* sp. on orange. Two specimens, Acc. No. 6162, Department of Agriculture.

This species agrees structurally with *flavopalliata* nearly. However, the discal bristle is absent from the fore wing; the stigmal vein is slightly longer and proximad slenderer, thus with more or less of a short neck; the antennal club enlarging distad, clavate. Otherwise I can not distinguish them. The original description of the species is correct, but not only the whole of the pronotum, but over the cephalic third of the mesonotum is dark brown; also, usually, but not always, the extreme tip of the abdomen and valves of the ovipositor. The dark band of the abdomen includes apparently the first and second segments and is at least a third of the length of the abdomen. Eyes naked; mandibles bidentate, the two acute teeth black at tips; cephalic tibial spur many-tined. The male is like the female. The oblique narrow crease of the fore wing is present but not the discal bristle. The species is somewhat variable in color. The tip of the antennal club may be dusky and a second band may be indicated on the abdomen by the presence of a dark spot on each side at distal three-fourths or even a whole convex band at that place.

I have studied the following specimens: The types consisting of three female specimens on a single slide in the collections of the United States National Museum, labeled "Type. *Signiphora aleyrodis* Ashm. Bred from *Aleyrodes* on Orange, etc. Trinidad, W. I. 6162." Relabeled, with type number. Two females on a slide from the collections of the United States Department of Agriculture labeled "1°3 C. Gn. 2, sp. 3. Saman, Peru. May 25. T." and reared by C. H. Tyler Townsend. (Homotypes.) A slide from the same collection bearing 10 males and 9 females together with the type of *Polynema aspidioti* Girault and labeled "1734. *Aspidiotus carinatus* [=*Lepidosaphes carinata* (Cockerell)] on Lime, Cuautla, Morelos, Mex., July 2, '97. Koebele." And fourthly, a slide bearing a single female from the same collection labeled "*Asp. ficus* [=*Chrysomphalus aonidum* (Linnæus)] and *A. dictyospermi*? on *Kentia*, Westgrove, Pa. A. F. Satterthwait, Feb. 8, 1908." Still another specimen, a male, has been seen, remounted on a slide with the homotype of *S. flava* and labeled "*Asp. camelliæ* on *Acacia* sp. Mexico. From A. L. Herrara, Dec. 15, 1905."; and another female on a slide from the United States Department of Agriculture collections, labeled "1453°3a. C. H. T., Lima, Peru. Nov. Gen. 2 d. sp. No. 5, Jan. 16, '10. T." and reared by C. H. Tyler Townsend.

Habitat.—West Indies (Trinidad); Mexico—Morelos and Vera Cruz. United States—Pennsylvania (Westgrove). Peru—(Lima; Payta; Saman).

Hosts.—*Aleyrodes* sp. on orange (Trinidad); *Lepidosaphes carinata* Cockerell on lime and *Aspidiotus camelliæ* on acacia (Mexico); *Chrysomphalus aonidum* Linnæus and *C. dictyospermi* on *Kentia* (Pennsylvania); *Aspidiotus* sp. on *Myrtus* (Mexico).

Types.—The three females indicated above.

Homotypes.—Accession No. 45094, Illinois State Laboratory of Natural History, Urbana, 2 females on a slide (Saman, Peru).

The following additional specimens: A slide from the collections of the United States Department of Agriculture bearing a single female and labeled "14°3a. Payta. Gen. Nov. 2d. sp.3d. C. H. T. Jan. 2, '10. T." and taken in Peru by C. H. Tyler Townsend. A male specimen on a slide with an *Aphelinus* from the same collection, labeled "1705. *Aspidiotus* sp. on *Myrtus* sp. Orizaba, Vera Cruz, Mex. July 15, '97. A. Koebele."

11. SIGNIPHORA COQUILLETTI Ashmead.

Signiphora coquilletti ASHMEAD, 1900, pp. 409, 412.

The original description is as follows:

Female.—Length, hardly 0.50 mm. Bright golden-yellow; vertex of head fuscous; thorax *entirely*, and abdomen, except a dark brown band at base which occupies fully one-third or more of its length, yellow; otherwise as in *Aleyrodis*.

Type.—Cat. No. 4857, U.S.N.M.

Habitat.—Rhynch.: *Aleyrodes* sp. on *Quercus agrifolia*.

Easily distinguished from *S. aleyrodis* by the fuscous vertex and the absence of the brown blotch on the anterior part of the thorax.

This species is like *aleyrodis* nearly but differs more than merely having the brown band across the abdomen slightly longer. Colorationally, it may be distinguished from *aleyrodis* thus and not otherwise: The latter is pallid or lemon yellow whereas *coquilletti* is deep orange in color, a striking difference when compared side by side; consequently, the brown band of the abdomen is more striking in *coquilletti* and has more black in it. Structurally, I am unable to separate the two species with the exception that the body of this species is a little more compact, slightly more robust and the wings perhaps a trifle broader. The mandibles are bidentate and black at tips. It varies considerably in size and some specimens may be twice the size of others. I have seen one specimen (female) among other typical ones which had all the abdomen black.

I have studied the following specimens: The single type female specimen mounted on a thick common glass slide in the United States National Museum collection, labeled "*Signiphora coquilletti* Ashm., female. Bred from *Aleyrodes* on *Quercus agrifolia*. Type 4857. Oct. 4, 1887. (72." and probably reared in California by Coquillett

(judging from the name, label, slide, and date). A slide bearing two females from the collections of the United States Department of Agriculture, labeled "No. 3. *Aleyrodes coronatus* on live oak. Groville, Cal. H. '07." Another slide from the same collection bearing four females, labeled "8183°. Par: on *Orthezia* sp.? Campesas,[1] Brazil. Fritz Noack." Another slide from the same collection bearing two females and the label "416ª. *Asp.* on quince, Fla. Mar. '80." Two females borne on another slide from the same source and bearing the label "(8). Bred from *Aleyrodes* sp. Pasadena, Cal., May, 1908." *Homotypes.* One female on a similar slide, together with two alphelinines, labeled "(18). 2 sps. Bred from *Aleyrodes gelatinosus* on oak, Los Angeles, Cal., April, '08." Five females on a slide from the same source bearing the label "Morrill No. 511" and probably taken in Florida (judging from the label). Another slide from the same source bearing three females, together with a female of *Prospaltella citrella* Howard and labeled "Morrill No. 508 and No. 511. 1 spec. of 508 and 3 specs. of 511" (judging from the label, from Orlando, Florida). A final slide labeled "1813. *Aspidiotus subrubescens* Mask. on Oleander, Honolulu, H. I. A. Koebele. 10.III.99." and bearing two females together with many specimens of an *Aphelinus*. In addition, two females of this species on a slide with *mexicana*, from the United States Department of Agriculture collections, labeled "1725. *Aspidiotus* on common wild shrub on streams: Calif.; Cuautla, Morelos, Mex. July 1, '97. Koebele."

Habitat.—United States—California (originally San Gabriel?; Groville, Pasadena, Los Angeles); Florida (? Orlando). Hawaiian Islands (Honolulu). South America—Brazil (Campesas?). Mexico (Cuautla, Morelos).

Hosts.—*Aleyrodes* sp. on *Quercus agrifolia*, *Aleyrodes coronatus* on live oak and *Aleyrodes gelatinosus* on oak (California); *Orthezia* sp. (Brazil). *Aspidiotus subrubrescens* Maskell on oleander (Hawaii). *Aspidiotus* sp. (Mex.; California).

Type.—The single female as noted above.

Homotypes.—Accession No. 45095, Illinois State Laboratory of Natural History, Urbana, two females in xylol-balsam, 1 slide (Pasadena, California).

12. SIGNIPHORA ASPIDIOTI Ashmead.

Signiphora aspidioti ASHMEAD, 1900, pp. 409, 412.

On the same page that *coquilletti* was described, Ashmead described a new species under the name of *aspidioti* in the manner quoted below. This species is identical with *coquilletti* structurally, but differs in that the distal half of the antennal club is dusky, a phenomenon not observed in the series of specimens of *coquilletti* examined by me but which would be expected to occur in a number of specimens if it was

[1] On the label merely this: "Camp.—"

merely an incidental variation. I can not do otherwise than consider *aspidioti* valid. Its original description was in this manner:

Female.—Length, about 0.50 mm. Lemon or golden yellow; head faintly dusky above; apical half of antennal club, anterior half of mesonotum, and a broad transverse band at base of abdomen, including nearly half its length, dark brown; wings with a broad fuscous band, as in previous species.

Type.—Cat. No. 4859, U.S.N.M.

Habitat.—Mexico: San Louis.

Host.—Rhynch.: *Aspidiotus nerii* Bouché. [=*hederæ* Vall.] Bred November, 1894, by Tyler Townsend.

Besides the type specimen, I found another female specimen of it in the collections of the United States National Museum labeled "470°². Bred from *Aspidiotus nerii* [=*hederæ* Vall.], San Luis, Mex., November, '94." This specimen is evidently an original one. I have labeled it as a *homotype.* The antennal club in *aspidioti* is more clavate and longer than that of *coquilletti* apparently. The single type female is labeled as the specimen just noted and, additionally, "4859," the type number.

13. SIGNIPHORA TOWNSENDI Ashmead.

Signiphora townsendi ASHMEAD, 1900, pp. 409, 412.

The original description of this insect is as follows:

Female.—Length, about 0.45 mm. Mostly dark brown; a broad band between the wings including the hind margin of the mesonotum, scutellum, and metathorax, and the apical third of abdomen, or less, lemon yellow. Wings hyaline, as in previous species, but the fuscous band has a deep median hyaline emargination on its basal margin. Antennæ and legs pale yellowish, the club rather short, about one-third shorter than in the other species.

Type.—Cat. No. 4856, U.S.N.M.

Habitat.—Mexico: Tabasco.

Host.—Rhynch.: *Aleyrodes* sp. on a coarse grass. Bred by Tyler Townsend, June 19, 1897. Four specimens.

When examining the type of this species I had first thought that it must be synonymic with *coquilletti,* or else *flavopalliata;* it agrees with the former structurally, but differs from the latter in lacking the discal bristle. Colorationally, it differs from *coquilletti* in that the yellow of the body is lemon yellow, not orange yellow; or, in other words, lighter in shade; also there is much more brown or dark brown present. A structural difference is present, too, in that the curve made by the inner margin of the stigmal vein is deeper and somewhat narrower in *townsendi* than in *coquilletti* and the marginal vein at the proximal end of the curve is distinctly broader and obtuse, not narrower and acute at the bristle there as in *coquilletti.* This appears to be characteristic, but I am uncertain whether it is real or not.

The following specimens: The four type females on a single slide labeled "7841°.[1] Par: on *Aleyrodes* on coarse grass, Tabasco, Mex.

[1] The original note gives the type locality as Sangrillo del Chico Sapote, Tabasco, Mexico.—J. C. CRAWFORD.

June 19, '97. (Townsend.) *Signiphora townsendi* Ashm." Also the following specimens in the collections of the United States Department of Agriculture: A single female on a slide with a *Prospaltella*, labeled "1745. *Aspidiotus* sp. on soft wooded fibrous tree, Cordoba, Mex." One female on a slide with *mexicana* and *flavopalliata* and some aphelinines, labeled "1768. *Aspidiotus* sp. on *Hibiscus*, Cuautla, Morelos, Mex. May 29, '97. Koebele." A third female on a similar slide with *flavopalliata* and *flavella*, labeled "1744. *Aspidiotus* on *Celtis occidentalis*. Amecameca, Mexico, Mex. June 7, '97. Koebele." One male, six females on a single slide labeled "*Hemich. lataniæ* on peach, Whitesboro, Tex. J. M. Buchanan. Let. Jan. 25, 1908. Bred Feb. 23, 1908. E. R. S." A male on a slide labeled "*Diaspis pentagona* Targ. and Asp. *perniciosus* on cherry, Washington, D. C. E. R. Sasscer, Aug. 21, 1907." Two females on a slide labeled "C. H. T. Lima, Peru. 219° 3c. Nov. gen. 2d. (2 spms.) sp. 2. Dec. 31, '09. T." Finally, a slide bearing a single male labeled "1629. *Aspidiotus* sp. *Quercus engelmanni*, Amecameca, Mex. 25.5.97. Koebele." And one bearing 5 males, 9 females + 1 of *townsendi* and labeled "1723. *Aspidiotus* on pyramidal willow near city Mexico, July 7, '97."

Hosts.—*Aleyrodes* sp. on coarse grass (Tabasco, Mexico); *Aspidiotus* on soft-wooded fibrous tree (Mexico); the same on hibiscus and *Celtis occidentalis* (Mexico); *Aspidiotus lataniæ* Signoret on peach (Texas); *Diaspis pentagona* Targione and *Aspidiotus perniciosus* Comstock on cherry (District of Columbia, U. S. A.); *Aspidiotus* sp. on *Quercus engelmanni* (Mexico).

Habitat.—Mexico—Tabasco, Cordoba, Cuautla (Morelos), Amecameca (Mexico). United States—Washington, District of Columbia, and Texas (Whitesboro). Peru (Lima).

Types.—The four females as noted above.

Homotypes.—Acccession No. 45090, Illinois State Laboratory of Natural History, Urbana, 1 male, 6 females on one slide (Whitesboro, Tex.).

DESCRIPTIONS OF NEW SPECIES.

The following species were discovered while revising the genus. The descriptions were all made from study under equal magnification.

14. SIGNIPHORA FLAVA, new species.

Normal position.

Female.—Length, 0.65 mm. Moderate in size.

General color lemon yellow, immaculate, or nearly, but the vertex and antennæ suffused with dusky as is also the extreme tip of abdomen; the whole body slightly suffused with orange; legs and antennal scape concolorous with body; remainder of antenna dusky; distal tarsal joints concolorous with remainder of legs; tips of mandibles black; eyes dark red; venation lemon yellow suffused with dusky;

fore wings fuscated nearly to tip but the fuscation is pronounced and conspicuous only under the venation or but slightly distad of it; caudal wings nearly hyaline; proximal portion of fore wing clearer or wholly clear; structurally, nearly as in *flavopalliata* from which I am hardly able to distinguish it; the stigmal vein, however, is longer as is also the proximal joint of the cephalic tarsi and the body is more robust. The discal bristle of the fore wing is absent and the antennal club is long and clavate, the pedicel long-obconic, four times longer than its width at apex.

Male.—Unknown.

Described from a single female specimen in the collections of the National Bureau of Entomology, mounted on a balsam slide and labeled "C. H. T., Lima, Peru. 192° 3a. Nov. Gen. 2nd sp. 1. Dec. 31, 09. T." (*Type.*) Also another mounted on a slide with *S. aleyrodis* and bearing the label "*Asp. camelliæ* on *Acacia* sp. Mexico. From A. L. Herrara, Dec. 15, 1905." (U. S. Department of Agriculture. *Homotype*, female.)

Habitat.—Peru (Lima); Mexico.

Host.—*Aspidiotus camelliæ* Signoret on *Acacia* in Mexico (*homotype*).

Type.—Cat. No. 14195, U.S.N.M., one female in balsam.

Homotype.—Accession No. 45096, Illinois State Laboratory of Natural History, Urbana, 1 female on a slide with a male of *S. aleyrodis* (Mexico).

15. SIGNIPHORA FLAVELLA, new species.

Normal position.

Female.—Length, 0.48 mm., mean. Small in size.

General color as in *flava* but the abdomen suffused with orange, especially along each side of the middle; differs from *flava* as follows: The stigmal vein forms a less regular and shorter concave curve, along its inner margin, with the apex of the inner margin of the marginal vein, but it is convex instead of concave at its point of origin. The fore wings are distinctly narrower but with the marginal cilia as long in proportion (long, graceful, distinctly longer than the greatest width of the wing). Otherwise the same in all visible details, except the wings, which are nearly similarly embrowned, but less deeply; also the antennal club is dusky at tip or distal fifth instead of being wholly dusky. The pedicel of the antenna is noticeably shorter and stouter, while the antennal club is noticeably shorter.

Male.—Unknown.

Described from four female specimens mounted on a slide with *S. basilica*, new species[1] and from the collections of the National Bureau of Entomology (U. S. Department of Agriculture). The slide bore the label "*Signiphora. Aspidiotus lataniæ.* Sapodella. *Ochras*

[1] Described next.

sapota. Miami, Fla. E. A. Bessey. Bred June 8, 1908." Also from the same collection, another female with specimens of *mexicana* on a slide bearing the labels "1722. *Aspidiotus* on Ciruela, Cuautla, Morelos, Mex. July 1, '97. Koebele." And a third slide bearing another female with specimens of *flavopalliata* and *townsendi*, labeled "1744. *Aspidiotus* sp. on *Celtis occidentalis*, Amecameca, Mexico, Mex. June 7, '97. Koebele."

Habitat.—United States—Florida (Miami); Mexico—Amecameca, Mexico; Cuautla, Morelos.

Host.—*Aspidiotus lataniæ* Signoret; *Aspidiotus* sp. on *Ciruela* and *Celtis occidentalis*.

Types.—Cat. No. 14196 U.S.N.M. Four females in balsam (1 slide; mounted with type female of *basilica*).

Homotype.—Accession No. 45092 Illinois State Laboratory of Natural History, Urbana, 1 female (Cuautla, Mexico), on a slide with homotypes of *S. mexicana*.

16. SIGNIPHORA BASILICA, new species.

Normal position.

Female.—Length, 0.32 mm. Small for the genus.

Similar to *aleyrodis* but differing in that a second brownish or dusky stripe across the abdomen is indicated by a black spot on each side at distal three-fourths, not reaching across to each other but separated mesially by the yellow of the body by a distance over the diameter of either spot and longitudinally separated from the proximal abdominal band by over its own length. Also the proximal abdominal band is only about half the length of that in *aleyrodis*, not more than a fourth the length of the abdomen. Antennal club shorter and stouter, dusky at distal fourth; proximal joint of intermediate legs shorter. Otherwise as in *aleyrodis* but much smaller.

Male.—Unknown.

Described from a single female specimen mounted with the types of *S. flavella*. (For data see that species.)

Habitat.—United States—Florida (Miami).

Host.—*Aspidiotus lataniæ* Signoret.

Type.—Cat. No. 14197, U.S.N.M. One female in balsam (mounted with the four type females of *S. flavella*).

17. SIGNIPHORA PULCHRA, new species.

Signiphora nigrita HOWARD MS.—JOHNSON, 1896, p. 75.

Normal position.

Female.—Length, 1.0 mm., mean. Large for the genus, variable.

General color sooty black with the fore wings deeply fumated (sooty), nearly out to their tips which are clear; all of legs excepting proximal three tarsal joints of caudal ones, which are yellow, antennæ

and venation concolorous with the body; narrow space beneath submarginal vein of fore wing clear and that wing clearer near base; eyes bright red, naked; mandibles fuscous, their tips black; posterior wings hyaline except proximad under the venation and a slight distance distad of the venation. Body shining black; mesoscutum finely, transversely lined.

Belongs to the *nigra* group and like that species in general form, but differing in the following structural details: The marginal cilia of the fore wing are distinctly longer, about three-fourths the greatest wing width; the discal bristle of the fore wing is present; the stigmal vein differs in shape, forms more of an angle with the marginal and its sides are not parallel; moreover, its inner edge forms a more concave curve with the inner edge of the marginal vein at its apex but of itself is not concave; the caudal wings moderate in width but much broader than in *flavopalliata*, for instance. Easily distinguished from *nigra* colorationally. Agreeing also with *noacki* Ashmead but may be distinguished by means of the different wing fumation, the different coloration of the tarsi and general body color, the somewhat longer marginal fringes of the fore wing in *pulchra* and presence of the discal bristle. Also agreeing structurally somewhat with *maxima* but in that species the marginal cilia are shorter, the caudal wings distinctly narrower, very broad in *maxima*.

In *pulchra* the cephalic tibial spur is short but curved and many tined beneath; the costal cell bears two short bristles proximad, side by side; in the fore wing just distad of the discal bristle is a long, very thin, oblique hairline running caudo-proximad and apparently a fold in the wing. It is more conspicuous in some specimens and then resembles a line of very minute, dark setæ, the individuals of which are not distinguishable; in other specimens there may be several such lines farther distad. The submarginal vein bears two bristles, the marginal and stigmal a total of seven. The marginal cilia of the posterior wing are distinctly longer than that wing's greatest width, which is near apex, the blade subclavate. Fumation of fore wing varies in density, sometimes very dense and conspicuous.

From 11 specimens, ⅔-inch objective, 1-inch optic, Bausch and Lomb.

Male.—Same as the female. Genitalia exserted, cylindrical, rather long, bifid.

From 19 specimens, the same magnification.

This very beautiful species appears to be common in the United States. It was described from the following balsam specimens in the collections of the United States National Museum, United States Department of Agriculture and the Illinois State Laboratory of Natural History: Seven slides bearing respectively 1 male, 1 male, 1 male, 2 males (cotypes), 2 males, 1 male and 3 males, 1 female (types), all

labeled "Bred from *Asp. uvæ* Comst. J. F. Zimmer, Washington, D. C., 1911," and respectively "No. 17, May 15;" "No. 15, May 17;" "No. 18, May 15;" "No. 16, May 15;" "No. 24, May 18;" "No. 20, May 16;" and "No. 13, May 19." One slide bearing 1 male and 2 females, labeled "No. 14. Bred from grape scale. C. W. Hooker, Vienna, Va., May 18, 1911." A slide bearing a single male and labeled "*Signiphora. Diaspis pentagona* on lilac. Washington, D. C. Bred by E. R. Sasscer. March 8, 1907. Coll. Feb. 12, 1907." Another slide bearing a single female and labeled "From *Aulacaspis rosæ*, Bouché. North Chevy Chase, Md. T. H. Leavering. September 26, 1910." U.S.N.M. A slide bearing a single pair, labeled "*Signiphora. Chionaspis americana* Johnson on *Ulmus americana*. Columbus, Ohio. J. G. Sanders. Coll. Sep. 3, 1906: Bred by E. R. S." From the Illinois State Laboratory of Natural History, Urbana, the following four slides: One bearing a single male specimen, labeled "No. 39119, *Signiphora*." and reared from *Aspidiotus uvæ* Comstock on cultivated grape collected at Anna, Illinois by L. M. Smith and reared July 17, 1908; two slides bearing 1 male, 4 females, and 1 male, 2 females, respectively, labeled "21477" and reared from *Diaspis rosæ*, August 15, 1895 (W. G. Johnson) at Urbana, Illinois. A fourth slide bearing 2 males and the accession Nos. "21458" and "21401" and reared from *Aspidiotus* sp. on currant, and the cherry *Aspidiotus* (*forbesi*?) at Urbana, Illinois, July 30, August 13, 1895, by W. G. Johnson. Also a probable specimen of this species, in bad condition on a slide, remounted from a tag in the United States National Museum collection, labeled "289. From *Pseudococcus aceris* Geoff. Sep. 4, 1896. W. G. Johnson, Paterson, New Jersey."

Habitat.—United States—District of Columbia (Washington); Maryland (North Chevy Chase); Illinois (Anna, Urbana); Virginia (Vienna); Ohio (Columbus); New Jersey (Paterson).

Hosts.—*Aspidiotus uvæ* Comstock; *Diaspis pentagona* Targione; *Aulacaspis rosæ* Bouché; *Chionaspis americana* Johnson; *Aspidiotus forbesi* Johnson (?) and on *Aspidiotus* on currant.

Types.—Cat. No. 14198, U.S.N.M., 3 males, 1 female, on a single slide (District of Columbia).

Cotypes.—Accession No. 45083, Illinois State Laboratory of Natural History, Urbana, 2 females on one slide (District of Columbia).

18. SIGNIPHORA MAXIMA, new species.

Normal position.

Male.—Length, 1.05 mm.; large, robust.

General color deep black, the whole body tinged with metallic greenish; tarsi yellowish, all the distal joints and the proximal joints of the intermediate and caudal legs dusky, the last named joints tinged with more or less fuscous. Tips of cephalic tibiæ and cephalic tibial spur yellowish; rest of legs concolorous with the body; caudal tibial

spur pallid yellowish; intermediate tibial spur dusky brownish. Fore wings hyaline with the exception of a large suffused smoky area beneath the stigmal vein and apex of the marginal extending to the caudal wing margin, its distal margin irregular, convexed; and a long moderately broad strip beneath and against the submarginal vein, its caudal edge straight, running out to the bend of the submarginal vein and there giving out an arm caudo-distad which nearly joins a proximal extension of the other sooty area and incloses a more or less ovate, rather large clear spot under the marginal vein (along its proximal half and more). Caudal wings hyaline. Antennæ brown; mandibles black at tip. Eyes dark.

Belongs to the *nigra* group and of the species resembles *noacki* and *pulchra*. From the former it may be distinguished by reason of the fact that the inner edge of the stigmal vein forms less of a regular concave curve with the inner edge of the marginal vein at apex, the body is much more robust, the posterior wings broader, their marginal cilia distinctly not as long as their greatest width; the proximal tarsal joint of the caudal legs is longer. From *pulchra* it differs structurally in lacking the discal bristle of the fore wing and in having much broader fore and posterior wings. The mandibles are bidentate; the bristles of the fore wing venation usual, as in the preceding species; both wings are obtusely pointed; the cephalic tibial spur is many tined beneath; the costal cell bears a single isolated short seta proximad; marginal cilia of both wings longest at middle, or nearly, of caudal margin; the intermediate tibiæ are clavate and resemble a barbed club; the intermediate femora are short and convexly swollen beneath and armed with short spines.

From a single specimen, ⅔-inch objective, 1-inch optic, Bausch and Lomb.

Female.—Unknown.

Described from a single male specimen in the collection of the United States Department of Agriculture, mounted on a slide with the type of *Acoloides aureus* Girault and bearing the following labels: "248. 1247. Johuaimaja, Feb. '11. C. H. T. March 15, 1910."

Habitat.—South America—Peru (Johuaimaja).

Host.—Not known.

Type.—Type No. 14199, U.S.N.M. One male in balsam (mounted with the type female of *Acoloides aureus* Girault.).

19. SIGNIPHORA MELANCHOLICA, new species.

Normal position.

Female.—Length, 1.15 mm.; large for the genus; body long.

General color black, tinged with aeneous; marked with silvery white thus: A faint narrow band of it across the cephalic margin of the mesoscutum, accented at each side (in balsam most of the band invisible, only the accented portions at each side distinct, appearing

like a subquadrate silvery white area some distance cephalad of the tegulæ at the cephalo-lateral angle of the thorax, but in direct light the whole band is visible); both wings hyaline excepting the fore wing at extreme base under the proximal third of the submarginal vein; venation dusky.

Belongs to the *unifasciata* group; it differs from *unifasciata* structurally in that the fore wings have distinctly shorter marginal cilia at apex which are only about a fourth the greatest wing width, in *unifasciata* over a half; the caudal wings are narrower; the inner edge of the stigmal vein forms no curve with the inner edge of the marginal at its apex, or, in other words, the stigmal vein makes no distinct angle with the marginal. From *fasciata*[1] it differs in the form of the stigmal vein, which in that species makes a concave curve along its inner margin with the apex of the inner margin of the marginal vein, not true with this species; *fasciata* also bears the discal bristle on the fore wing; from both *unifasciata* and *fasciata*, *melancholica* differs in its longer and somewhat narrower abdomen. From *rhizococci* it differs in the broader posterior wing, the shape of the stigmal vein and the absence of the discal bristle, aside from the obvious differences in color.

From 1 specimen, the same magnification.

Male.—Unknown.

Described from a single female specimen in balsam, from the collections of the United States Department of Agriculture and labeled "1° 3 f. Gn. 2, sp. 7. Saman, July 26, 10. T." (Collected by C. H. T. Townsend.)

Habitat.—South America—Saman, Peru.

Host.—Not known.

Type.—Type No. 14200 U.S.N.M. One female in balsam.

20. SIGNIPHORA FASCIATA, new species.

Normal position.

Female.—Length, 0.65 mm., mean. Moderate in size for the genus but variable, sometimes robust.

Like *unifasciata* in general coloration, but considerably smaller and differing as follows: In general coloration the fore wings differ in that they are fumated out to the apex of the venation and the general black of the body is suffused with more brownish. Structurally differing in that the marginal fringes of the fore wing are decidedly shorter, the longest being not more than a third or fourth of the wing's greatest width, whereas in *unifasciata* they are over two-thirds the greatest width of the fore wing in that species; the marginal fringes of the posterior wing are not subequal to those of the fore wing, as in *unifasciata*, but longer; the discal bristle of the fore wing is present,

[1] Described next.

and, as in *pulchra*, also an oblique hair line or narrow crease just distad of the bristle, originating caudo-distad of the apex of the stigmal vein; the latter differs from that of *unifasciata* in forming a somewhat shallow, nevertheless regular, concave curve along the inner margin with the apex of the marginal vein. Also agreeing with *nigra* somewhat, but easily distinguished by the differences in the coloration of the body and wing and the form of the stigmal vein, as well as the longer marginal cilia of the wings. The mandibles are bidentate and black at tips; the tarsi are pallid yellow, their distal joints dusky; the longest marginal fringes (caudad) of the posterior wing are three-fourths or slightly more the greatest width of those wings. The tibial spurs are single, the cephalic ones, as usual, many tined beneath.

From 6 specimens, the same magnification.

Male.—The same.

From 2 specimens, the same magnification.

Described from 2 males and 6 females mounted in balsam: One female in the collections of the United States National Museum, mounted on a tag (now in balsam with the type of *unifasciata*) and labeled "No. 2488[01]. From *Aleurodes* on *Hydroxylon*. Issued Dec. 29, '81"; 1 male, 4 females, on a slide in the collections of the United States Department of Agriculture, labeled "1624. Lecanid—*Inglisia* on cotton, Cuautla—Morelos, Mex. July 1, '97. Koebele," *homotypes;* and a male and female from the same collections on a single slide labeled "1755. *Pulvinaria* on ash, Cuautla, Morelos, Mex., May 29, '97. Koebele," *types.*

Habitat.—North America—Mexico (Cuautla, Morelos); one other unknown locality.

Hosts.—*Pulvinaria* sp. on ash; *Inglisia* sp. on cotton; *Aleyrodes* sp. on *Hydroxylon.*

Types.—Cat. No. 14201, U.S.N.M. One male, 1 female in balsam, 1 slide (Mexico).

Homotypes.—Accession No. 45088, Illinois State Laboratory of Natural History, Urbana, the 1 male, 4 females as noted above (Mexico).

21. SIGNIPHORA HYALINIPENNIS, new species.

Normal position.

Female.—Length, 0.75 mm.; moderate in size for the genus.

General color black, the mesoscutum finely, transversely lined; legs and antennæ brown, tarsi pallid; wings wholly hyaline or very faintly clouded proximad, their venation brown; a narrow transverse silvery white band across the space between the mesoscutellum and metascutum which narrows so much mesad as to disappear, nearly, at the meson and thus is broadened and accented at each side (dorsal aspect); mesoscutellum brownish.

Belongs between the *nigra* and *unifasciata* groups and may be distinguished by the perfectly clear wings. In the *nigra* group it resembles more closely *pulchra, noacki,* and *maxima;* from the former it differs in having shorter marginal fringes, in lacking the oblique crease in the fore wing, in bearing a longer antennal club and somewhat broader wings; from *noacki* in having the discal bristle of the fore wing, shorter marginal cilia of the same wings and much longer antennal club; and from *maxima* in the smaller wings, posterior ones especially, and in the presence of the discal bristle of the fore wing. Of the species of the *unifasciata* group it is more like *fasciata,* being easily distinguished from *melancholica, unifasciata,* and *rhizococci* by the different stigmal vein and marginal ciliation of the fore wings. From *fasciata* it differs in having the curve made by the inner margin of the stigmal with that of the marginal at apex shallower and longer, in the absence of the oblique hair line or crease in the fore wing and in having a decidedly longer antennal club. Placed with the *unifasciata* group.

From 1 specimen, the same magnification.

Male.—Unknown.

Described from a single female specimen found tag-mounted in the collections of the United States National Museum, since remounted in balsam. The specimen bore the label "Par. on *Capulinia jaboticabæ,* San Paulo, Brazil. A. Hempel, Coll., May 11, '98. H. No. 214x".

Habitat.—South America—Brazil (Sao Paulo).

Host.—*Capulinia jaboticabæ* von Ihering.

Type.—Type No. 14202, U.S.N.M. One female in balsam.

22. SIGNIPHORA MACULATA, new species.

Normal position.

Female.—Length, 0.70 mm., mean. Moderate in size for the genus. General color brown, the abdomen darker, sometimes wholly blackish but usually with only the sides blackish; fore wings fumated much as in *pulchra,* but the portion of the fumated area distad of the end of the venation is maculate or broken up into small, rounded spots; also the area does not extend quite so far distad as in *pulchra,* half way to the wing apex from the stigmal vein; nevertheless, this clearer apical portion is not hyaline as in the other species, but distinctly though more or less faintly suffused with brownish. The proximal half of the posterior wing is similarly fumated. The clouded area of the fore wing is distinctly clearer under the proximal half of the submarginal vein (sometimes under the whole of that vein), while a longitudinal dark streak divides the proximal half of the wing nearly into longitudinal halves; under (caudad of) the

streak is a conspicuous conicoclavate clear area whose head projects directly distad into the clouded area and nearly meets a caudo-proximal part of the oblique streak or fold, present in this species. All appendages and venation concolorous with general body color; distal end of antennal club and caudal tibiæ often dusky. Lower end of face (the cephalo-ventral aspect) suffused slightly with lemon yellow, which, however, does not stand out conspicuously. Eyes red. Mandibles bidentate, their tips black.

Marginal fringes of the fore wing long and slender, slightly longer than the greatest width of that wing, subequal in length to those of the caudal wings. Discal bristle absent; oblique streak on fore wing present. Caudal wings moderate in width, about twice the width of those in *flavopalliata*.

Belongs near to the *flavopalliata* group by reason of its general coloration (brown). Of the species of this group—*flavopalliata*, *mexicana*, and *townsendi*—it closely resembles none of them. From the first two it differs in having the wings broader, the fore wings fumated further distad and spotted, in lacking the discal bristle and in having the curve along the inner margin of the stigmal and marginal (at apex) vein longer. From *mexicana*, aside from differences in coloration, it may be distinguished by means of the narrower wings (posterior especially), the longer marginal cilia and the absence of the discal bristle and from *townsendi* in general coloration and in bearing longer marginal cilia on the wings. At once separable from all species of the genus by having a portion of the distal half of the fore wing maculate or spotted.[1]

From 18 specimens the same magnification.

Male.—Unknown.

Described from 18 female specimens sent to me for identification and study by Dr. L. O. Howard and mounted on three balsam slides, all labeled "7231. Mayo, 1911. *Signiphora* sp. Let. fr. P. Cardin, June 21, 1911. Santiago de las Vegas, Cuba," and bearing, respectively, 3 females, 4 females and 11 females. In a letter dated July 11, 1911, Doctor Howard informed me that this species was reared from *Lepidosaphes alba* (Cockerell) by Patricio Cardin, entomologist, experiment station, Santiago de las Vegas, Cuba.

Habitat.—West Indies—Cuba (Santiago de las Vegas).

Host.—*Lepidosaphes alba* (Cockerell).

Type.—Cat. No. 14203, U.S.N.M. Eleven females in balsam (1 slide).

Cotype.—Accession No. 45084, Illinois State Laboratory of Natural History, Urbana, 4 females in balsam (1 slide).

Homotypes.—(3 females) in the collections of the United States Department of Agriculture.

[1] This maculation, however, sometimes occurs in other species; for instance, the type-species.

23. SIGNIPHORA NIGRELLA, new species.

Normal position.

Male.—Length, 0.60 mm. Moderately small in size for the genus. Black, suffused slightly with brownish at the thorax; legs and antennæ brownish, the tarsi brownish yellow. Fore wings smoky out nearly to the end of the marginal vein, the area clearer, however, proximad of the bend of the submarginal vein but not wholly clear, not then a distinct smoky band across the wing as in *dactylopii*. Marginal fringes of the fore wing moderate in length, longest along the caudal margin of the posterior wing, there distinctly longer than the greatest width of that wing. Oblique crease in fore wing slightly indicated; discal bristle absent. Longest marginal fringes of the fore wing equal to about half of that wing's greatest width. Antennal club long.

Belongs to the *nigra* group and closely resembles both *nigra* and *dactylopii*. From the former it differs colorationally in not having the distal third of the fore wing more or less infuscated and structurally in having the marginal fringes at the apex of the fore wing twice longer than those of *nigra* at the same place, in having posterior wings which are at least a third narrower and with distinctly longer marginal fringes and in having a stigmal vein which is less straight in relation to the marginal. From *dactylopii* it differs in color in having proximal portions of the fore wing more or less smoky; and in structure in all of the features pointed out for *nigra* but differing even more pronouncedly in them. Also, it is not marked with metallic green.

From single specimen, the same magnification.

Female.—Unknown.

Described from a single male specimen remounted in xylol-balsam from a tag in the U.S.N.M. labeled "471[01]. Iss. 16 Jan. '94. Par: *Asp.* [*Chrysomphalus*] *tenebricosus* Comstock, Waco, Tex."

Habitat.—United States—Texas (Waco).

Host.—*Chrysomphalus tenebricosus* (Comstock).

Type.—Cat. No. 14204, U.S.N.M. One male in xylol-balsam (Texas).

24. SIGNIPHORA FAX, new species.

Normal position.

Female.—Length, 0.47 mm., mean. Small in size for the genus. General color dark or sooty brown, varying to brown, the thorax (dorsal aspect) marked with lemon yellow, excepting the pronotum and cephalic two-thirds of the mesoscutum, the yellow band thus moderate in width. When brown, the abdomen is lighter at tip. Fore wings smoky out to the end of the venation, the smoky area, as usual, lighter proximal. Legs variable, brown in dark specimens, with the knees, tips of tibiæ and all of tarsi pallid yellowish; in light

specimens nearly uniformly pallid yellowish white. Eyes dark red; ocelli ruby red. Antennæ yellowish, the tip (distal third) of the club and a portion of the upper side dusky.

Belongs to the *flavopalliata* group and resembles that species in structure; however, it is smaller, the antennal club is shorter and more clavate, marked with dusky and yellow as described. The two species are readily distinguished upon comparison. It seems to be confined to the West Indies.

Male.—Unknown.

Described, with the same magnification, from the following series of slides from the collections of the Bureau of Entomology, United States Department of Agriculture, Washington, D. C.: Two slides bearing respectively one and three females, each labeled "459°. Par. of *Asp. personatus* on *Mango* and *Guanabana* San Juan Porto Rico, Jan. 99. A. Busck." A third slide bearing six females and labeled "*Chrysomphalus personatus* Comstock on nutmeg, Grenada, Barbados, West Indies. D. Morris, July 25, 1899." And the last, bearing seven females, together with specimens of *Arrhenophagus chionaspidis* Aurivillius, labeled "103e, 103g, 103h. Barbados, Aug. 19, 1910. T." The collector was C. H. Tyler Townsend. The Porto Rican specimens were of the light variety; the others all dark.

Habitat.—West Indies—Porto Rico (San Juan); Barbados (Grenada).

Host.—*Chrysomphalus personatus* (Comstock).

Types.—Cat. No. 14205, U.S.N.M. Six females on a single slide (Grenada, Barbados).

Cotypes.—Accessions No. *45091*, Illinois State Laboratory of Natural History, Urbana, Illinois, three females on a single slide (San Juan, Porto Rico, "Guanabana".)

25. SIGNIPHORA FUNERALIS, new species.

Normal position.

Female.—Length, 0.55 mm.; moderately small for the genus.

General color uniformly black, slightly suffused with brownish and distinctly metallic on head and mesoscutum, the metallic coloration being bluish green; antennæ and legs nearly concolorous, sooty black, the tarsi pallid yellow. Eyes dark red. Fore wings distinctly fumated throughout, but the sootiness gradually deepens proximad; there at the caudal wing margin caudal of the distal portions of the submarginal vein is a longitudinal clear area, subrectangular in shape.

Belongs to the *nigra* group and to that section of it including those species bearing short marginal fringes at the apex of the fore wing, namely, *nigra* Ashmead, *australiensis* Ashmead and *dactylopii* Ashmead, and more closely allied with the first. However, it differs

from it as follows: The fore wings are fumated continuously throughout, the body bears metallic coloration, the marginal fringes of the fore wing at apex are somewhat shorter. With the two other species it need not be confused. As concerns the other species of the *nigra* group, namely *noacki* Ashmead, *maxima* Girault, *pulchra*, Girault, and *nigrella* Girault, *funeralis* should not be confusable, since all of these species bear much longer marginal ciliation on the fore wings; specifically, in general coloration it differs from all of these species excepting *pulchra* because the fore wings are nearly uniformly fumated throughout; from *pulchra* it may be distinguished also by means of the pallid tarsi, the broader wings, the absence of the discal bristle and so on.

Antennal club not unusually long, conic-ovate and about four times longer than its greatest width; fore wings moderately broad, their longest marginal cilia somewhat less than half their greatest width; discal bristle absent. Posterior wings moderate in width, not as wide as their longest marginal cilia. Oblique hair-line crease of fore wing slightly indicated, present but faint.

From one specimen, the same magnification.

Male.—Unknown.

Described from a single female specimen mounted in balsam and captured from a window in an empty dwelling, December 28, 1911, at Herberton, North Queensland, Australia.

Habitat.—Australia—Queensland (Herberton).

Host.—Unknown.

Type.—One female in xylol-balsam (mounted with some trichogrammatids—*Abbella*, *Trichogrammatoidea*, and an *Anagrus*) deposited in the Queensland Museum, Brisbane, No. Hy./771.

26. SIGNIPHORA CORVINA, new species.

Normal position.

Female.—Length, 1.10 mm.; large, robust.

General color deep black, tinged on the head and thorax with metallic bluish green, the whole of the mesonotum thus colored; legs, antennæ and venation brownish black, but the tarsi and cephalic tibiæ interiorly yellowish brown. Fore wings hyaline excepting along about the proximal half, or out not quite to the end of the venation. The stained proximal area of the wing is peculiar; thus its distal margin is obliquely (caudo-proximad) truncate, the caudal midlongitudinal (nearly) half being more clear. Hence, somewhat as in *melancholica*, the fumation is under the venation extending caudad somewhat beyond the midlongitudinal line of the blade. It is longer, however, than the clouded area of the species named. Distal tarsal joints only slightly darker.

Belongs to the *nigra* group and to that portion of it including *funeralis*, *australiensis*, *nigra*, and *dactylopii* but is more closely related to the last named two. It differs from *nigra* in that the fore wings are fumated somewhat farther distad (nearly to the apex of the stigmal vein), the body is metallic on the head and thorax, finely, transversely lined at the mesonotum and more robust. From *dactylopii* it differs as much as it does from *nigra;* however, the fumation of the fore wing does not form a band across the wing from the marginal vein but is quite different and distinct.

The fore wings are broad, their marginal cilia very short, subequal in length to the stigmal vein, somewhat shorter at the apex; oblique crease slightly indicated; discal bristle absent; stigmal vein straight, a conical prolongation of the marginal vein. Posterior wings very broad, two-thirds the width of the broad fore wing, which is only twice longer than broad.

Marginal fringes of posterior wings subequal in length to those of the fore wing. Mandibles bidentate. Proximal joint of cephalic tarsus only half the length of the same joint of the caudal tarsus. Antennal club stout, conic-ovate, bearing a number of short longitudinal sulci, which are arranged in three circular groups along the joint, giving the appearance (casually) of three joints; the club only about two and a half times longer than wide (its greatest width at apex of proximal third).

From one specimen the same magnification.

Male.—Unknown.

Described from a single female specimen captured from a window in a granary and barn on a wheat farm at Roma, Queensland, October 6, 1911.

Habitat.—Australia—Queensland (Roma).

Host.—Unknown.

Type.—No. Hy./772, Queensland Museum, Brisbane, one female in xylol-balsam (mounted with the female type of *Gonatocerus huxleyi* Girault and specimens of *Signiphora australiensis*, *Abbella subflava*, *Ufens* and *Aphelinoidea* all captured at the same time).

27. SIGNIPHORA AUSTRALICA, new species.

Normal position.

Male.—Length, 0.54 mm.; moderately small for the genus.

General color black, the vertex and mesonotum metallic bluish green, the antennæ, venation and caudal femur sooty black, the tarsi and remainder of legs pallid yellowish, the distal tarsal joint not much darker if at all; fore wings fumated throughout, the proximal fumation (out nearly to the end of the marginal vein) deeper, the whole divided somewhat distad of the middle of the wing by a moderately broad subhyaline band which is nearly regular in width and joining the costal wing margin at the end of the stigmal vein;

the fore wing is also clear directly beneath the submarginal vein for nearly its whole length.

Belongs to the *nigra* group and that section of it containing those species bearing marginal cilia at the apex of the fore wing which are subequal to or longer than a third of the wing's greatest width, hence allied with *maxima* Girault, *pulchra* Girault, *noacki*, Ashmead, and *nigrella* Girault. However, resembling *australiensis* Ashmead and at first mistaken for that species; the transverse clear band is somewhat farther distad (on the costal margin half or more of it extending beyond the apex of the stigmal vein), more uniform and not coming to a point at the stigmal vein; the longer marginal cilia of the fore wing in *australica*, the narrower fore wings, the pallid legs and other characters easily distinguish the two species. Of the four species with which it is allied, it resembles, perhaps, *pulchra* more than the others because of its moderately narrow fore wings, but the discal bristle is absent and the oblique hair line-like crease but slightly indicated; the legs are much lighter in color. The species need hardly be confused with any other species of the genus, even its closest allies.

Fore wings with the marginal cilia moderately long, those at apex only about slightly over a third of the greatest width and slightly longer than the apical marginal cilia of the posterior wings; stigmal vein forming a regular concave curve with the inner edge of the marginal vein at its apex, but the curve is not as deep as usual. Posterior wings moderately broad, subequal in greatest width to their longest marginal cilia or slightly more or less than subequal. Antennal club long and moderately stout, spindle shaped, slightly over four times longer than its greatest width which is near its middle, with no regularly grouped nor prominent longitudinal sulci.

From two specimens, the same magnification.

Female.—Unknown.

Described from two male specimens mounted in xylol-balsam and captured December 4 and 21, 1911, from a window in men's quarters on a sugar farm near Nelson, North Queensland.

Habitat.—Australia—Queensland (Nelson, near Cairns).

Host.—Unknown.

Type.—No. Hy./773, Queensland Museum, Brisbane, one male in xylol-balsam (mounted with a female of *Aphelinoidea howardii* Girault).

TABLE TO THE SPECIES OF SIGNIPHORA ASHMEAD.—MALES, FEMALES.

Table to the species groups.

Body, excluding appendages, all black, blue-black tinged with greenish or black suffused slightly with brownish. In balsam mounts, body appearing a uniform dead black, unmarked and no yellow.....*nigra* group.

Body, excluding appendages, the same but marked with a transverse band or several spots of silvery or yellowish white (dorsal aspect).....*unifasciata* group.

Body, excluding appendages, brown, marked with a broad band of ivory white between wings and across ventral half of face.....*rhizococci* group.

Body, excluding appendages, mostly brown or black brown, marked with orange or lemon yellow, the brown predominating.....*flavopalliata* group.

Body, excluding appendages, uniformly brown, the abdomen marked with brown black, marginal cilia long.....*maculata* group.

Body, excluding appendages, mostly lemon or orange yellow, marked with brown or brown-black, the yellow predominating.....*aleyrodis* group.

I. nigra group.

This group includes the following species which are all uniformly black, or black tinged with metallic greenish, or black suffused slightly with brownish: *nigra* Ashmead, *australiensis* Ashmead, *dactylopii* Ashmead, *noacki* Ashmead, *pulchra* Girault, *maxima* Girault, *funeralis* Girault, *corvina* Girault, *australica* Girault, and *nigrella* Girault. The species may be identified by the use of the following table:

Marginal cilia of the fore wing at extreme apex short, distinctly much shorter than a third of the greatest width of the fore wing; stigmal vein at inner edge nearly in a straight line with the marginal vein, or making only a slight acute angle. Posterior wings broad.....1.

Marginal cilia of the fore wing at extreme apex moderately long, twice longer than in the first group and distinctly as long as or longer than a third of the greatest width of the fore wing; inner margin of stigmal vein forming a more or less distinct curve with the inner margin of the marginal vein at apex or making an obtuse angle. Posterior wings variable, often moderately narrow.....2.

1. Apical half of the fore wing not clouded or but slightly so, not smoky like the proximal portions.

   Proximal third of fore wing smoky, the smoky area not reaching to the end of the marginal vein but ending about the length of the stigmal vein distant from it; distal third of fore wing sometimes slightly clouded; body black. Marginal cilia at apex of fore wing longer, distinctly longer than the stigmal vein. *nigra* Ashmead.

   Fore wings fumated not quite out to the end of the stigmal vein but the distal margin of the fumation is obliquely truncate, caudo-proximad and the caudal half of the wing under the venation is nearly hyaline; body marked with metallic green; marginal cilia at apex of fore wing very short...*corvina* Girault.

   Fore wings with a somewhat irregular, clear-cut, moderately broad smoky band across it from the marginal vein, the band narrowed at its middle; otherwise hyaline. Body black, marked with metallic green on the vertex and mesonotum. Marginal cilia at apex of fore wing subequal in length to stigmal vein.....*dactylopii* Ashmead.

Nearly all of the apical portion of the fore wing (nearly a half), except perhaps at extreme apical margin, clouded nearly as deeply as proximal portions.

Fore wings entirely smoky excepting at extreme apical margin and conspicuously near the middle where a moderately broad elliptical subhyaline band crosses from the apex of the venation (excluding the usual clear spot more proximad, near caudal margin); this band is widest at the middle, its edges irregular. Body black, the vertex and mesonotum metallic green. Marginal cilia at apex of fore wing distinctly longer than stigmal vein but variable, sometimes no longer than the stigmal vein or somewhat shorter. *australiensis* Ashmead.

Fore wings fumated throughout, nearly uniformly but the fumation is deeper proximad. Marginal cilia at apex of fore wing nearly twice longer than the stigmal vein.....*funeralis* Girault.

2. Posterior wings very broad, distinctly broader than their longest marginal cilia; fore wings with a delimited clear rounded area against the marginal vein.

Fore wings with a large smoky area crossing them at the apex of the marginal vein and a rectangular smoky area under all of the submarginal vein proximad of its bend, the area then extending disto-caudad to about a point on the midlongitudinal line of the wing and nearly reaching a reciprocal extension from the middle smoky area, these two extensions inclosing a rounded subhyaline area against the marginal vein. Marginal cilia at apex of fore wing only slightly more than a third of that wing's greatest width. Robust, black.

maxima Girault.

Posterior wings only moderate in width or moderately narrow, distinctly narrower than the length of their longest marginal cilia, or slightly more or less than subequal in width to them but usually much narrower; fore wings nearly entirely smoky or smoky at proximal fourth or proximal half, without a delimited clear area under the marginal vein.

Fore wings wholly smoky except at apex; discal bristle present. Longest marginal cilia of fore wing equal to about three-fourths or somewhat more of that wing's greatest width; tarsi brown, excepting proximal three joints of caudal tarsi.....*pulchra* Girault.

Fore wings the same in regard to fuscation but the smokiness is deeper from base out to the end of the marginal vein, the whole divided somewhat distad of the middle of the wing by a moderately broad subhyaline band which is nearly uniform in width and joins the costal margin at the end of the stigmal vein; tarsi and legs, except caudal femur, pallid yellow; discal bristle absent.

australica Girault.

Fore wings with the major portion hyaline; discal bristle absent. Only the proximal fourth (out to base of marginal vein) of the fore wing smoky; longest marginal cilia of fore wing only about two-thirds the wing's greatest width; tarsi pallid to tip.....*noacki* Ashmead.

Fore wings smoky at proximal half (to end of marginal vein). Longest marginal cilia of fore wing about half that wing's greatest width.....*nigrella* Girault

II. unifasciata group.

Like the preceding group but marked with silvery white or yellowish white. The following species: *unifasciata* Ashmead, *bifasciata* Ashmead, *fasciata* Girault, *melancholica* Girault, and *hyalinipennis* Girault. The following table should enable the identification of these forms:

Body unmarked save for a transverse whitish band across the thorax at scutellum.

The inner margin of the stigmal vein forms either a long or short concave curve with the inner margin of the marginal vein at apex; discal bristle present. Tip of stigmal vein pointing distad.

Fore wings fumated out to the end of the venation; marginal cilia at apex not more than a third of the fore wing's greatest width. Curve of inner edge of stigmal vein shorter and more concave.....*fasciata* Girault.

Fore wings nearly hyaline, only a slight suffused cloudiness present proximad; marginal cilia at apex nearly a half the fore wing's greatest width; curve formed by inner edge of marginal and stigmal veins long and shallow.

hyalinipennis Girault.

The inner margin or edge of the stigmal vein does not form a regular concave curve with the inner margin of the marginal vein but the latter is straight, the stigmal vein curved caudo-distad forming an obtuse angle with the marginal vein. Discal bristle absent. Tip of stigmal vein pointing disto-cephalad.

Fore wings fumated only out as far as the middle of the marginal vein (or at proximal third); marginal cilia of fore wing at apex equal to about half of the greatest width of that wing.....*unifasciata* Ashmead.

Body unmarked save for two transverse yellowish white bands across the thorax at scutellum and hind border of mesonotum; fore wings fumated out to end of the stigmal vein. Discal bristle present.....*bifasciata* Ashmead.

Body unmarked save for a subquadrate spot of silvery white on each side at the cephalo-lateral angle of the thorax (in reality joined by a very faint band crossing the thorax at the cephalic margin of the scutum).

Fore wings nearly hyaline but distinctly clouded proximad under the proximal third of the submarginal vein (or at proximal seventh); discal bristle absent; marginal cilia at apex of the fore wing subequal to a fourth of the wing's greatest width. Tip of stigmal vein pointing distad, the inner margin of the stigmal vein nearly in a straight line with the inner margin of the marginal at apex. *melancholica* Girault.

III. rhizococci group.

This group contains but a single species, *rhizococci* Ashmead, which is characteristically marked but which is likely to be confused with several species in other groups, for instance, the one preceding and the one following. It may be distinguished at once from any species of the *unifasciata* group by reason of the length of the white band across the thorax, which is equal nearly to half of the length of that region; also by reason of its general color, which is a sooty brown, not a pure deep black. In the *flavopalliata* group it is most likely to be confused with *flavopalliata* itself, which it closely resembles in the pattern of general body coloration. However, white differs from yellow and the two species differ that much in coloration; structurally, they may be distinguished readily by reason of the differences in the width of the caudal wings which are about twice broader in *rhizococci* and different in shape, tapering somewhat distad, broadest proximad at apex of the venation, not true in *flavopalliata*, the posterior wings there nearly equal in width throughout and narrow; the fore wings are also somewhat broader in *rhizococci* and differ in shape, being broader distad, broad proximad in *flavopalliata*. It is scarcely probable that the species will be confused with any others aside from the ones mentioned. It is sooty or smoky brown in color, marked with ivory white.

Fore wings clouded out to the end of the venation; longest marginal cilia of fore wing about three-fourths that wing's greatest width; discal bristle present; posterior wings with their longest marginal cilia distinctly longer than the wing is wide; antennal club brown; remainder of antennæ and legs pallid yellowish white.....*rhizococci* Ashmead

IV. flavopalliata group.

This group is characterized by having a predominance of smoky brown or dark brown in its general body coloration, marked on the head, thorax or abdomen, or all, with lemon or golden yellow; in other words, yellow is present but this color forms but a small proportion of the whole body pattern. It includes the following species: *flavopalliata* Ashmead, *mexicana* Ashmead, *townsendi* Ashmead, and *fax* Girault, forms which may be identified by the use of the following table. All of these species are closely allied, very similar structurally and hence great care must be exercised in attempting identification in this group. A careful study of the following table should prove of great aid. The species *flavopalliata* and *townsendi* are more nearly structurally identical.

Body marked with a broad band of orange or lemon yellow across the thorax, including the metanotum and most of mesonotum except cephalic half, sometimes excepting the scutum; rest of body sooty brown but sometimes more or less of the head and tip of abdomen is yellow. Fore wings fumated out to end of venation; stigmal vein at inner margin forming a regular curve.

Caudal wings narrow; longest marginal cilia of fore wing as long or slightly longer than the greatest wing width.

Sooty brown, the mesoscutellum alone or all parts of the throax excepting pronotum and cephalic half or third of mesoscutum, orange yellow; abdomen sometimes lighter brown suffused with yellowish at tip or even to proximal half; discal bristle present. Caudal wings very narrow; antennal club uniformly dusky, subclavate. Distal portion of fumated area caudad, often maculate. Moderately large species.

flavopalliata Ashmead (*occidentalis* Howard).

Sooty brown, the thorax lemon yellow, excepting pronotum and cephalic half of mesoscutum; the distal half of abdomen usually distinctly lighter, suffused with yellowish, the light area with a convex margin proximad; sometimes only tip lighter, sometimes whole distal half yellow crossed in middle by a brown band. Caudal and cephalic wings slightly broader. Antennal club uniformly dusky, subclavate. Moderately large species. The inner margin of the stigmal vein in this species forms a deeper and narrower curve than in the others and the marginal vein just proximad of the curve (at apex of vein) is broader than usual and obtusely rounded. Discal bristle absent.....*townsendi* Ashmead.

Sooty brown or brown, the thorax, except pronotum and cephalic two-thirds of mesoscutum, lemon yellow; in darker specimens abdomen all dark, but lighter distad in lighter brown specimens; discal bristle present; wings as in *flavopalliata;* antennal club shorter, clavate, the antennæ yellowish, the club dusky at distal third. Small species .....*fax* Girault.

Caudal wings broad; longest marginal cilia of fore wing only about three-fourths that wing's greatest width.

Sooty brown, the abdomen darker; mesoscutellum and lateral margins of mesoscutum orange yellow; discal bristle present. Fore wings broad, about twice the width of the posterior wings.....*mexicana* Ashmead.

V. maculata group.

Containing but a single species, this group is intermediate between the preceding and the following, though in a sense less related to either than each is to the other. The body of the single species is brown, marked with no yellow, the abdomen either subconcolorous or else dark along each side or almost entirely dark. The group is characterized by the absence of orange or lemon yellow in the general body coloration.

Fore wings fumated out slightly beyond a point between the wing apex and apex of the venation, the portion of the fumated area distad of the apex of the venation (and farther proximad near caudal margin) broken into small spots or maculate; discal bristle absent; longest marginal cilia of fore wing subequal to that wing's greatest width, the cilia long and slender; caudal wings narrow. All of legs and antennæ brown.....*maculata* Girault.

VI. aleyrodis group.

The species of this group are characterized by having a predominance of orange or lemon yellow in their coloration but through *townsendi* and to a less extent variations of *flavopalliata*, they are more or less closely related to species group IV. Thus *coquilletti* of this group is nearly structurally identical with *townsendi* of the other; if the distal half of the abdomen of *townsendi* should become wholly orange yellow instead of merely lighter brown or instead of yellow broken by a dark band, the two species could not be told apart. The following species: *aleyrodis* Ashmead, *coquilletti* Ashmead, *aspidioti* Ashmead, *flava* Girault, *flavella* Girault, and *basilica* Girault. In spite of what has just been written, however, I believe all of these species are

valid; nevertheless the possibility of some of them being synonymic with some in the *flavopalliata* group must be held constantly before the mind in dealing with them. This applies especially to those named in this connection. In all of the species of this group, the smoky area of the fore wing has more of a tendency to be a band across the wing at the marginal vein, the proximal portion of the wing clear or nearly, not merely broken as in the *flavopalliata* group. The discal bristle is absent in all of the species.

Body lemon yellow excepting pronotum, cephalic half of mesoscutum and a broad smoky band across the abdomen, which is as long as about a third of the abdomen's length, or slightly less; sometimes a second band indicated distad; fore wings hyaline with the exception of the band across it. Antennal club wholly yellow but sometimes dusky at tip. Abdomen longer than thorax, body long, cylindrical ovate.....*aleyrodis* Ashmead.

The same but basal band of abdomen nearly a half narrower or shorter and a second smoky band across the abdomen is indicated by a distinct spot on each side at distal three-fourths; antennal club much shorter and at distal fourth is dusky. Fore and posterior wings much narrower, narrower than in *flavopalliata*. Very small. Fuscous band of wing not clear. Abdomen subequal to thorax, body ovate.....*basilica* Girault.

The same but nearly immaculate, the body suffused more or less with orange. Fore wings slightly fumated to tip.

The whole body slightly suffused with orange or pinkish; antennal club nearly wholly dusky. Fore wings moderately broad, the smoky band distinct but the wing slightly clouded to tip; pedical of antenna long-obconic, about four times longer than broad at tip and nearly half the length of the club; curve formed by inner margins of stigmal and marginal (distad) veins long. *flava* Girault.

Only the abdomen suffused with orange or pinkish; antennal club lighter, at tip distinctly capped with dusky; fore wings narrower, the smoky band fainter, the wing still more faintly fumated to tip; pedicel of antenna obconic, broader at tip and shorter, only slightly over twice its longest width; the antennal club much shorter. Curve formed by stigmal vein at inner margin short and unequal.....*flavella* Girault.

Body orange yellow, excepting pronotum, cephalic half or more of mesoscutum and a broad band across the abdomen which is as long as about half of the abdomen's length or slightly less, sometimes only slightly more than a third. This band is a dark brown.

Antennal club wholly yellowish, uniform in color.....*coquilletti* Ashmead.

Antennal club half yellowish (base) and half dusky (tip), two distinct colored portions.....*aspidioti* Ashmead.

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Original description of the genus and of *flavopalliata* its type; notes on habits of the species.

Howard, Leland Ossian in John Henry Comstock. Report of the Entomologist of the United States Department of Agriculture for 1880, 1881, p. 371.

Critical remarks on *Signiphora* Ashmead: The "anomalous 5-lobed appendage" of Ashmead is on the middle tibia, not posterior, and is homologous to the middle tibial spur of the encyrtids. The genus, however, belongs to the Mymaridae.

HOWARD, LELAND OSSIAN. Insect Life, United States Department of Agriculture, Washington, D. C., vol. 6, 1894, pp. 233–235, fig. 10.

Redescription of the genus; original description of *occidentalis* with figure of adult female. From *Aspidiotus aurantii citrinus*. Signiphorinæ established.

JOHNSON, WILLIS GRANT. Bull. No. 6, new series, Division Ent., U. S. Department of Agriculture, Washington, D. C., 1896, p. 75.

States that *Signiphora nigrita* Howard MS. reared, among others (aphelinines) from *Aspidiotus forbesi* Johnson. (The species *nigrita* is a *nomen nudum* and is the same as *pulchra* Girault.)

DALLA TORRE, CARL G. DE. Catalogus hymenopterorum hucusque descriptorum systematicus et synonymicus, Lipsiæ, vol. 5, 1898, p. 217 and footnotes 1 and 2.

Catalogue of the subfamily; *flavopalliata* Ashmead and *occidentalis* Howard the two species included.

ASHMEAD, WILLIAM HARRIS. Proc. Ent. Soc. Washington, Washington, D. C., vol. 4, pt. 3, May 24, 1899, pp. 236, 248.

Divisions of the Chalcidoidea stated—Signiphorinæ, one of them, p. 236. Synopsis of the subfamilies of the Chalcidoidea; Signiphorinæ of the Encyrtidæ; same as Ashmead (1904).

———— On the genera of the Chalcid-flies belonging to the subfamily Encyrtinæ. Proc. U. S. Nat. Mus., Washington, D. C., vol. 22, 1900, pp. 409–412.

Table of the species of *Signiphora: nigra, australiensis, dactylopii, noacki, unifasciata*, p. 410; *bifasciata, mexicana, rhizococci*, p. 411; *aleyrodis, coquilletti, aspidioti, townsendi*, p. 412 (new species).

———— Classification of the Chalcid Flies or the superfamily Chalcidoidea, with *etc.* Memoirs of the Carnegie Museum, Pittsburgh, vol. 1, No. 4, January, 1904. (Serial No. 21, Publications of the Carnegie Museum), pp. 286–287, 311, 388, 497.

SCHMIEDEKNECHT, OTTO. Genera insectorum (P. Wytsman), Bruxelles, 1909, 97me fascicule, family Chalcididæ, pp. 191, 261.

[SCIENTIFIC RESULTS OF THE PHILIPPINE CRUISE OF THE FISHERIES STEAMER "ALBATROSS," 1907–1910.—No. 26.]

THE GIANT SPECIES OF THE MOLLUSCAN GENUS LIMA OBTAINED IN PHILIPPINE AND ADJACENT WATERS.

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During the cruise of the United States Fisheries steamer *Albatross* in Philippine and adjacent waters a number of Giant Limas were obtained. Here, as elsewhere, they occurred only in deep water, the least depth at which they were found being 161 fathoms, the greatest 559, with an average of 313.6. They were by no means abundant or universally distributed, for of the 369 dredgings made in more than 100 fathoms, only 18 yielded these mollusks, and 205 of these stations were made in depths between the two extremes in which Giant Limas were obtained. To these 205, eleven stations might be added, which differ only a couple of fathoms in depth from the above. Some of the new species here described are remarkable for their great size, being of much greater dimensions than any Giant Lima heretofore known.

The three large species obtained in the Sulu Sea and its ramifications among the islands, differ from those heretofore known by having a shallow, broad, and oval resilium, which follows the outer border of the hinge for a much greater distance than in typical *Acesta*, characterized by *Lima excavata* Fabricius, the type of *Acesta*, in which we have the resilium assuming the form of a deep curved wedge. The characters of the two groups are well shown in our figures of *L. rathbuni* and *L. celebensis*. These characters, taken in conjunction with the much less strongly developed sculpture in the three large Philippine species, is deemed sufficient to merit at least a sectional recognition for which I propose the name *Callolima*, with *Lima* (*Callolima*) *rathbuni* as type.

In the adjoining table I quote measurements and data of previously described species from the papers by Mr. E. A. Smith [1] and Dr. W. H. Dall.[2] To these are added similar data from the present material to render the table complete.

[1] Ann. Mag. Nat. Hist., ser. 7, vol. 4, 1899, p. 251.
[2] The Nautilus, vol. 16, No. 2, June, 1902, pp. 15–17

Distribution and measurements of known species of Giant Limas.

Name.	Locality.	Depth in fathoms.	Measurements in mm.		
			Alt.	Lat.	Diam.
(*Acesta*) *excavata* Fabricius, 1779	Norway	150-300	170	125	55
(*Acesta*) *goliath* Sowerby, 1883	Japan	775	150	110	36
(*Acesta*) *indica* Smith, 1899	Arabian Sea	430	75	61	34
(*Acesta*) *patagonica* Dall, 1902	Patagonia	245-481	100	72	31
(*Acesta*) *agassizi* Dall, 1902	Panama	322	97	78	30
(*Acesta*) *verdensis*	Philippines	394	48	40.4	21.5
(*Acesta*) *celebensis*	Buton Strait	519	159	(?)	(?)
(*Acesta*) *butonensis*	do	559	26.8	22	11
(*Callolima*) *smithi*	Philippines	281-508	175	118	48
(*Callolima*) *rathbuni*	do	161-226	208	156	59
(*Callolima*) *philippinensis*	do	190	177	111	37
(*Callolima*) *borneensis*	Borneo	305	39.2	33	16

The photographs of the accompanying illustration were made by the Photographer of the United States National Museum, and were retouched by Mrs. E. Bennett Decker.

LIMA (CALLOLIMA) SMITHI, new species.

Plates 12 and 13.

Shell large, slightly gaping for the greater part of both the anterior and posterior lateral margin. Pale lemon yellow, which is more intensified at the border than at the center of the disk, and also appears more emphasized on a series of rings which probably mark resting stages. Outline very oblique; the anterior lateral margin being much less curved than the posterior, which is very strongly arched. Hinge slightly curved, with a general upward slant posteriorly; scarcely produced beyond the beaks anteriorly. Lunule slight, outer surface marked with strongly impressed, quite regular and fairly evenly distributed somewhat zig-zag radiating lines which are less expressed on the early part of the shell and are almost obsolete on a narrow line radiating from the beak ventrally. The radiating lines are strongest on the lunule. Interior bluish white with the intensified yellow portion shining through the substance of the shell. Resilium large, with the posterior margin evenly curved and the ventral sigmoid.

The type, Cat. No. 256977, U.S.N.M., was dredged at station 5533, off Baliscasag Island, in 432 fathoms, on green mud and sand bottom, bottom temperature 53°.3. The type, which is the largest specimen, measures: alt. 175 mm., lat. 118 mm.; diameter 48 mm. The smallest specimen was obtained at station 5283. The ventral portion of this is broken, which prevents giving the height; but the breadth is 14.5 mm.

Lima (*Callolima*) *smithi* seems to prefer a finely sandy mud bottom. It was dredged at depths varying from 281 to 508, or at an average of 401 fathoms.

This species is named for Dr. Hugh M. Smith, Commissioner of Fish and Fisheries and director of the Philippine Expedition.

Specimens were obtained at the following stations:

Station 5124, north of Point Origon, Mindoro (lat. 12° 52′ N.; long 121° 48′ 30″ E.), in 281 fathoms, on soft green mud bottom. Cat. No. 256978, U.S.N.M.

Station 5283, off Malavatuan Island (lat. 13° 48′ 30″ N.; long. 120° 28′ 40″ E.), in 280 fathoms, on dark gray sand bottom; bottom temperature, 46°.8; density of water at bottom, 1.02517. Cat. No. 237577, U.S.N.M.

Station 5423, south of Cagayan Island, Jolo Sea (lat. 9° 38′ 30″ N.; long. 121° 11′ E.), in 508 fathoms, on gray mud and coral sand bottom; bottom temperature, 49°.8. Cat. No. 255175, U.S.N.M.

Station 5513, off Camp Overton Light, Mindanao (lat. 8° 16′ 45″ N.; long. 124° 02′ 48″ E.), in 505 fathoms, on gray mud and fine sand bottom. Cat. No. 255177, U.S.N.M.

Station 5533, off Balicasag Island (lat. 9° 27′ 15″ N.; long. 123° 31′ 48″ E.), in 432 fathoms, on green mud and sand bottom; bottom temperature, 53°.3. Cat. No. 256977, U.S.N.M.

LIMA (CALLOLIMA) PHILIPPINENSIS, new species.

Plates 14 and 15.

Shell large, of spatulate outline, slightly gaping at the lunule and narrowly so for the entire length of the posterior lateral margin; yellowish white, with concentric bands of pale lemon yellow, which probably mark resting stages. Hinge slightly curved, bending slightly upward posteriorly; scarcely at all produced anteriorly beyond the beak. Outer surface marked with well-incised, fine, quite regular and fairly regularly spaced wavy radiating riblets excepting a narrow band that extends from the beak ventrally, spreading slightly to form a triangular area with the beak at the angle, which is free from these markings. The incised lines are a little stronger at the lunule than anywhere else. Interior bluish white, through which the yellow areas of the outside show. Dorsal boundary of the resilium evenly curved; the ventral sigmoid.

The type, Cat. No. 256976, U.S.N.M., was dredged at station 5373, off the outer Tayabas Light (lat. 13° 40′ N.; long. 121° 31′ 10″ E.), in 190 fathoms (sounding not made but taken from chart), on gray mud bottom. It measures: alt. 177 mm., lat. 111 mm.; diameter 37 mm.

LIMA (CALLOLIMA) RATHBUNI, new species.

Plates 16 and 17.

Shell very large, slightly gaping for about a third of the anterior lateral margin and for about half of the posterior lateral; lemon yellow, fading to yellowish white at the edges. Outlines irregularly oval; hinge slightly, obliquely, downward slanting posteriorly, scarcely produced anterior to the beak; lunule concavely, obliquely sloping; the remaining outline curving in a regular oval. Outer

surface marked with irregular wavy, faintly impressed, and irregularly distributed radiating lines, and fine concentric lines of growth. The radiating lines are decidedly stronger on the lunule than on any other part of the shell. Interior bluish white; within the umbones an iridescent intensified canary yellow callus patch occurs, which gradually becomes attenuated and diffused ventrally, extending weakly as far as the palial line. A rosy flush extends from a little within the ventral border dorsally, over about two-thirds of the inner surface of the shell. Resilium almost straight dorsally, with a sigmoid curve ventrally. Hinge with obsolete lateral teeth indicated, the anterior one of which is a little stronger than the posterior.

The type, Cat. No. 256975, U.S.N.M., was dredged at station 5173, off Jolo Light, in 186 fathoms, on shell and coral bottom. It measures: alt. 182 mm., lat. 135 mm.; diameter 52 mm. The smallest specimen obtained, Cat. No. 254979, U.S.N.M., comes from station 5519 and measures: alt. 63 mm., lat. 51 mm.; diameter 22.3 mm. The largest specimen, Cat. No. 254978, U.S.N.M., comes from station 5371 and measures: alt. 208 mm., lat. 156; diameter 59 mm.

This species was obtained at the following stations:

Station 5135, off Jolo Light (lat. 6° 11′ 50″ N.; long. 21° 08′ 20″ E.), in 161 fathoms, on fine coral sand bottom; bottom temperature, 57°.4. Cat. No. 254980, U.S.N.M.

Station 5173, off Jolo Light (lat. 6° 02′ 55″ N.; long. 120° 53′ 00″ E.), in 186 fathoms, on shell and coral bottom. Cat. No. 256975, U.S.N.M.

Station 5198, off Baliscasag Island (lat. 9° 31′ 50″ N.; long. 123° 39′ 45″ E.), in 220 fathoms, on green mud bottom; bottom temperature, 53°.9; density of water at bottom, 1.02500. Cat. No. 256975, U.S.N.M.

Station 5371, off outer Tayabas Light (lat. 13° 49′ 40″ N.; long. 121° 40′ 15″ E.). Sounding not made, depth taken from chart which says 83 fathoms. (This is probably incorrect, for all the other Giant Limas were taken at much greater depth.) Bottom green mud. Cat. No. 254978, U.S.N.M.

Station 5387, off outer Bagatao Island Light (lat. 12° 54′ 40″ N.; long. 123° 20′ 30″ E.), in 209 fathoms, on soft green mud bottom; bottom temperature, 52°.4. Cat. No. 254976, U.S.N.M.

Station 5503, off Macubalan Point Light, Mindanao (lat. 8° 36′ 26″ N.; long. 124° 36′ 08″ E.), in 226 fathoms, on green mud bottom; bottom temperature, 53°.3. Cat. No. 254976, U.S.N.M.

Station 5516, off Point Tagolo Light, Mindanao (lat. 8° 46′ 00″ N.; long. 123° 32′ 30″ E.), in 175 fathoms, on globigerina bottom; bottom temperature, 54°.3. Cat. No. 254974, U.S.N.M.

Station 5519, off Point Tagolo Light, Mindanao (lat. 8° 47′ 00″ N.; long. 123° 31′ 15″ E.), in 182 fathoms, on globigerina and sand bottom; bottom temperature, 54°.3. Cat. No. 254979, U.S.N.M.

From the above one sees that *Lima* (*Callolima*) *rathbuni* seems to like a soft mud habitat, ranging in depth from 161 to 226, or an average of 194 fathoms.

This species is named for Dr. Richard Rathbun.

LIMA (CALLOLIMA?) BORNEENSIS, new species.

Plate 20, figs. 1, 2.

Shell apparently large, of suboval outline. Hinge slanting slightly upward, with the area occupied by the lunule concavely excavated. Pale canary yellow. Outer surface marked by numerous, somewhat wavy, almost equal and equally spaced radiating riblets, which are a little stronger at the lunule than on the rest of the shell. In addition to these riblets, the surface is marked by concentric lines of growth with stronger ridges at intervals indicating resting stages. The hinge area is slightly worn which makes it impossible to be positive about the type of resilium. Interior white, edged with a yellowish band.

This type, a young specimen, Cat. No. 229312, U.S.N.M., differs from the young shells of any of the species we know, and forces us to consider it distinct. It comes from station 5592, off Silungan Island, Borneo (lat. 4° 12′ 44″ N.; long. 118° 27′ 44″ E.), in 305 fathoms, on green mud bottom; bottom temperature 43° .2. The shell measures: alt. 39.2 mm., lat. 33 mm.; diameter of the single valve 8 mm.

LIMA (ACESTA) VERDENSIS, new species.

Plate 20, figs. 5, 6.

Shell moderately large, irregularly oval; bluish white; slightly gaping at the lunule. Outer surface marked by numerous, quite regular and regularly spaced radiating riblets which are stronger on and near the lunule than on the rest of the shell. The early central portion of the disk is almost smooth. In addition to the radial sculpture, the surface is marked with numerous lines of growth, some of which, marking resting stages, are much stronger than the rest. Hinge slightly curved, almost at right angles to the long diameter of the shell, extending very slightly anterior to the beaks. Resilium deeply impressed, wedge shaped. Lunule strongly developed and deeply impressed. Interior bluish white.

The young type, Cat. No. 249132, U.S.N.M., was dredged at station 5119, off Sombrero Island (lat. 13° 45′ 05″ N.; long. 120° 30′ 30″ E.), in 394 fathoms, on green mud and sand bottom; bottom temperature, 43° .7; density of water at bottom, 1.02468. It measures: alt. 48 mm., lat. 40.4 mm.; diameter, 21.5.

LIMA (ACESTA) CELEBENSIS, new species.

Plates 18 and 19.

Shell large, oval, with the hinge slightly curved, forming almost a right angle with the long diameter of the shell, and scarcely at all produced anterior to the beak. Outer surface marked by many coarse radiating ribs which are strongest on the lateral borders, particularly on the very strongly excavated lunule. In the depressed grooves between these ribs, finer threads frequently occur. Hinge broad. Resilium deeply impressed, wedge shaped, as in *Lima (Acesta) excavata.*

Two left valves and a lot of fragments probably belonging to these two valves, Cat. No. 249133, U.S.N.M., were dredged at station 5647, south of North Island, Buton Strait (lat. 5° 34′ 00″ S.; long. 122° 18′ 15″ E.), in 519 fathoms, on green mud bottom. One of these measures: alt. 159 mm.

A young specimen collected on the Philippine Expedition, Cat. No. 229395, U.S.N.M., without specific locality, undoubtedly belongs here. I have given a figure of this also.

LIMA (ACESTA) BUTONENSIS, new species.

Plate 20, figs. 3, 4.

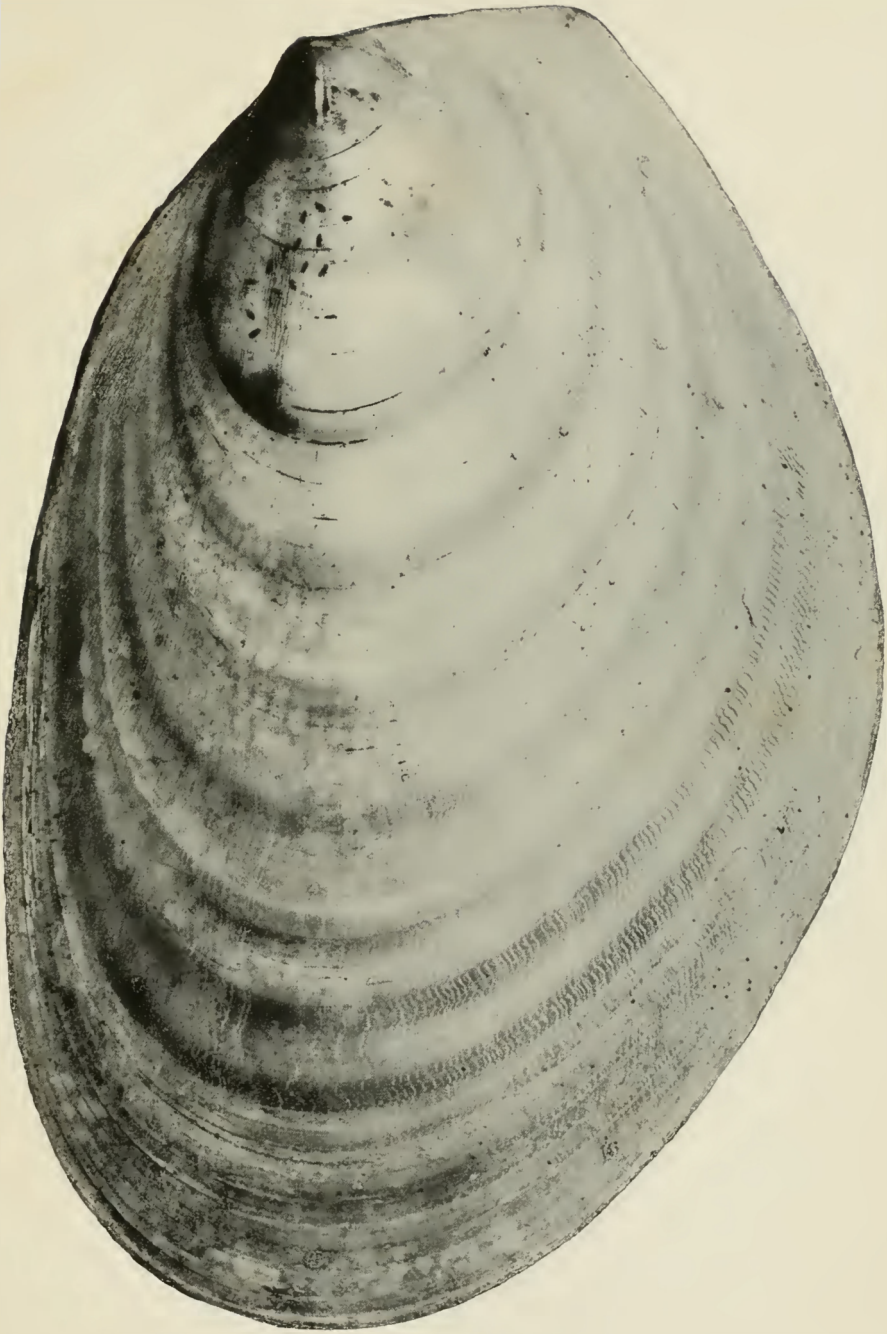
Shell small, irregularly oval. Hinge very slightly curved, extending almost at a right angle to the long axis of the shell. Lunule excavated. Outer surface marked by very fine, regular, and regularly spaced radiating riblets which are a little stronger near the lunule than on the rest of the surface and weakest on the middle of the disk. In addition to the radiating sculpture, the surface is marked with fine concentric lines which are emphasized in the form of resting stages at irregular intervals. Ligament wedge shaped. Interior bluish white, edged with a yellowish border.

The single valve of this species, Cat. 239399, U.S.N.M., was dredged at station 5648, south of North Island, Buton Strait (lat. 5° 35′ 00″ S.; long. 122° 20′ 00″ E.), in 559 fathoms on green mud bottom. It measures: alt. 26.8 mm., lat. 22 mm.; diameter of single valve 5.5 mm.

EXPLANATION OF PLATES.

All figures natural size.

Plate 12. *Lima (Callolima) smithi*, exterior. See page 236.
13. *Lima (Callolima) smithi*, interior. See page 236.
14. *Lima (Callolima) philippinensis*, exterior. See page 237.
15. *Lima (Callolima) philippinensis*, interior. See page 237.
16. *Lima (Callolima) rathbuni*, exterior. See page 237.
17. *Lima (Callolima) rathbuni*, interior. See page 237.
18. *Lima (Acesta) celebensis*, exterior. See page 240.
19. *Lima (Acesta) celebensis*, interior. See page 240.
20, fig. 1. *Lima (Callolima?) borneensis*, exterior. See page 239.
2. *Lima (Callolima?) borneensis*, interior. See page 239.
3. *Lima (Acesta) butonensis*, exterior. See page 240.
4. *Lima (Acesta) butonensis*, interior. See page 240.
5. *Lima (Acesta) verdensis*, exterior. See page 239.
6. *Lima (Acesta) verdensis*, interior. See page 239.



LIMA (CALLOLIMA) SMITHI.

FOR EXPLANATION OF PLATE SEE PAGE 240.



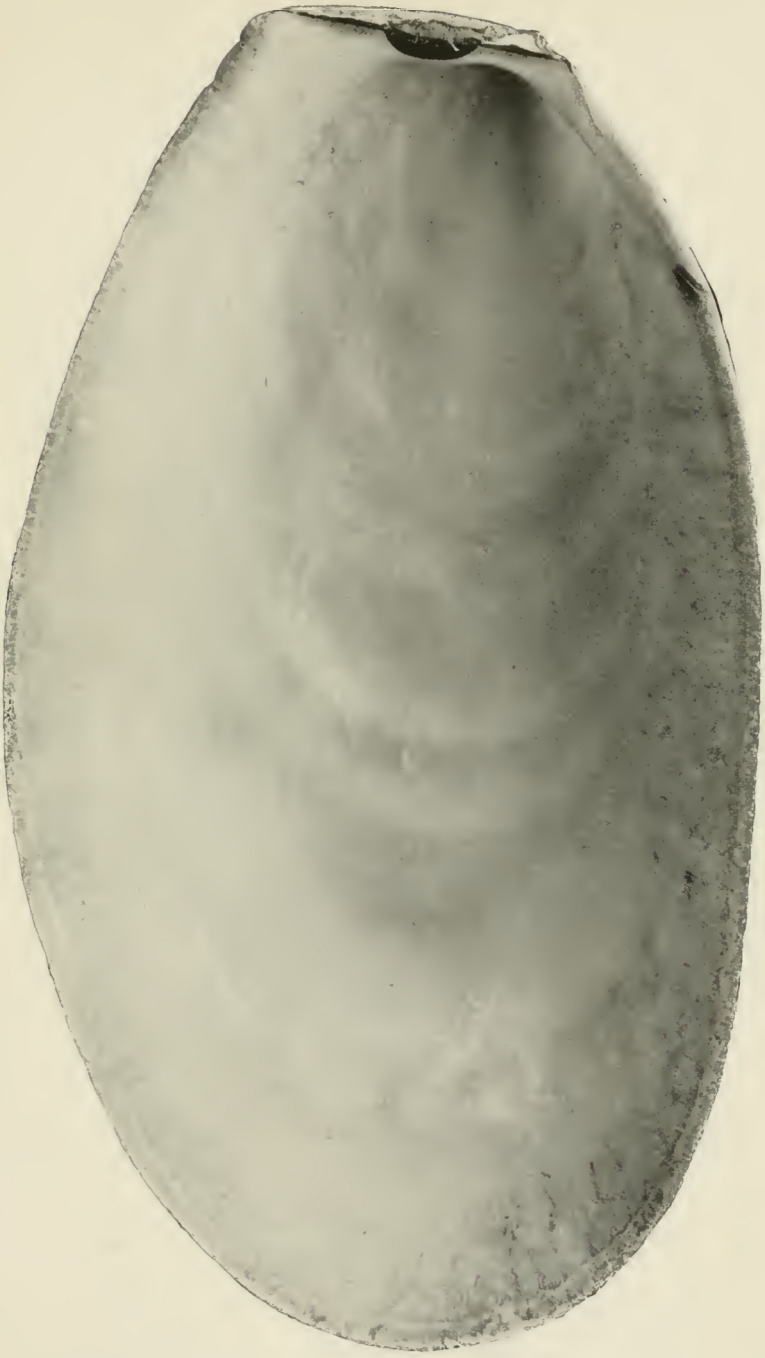
LIMA (CALLOLIMA) SMITHI.

FOR EXPLANATION OF PLATE SEE PAGE 240.



LIMA (CALLOLIMA) PHILIPPINENSIS.

FOR EXPLANATION OF PLATE SEE PAGE 240.



LIMA (CALLOLIMA) PHILIPPINENSIS.

FOR EXPLANATION OF PLATE SEE PAGE 240.



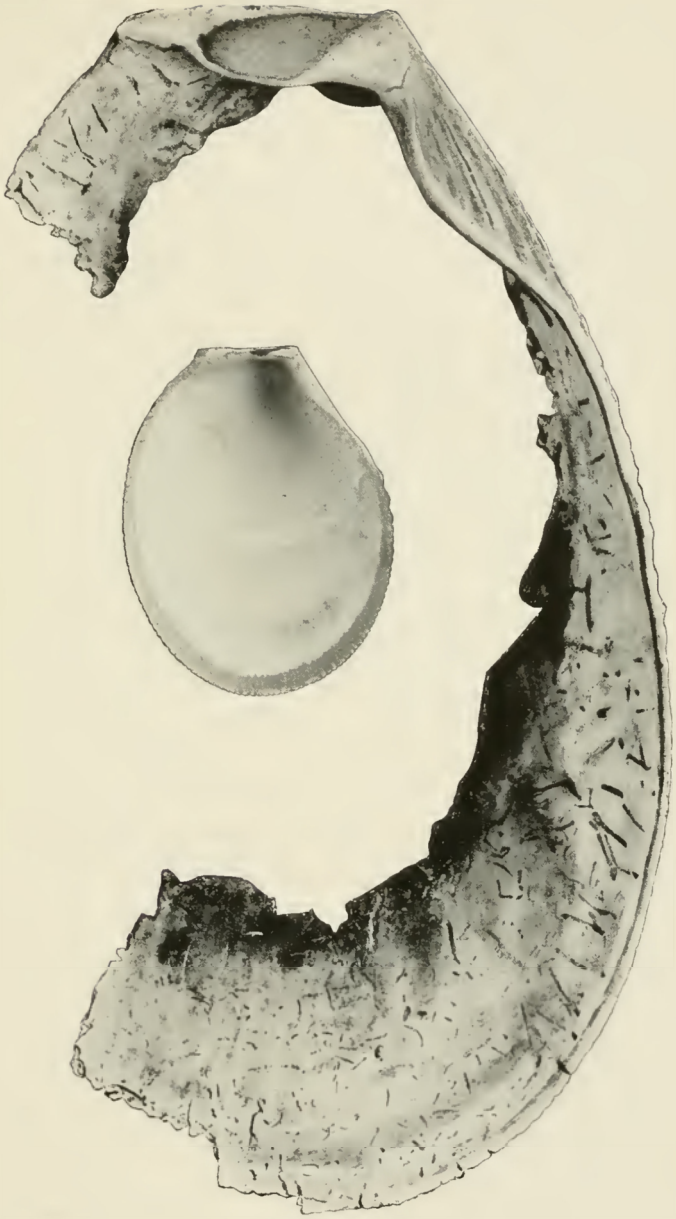
LIMA (CALLOLIMA) RATHBUNI.

FOR EXPLANATION OF PLATE SEE PAGE 240.



LIMA (CALLOLIMA) RATHBUNI.

FOR EXPLANATION OF PLATE SEE PAGE 240.



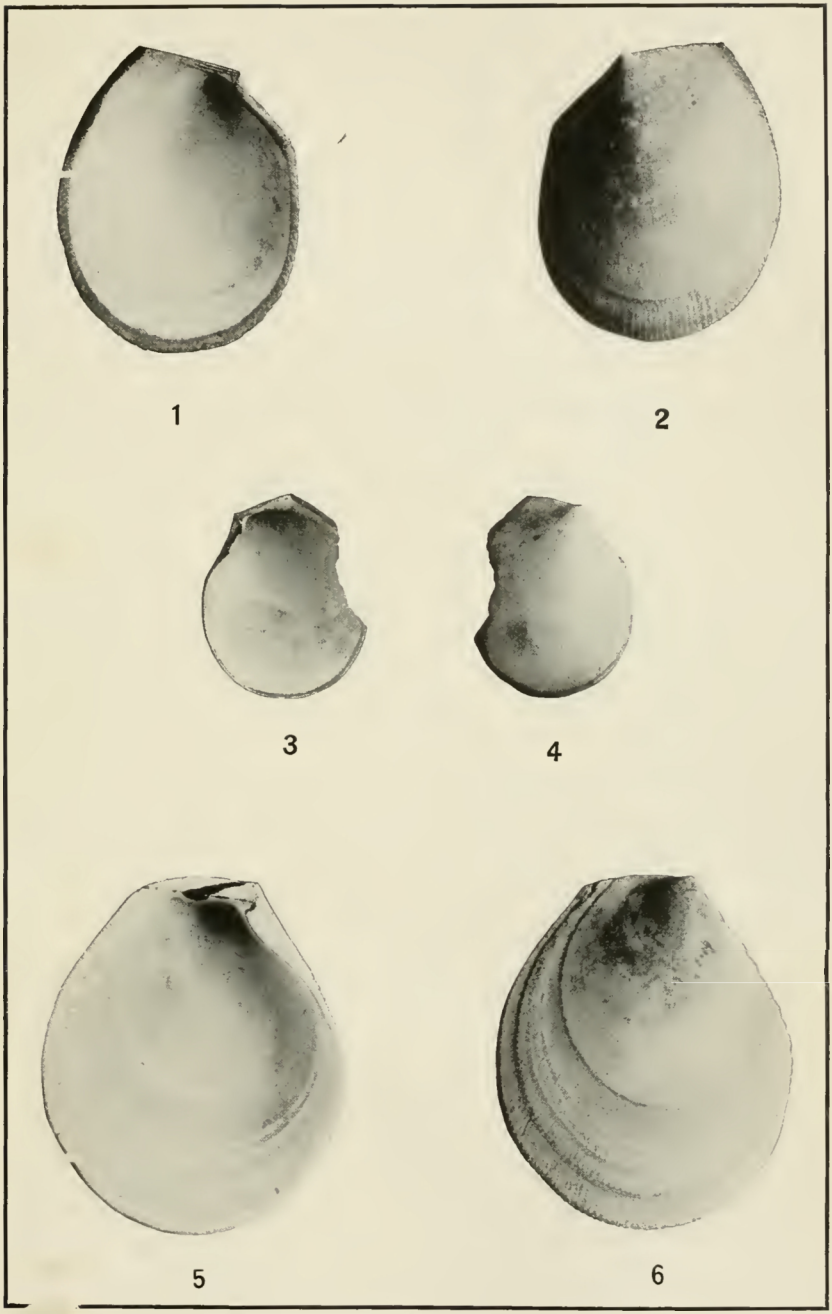
LIMA (ACESTA) CELEBENSIS.

FOR EXPLANATION OF PLATE SEE PAGE 240.



LIMA (ACESTA) CELEBENSIS.

FOR EXPLANATION OF PLATE SEE PAGE 240.



NEW GIANT LIMAS.

FOR EXPLANATION OF PLATE SEE PAGE 240.

DESCRIPTIONS OF NEW HYMENOPTERA, NO. 6.

By J. C. Crawford,
Associate Curator, Division of Insects, United States National Museum.

In this paper where both sexes of a species are described, that last described is the allotype.

Comparative measurements where given in figures were made with the Zeiss binocular microscope equipped with No. 2 eyepieces and the a_3 objective and an eyepiece micrometer.

Superfamily APOIDEA.

EUGLOSSA SURINAMENSIS Linnæus.

A single male of this species was taken at Brownsville, Texas, March 23, 1908, on *Opuntia lindheimeri* (Jones and Pratt coll.). This is, so far as I know, the first record of a species of this family in the United States.

PROTANDRENA SWENKI, new species.

Female.—Length about 6 mm. Black, with a small yellow spot on middle of upper edge of clypeus; front and middle knees, tubercles and a spot on tegulæ, yellow; face below antennæ coarsely punctured, the punctures separated by more than a puncture width; the punctures on the clypeus coarser than on sides of face; above insertion of antennæ the punctures finer and closer; process of labrum subtruncate apically and the sides straight; flagellum beyond basal joints fulvous, somewhat darkened above; mesoscutum and scutellum coarsely and closely punctured, punctures on disk of mesoscutum more sparse than elsewhere; on scutellum coarser than on scutum; metanotum rugoso-punctate; basal triangle of propodeum irregularly rugulose; sides of propodeum punctured; truncation finely rugoso-punctate; wings dusky, stigma and veins light brown; legs dark brown; abdomen punctured, segments 1–3 closely and coarsely punctured, segment 4 obliquely so and more shiny than basal segments; segment 5 about as 4; apical margins of segments 1–4 broadly depressed, brownish, finely and closely punctured, the punctures crowded.

Type-locality.—West Point, Nebraska.

Type.—Cat. No. 15299, U.S.N.M.

One specimen taken on September 6, 1912, flying around *Physalis* and other low weeds. (J. C. Crawford, collector.)

This species is the size of *P. heteromorpha* Cockerell, but that species is more shining, has the mandibles with a yellow mark, a large clypeal mark, process of labrum broadly rounded apically and the sides convex; the punctures of the mesonotum fine, of the abdomen somewhat sparser and with the sculpture of the third segment like that of 4 and 5 rather than 1 and 2.

This species is named in honor of Prof. Myron H. Swenk, in recognition of the fine work which he is doing on the bees of Nebraska.

AUGOCHLORA MACULIVENTRIS, new species.

Female.—Length about 6 mm. Head and thorax green, abdomen brown; face with white, subappressed pubescence, closely and very finely punctured above antennæ, below more like the fine reticulations and on clypeus and supraclypeal area more so than on sides of face; supraclypeal area with a median smoother area; clypeus along anterior portion with a yellowish mark which medially extends upward to a point; the maculate portion with large punctures, the rest reticulate and with a few fine scattered setigerous punctures; mesoscutum finely closely punctured but almost concealed by the short erect subappressed yellowish pubescence; tubercles yellow; tegulæ testaceous; scutellum and metanotum with pubescence similar to that on mesoscutum; dorsal surface of propodeum long, angularly separated from sides and truncation and with very fine thimble-like punctures, the posterior margin medially notched; this notch at the head of the furrow on posterior face; lateral angles of truncation well rounded; wings slightly dusky and with the apical margin distinctly darkened; stigma light brown, veins lighter; second submarginal slightly shorter than the third, receiving the recurrent nervure just before apex, and narrowed almost one-half anteriorly; mesopleuræ with sculpture similar to that on propodeum; legs brown, anterior tibiæ mostly yellow and with a narrow darkened stripe; inner hind spur with about 4 long teeth; abdomen finely sericous; second segment with a triangular spot at base on each lateral margin, the spot extending along lateral margin for a greater distance than the width at base; third segment with a transverse spot at each side almost meeting medially, fourth and fifth segments with complete bands, that on fifth segment often concealed by the retraction of the segment.

Habitat.—Coroico, Yungas, Bolivia.

Type.—Cat. No. 15317, U.S.N.M.

Described from five females, some of which have the abdomen extended sufficient to show the band on segment 5 and others have it completely concealed.

In Vachal's tables [1] this runs to *trinax* which is said to have all the spots on the abdomen large, almost meeting, the truncation of propodeum not rounded laterally and the wings dirty hyaline. He also mentions maculations only on segments 2 and 3; but as he also says the same for *A. callichroma* Cockerell, which in the original description mentions marks on segments 2–5, this may be a typographical error.

AUGOCHLORA PURA (Say).

Halictus astios VACHAL.
Augochlora banksiella COCKERELL.

Mr. Charles Robertson has well redescribed this species and given the earlier synonomy [2] and there can be no doubt that he is correct. Specimens from the same set of cells taken at Plummer's Island, Maryland, are either entirely blue-green or distinctly brassy, and this latter is the individual variation described by Professor Cockerell. What Mr. Vachal had under the name *pura* in his extensive table [3] is undoubtedly in need of a new name.

The minutely truncate marginal cell, the keel or tooth on the first ventral segment of the female and the falcate inner hind spur on the posterior tibiæ characterize the species of this group.

In *A. pura* the keel is subtriangular in outline and small.

Superfamily SERPHIDOIDEA.

TELENOMUS GONIOPIS, new species.

Female.—Length about 1.12 mm. Black, antennæ and femora light brown; coxæ dark brown, the trochanters, tibiæ and tarsi testaceous, the tarsi lighter than the tibiæ; head transverse, twice as wide as thick (viewed from above) medially; head excavated behind and from above subreniform in outline; first joint of funicle somewhat longer than broad, shorter than the pedicel; second joint of funicle subquadrate, joints 3 and 4 transverse, club composed of the last five joints; vertex finely reticulated; in front of anterior ocellus, smooth, polished; inner orbits just above level of insertion of antennæ with a small area which is reticulated, rest of face smooth, polished; mesoscutum finely reticulated, dull; scutellum, except base, smooth, polished; metanotum rugose; wings hyaline, veins pallid; first abdominal segment with a row of pits at base; second segment with a similar row and back of this medially a few very faint lines; second segment almost twice as long as the width at apex.

[1] Misc. Ent., vol. 12, 1904, pp. 115 *et seq.*
[2] Trans. Acad. Sci. St. Louis, vol. 7, No. 14, 1897, pp. 323-324.
[3] Misc. Ent., vol. 19, 1911, pp. 9-24 and 41-50.

Male.—Length about 1 mm. Head and thorax above reddish brown, abdomen dark brown; lower part of face testaceous shading into brown above; pleuræ dark honey color; antennæ testaceous, flagellum above brownish; legs including coxæ testaceous; otherwise very similar to the female.

Habitat.—Plummer's Island, Maryland.

A large series (about 70) of which only eight are males, reared from the eggs of *Goniops chrysocoma*, July 11, 1910, by Mr. W. L. McAtee.

Type.—Cat. No. 15417, U.S.N.M.

TELENOMUS LATISULCUS, new species.

Female.—Length about 2 mm. Black, scape, pedicel, joints of funicle and legs, except coxæ, reddish-testaceous; rest of antennæ brown, the transition gradual; face with three carinæ running from mouth part to eyes, the lower one forming the border of the face, the two upper ones with a furrow between them; orbits carinate, the posterior ones more distinctly; face medially transversely, carinate, the carinæ less numerous and less distinct toward eyes; first joint of funicle longer than pedicel; club 6-jointed; mesoscutum irregularly reticulately rugose, toward rear the rugæ becoming longitudinal; scutellum separated from the scutum by a deep fissure; scutellum with sculpture similar to that on scutum, at apex with a row of pits; metanotum covered by a row of pits; marginal vein short, about half as long as the stigmal and about one-third as long as the postmarginal; first abdominal segment longitudinally carinate and with a basal row of pits; second segment carinate for about three-fourths its length and with a basal row of pits; second segment wider than long (about as 26 : 19).

Male.—Unknown.

Habitat.—Taihoku, Formosa.

Bred from the eggs of *Biprorulus bibax* by T. Shiraki and sent under his No. 107.

Type.—Cat. No. 15104, U.S.N.M.

Superfamily CYNIPOIDEA.

GANASPIS HOOKERI, new species.

Female.—Length about 1.25 mm. Black or brownish-black, the abdomen more distinctly brownish, becoming lighter ventrad; legs, including coxæ, flavous; mandibles testaceous with apices dark; antennæ flavous with the last five joints dark; third joint of antennæ fully as long as scape, following four joints submoniliform, eighth joint somewhat enlarged, apical five joints forming the club; head and thorax smooth, polished; elevation of scutellum narrow, area surrounding elevation coarsely roughened; propodeum medially excavate,

the excavation bounded on each side by a carinate ridge; wings hyaline, veins light honey color.

Habitat.—Mayaguez, Porto Rico.

Three females with the additional data, No. 5064, bred from the mango fruit fly known as "the jobo," September 5, 1912. (C. W. Hooker, collector.)

Type.—Cat. No. 15318, U.S.N.M.

In color this species resembles *G. iridipennis* Ashmead, but in that species the elevation of the scutellum is broad and each cheek has a vertical carina.

The species is named after the collector.

Superfamily CHALCIDOIDEA.

Family CALLIMOMIDÆ.

PODAGRION SHIRAKII, new species.

Female.—Length about 2.75 mm.; ovipositor about 3.75 mm. Green; similar to *repens* Motschulsky but with coarser sculpture; propodeum with an inverted V-shaped carina and with thimble-like punctures; antennæ testaceous, with one ring joint, the first joint of the funicle longer than the pedicel; the club moderately enlarged; metapleuræ with the disk shiny, with a few impressed lines visible only under high magnification; front and middle legs testaceous, more or less infuscated and the coxæ with some green at bases; hind coxæ as long as their femora, green; hind femora outwardly green, with about 7 short teeth, the two apical ones the longest; rest of hind legs testaceous; abdomen subsessile.

Male.—(The abdomen and the apical joints of the antennæ missing.) Similar to the female in structure.

Habitat.—Taihoku, Formosa.

Specimens reared from the egg masses of *Paratenodera aridifolia* by Prof. T. Shiraki (after whom the species is named) and sent under his No. 109.

Type.—Cat. No. 15089, U.S.N.M.

P. repens Motschulsky has the teeth on the hind femora long and the whole of the metapleuræ distinctly sculptured with parallel rugulæ.

Family EUPELMIDÆ.

BRUCHOCIDA, new genus.

Belongs to the tribe Eupelmini as defined by Ashmead; mandibles 3-toothed; maxillary palpi with the apical joint greatly enlarged and flattened in the female and slightly so in the male; eyes with short inconspicuous hairs; in the female the marginal vein about one-half as long as the submarginal, about twice as long as the postmarginal;

the stigmal vein about as long as the postmarginal; in the male the postmarginal somewhat longer than the stigmal; hind legs with one apical spur; pubescence in female flattened, scale-like, in the male normal; axillæ at base not widely separated; lateral ocelli somewhat more than the diameter of an ocellus from the eye margin; in the female the first four abdominal segments deeply incised medially; in the male, the basal segment only; antennæ 13-jointed with a subquadrate ring joint; the three apical joints forming a club distinctly enlarged in the female and slightly in the male; ovipositor in the female exserted.

Type of the genus.—*Bruchocida vuilleti* Crawford.

In Doctor Ashmead's classification of this group [1] this genus runs to couplet No. 19 and runs out, since it has segments 1–4 of the abdomen incised apically. The genus can be recognized by this, by the swollen apical joint of the maxillary palpi and in the female by the appressed pubescence.

BRUCHOCIDA VUILLETI, new species.

Female.—Length about 3 mm.; sheaths of ovipositor about 0.75 mm. Green with bronzy tints; the head and thorax with thimble-like punctures, where coarsest somewhat resembling reticulations by carinæ; those at rear of mesopleuræ coarse and deep, on disk of mesopleuræ very fine, anteriorly somewhat coarser; scape testaceous, pedicel greenish, rest of antennæ dark brown; first joint of funicle about one and one-half times as long as pedicel; the following joints of funicle successively decreasing in length, the last subquadrate; sides of abdominal segments reticulate-punctate; dorsal surface finely reticulated on segments 1–4; segment 5 reticulate-punctate; legs reddish, coxæ green, tarsi whitish, wings slightly dusky, hairs on wings all dark.

Male.—Length about 2.25 mm. Green with some brassy tints; head and thorax reticulate-punctate, the scutellum reticulate; antennæ more elongate than in the female; scape testaceous, pedicel brown with a small green spot above; rest of antennæ dark brown; wings not as dusky as in female nor as distinctly hairy, but all hairs dark colored; abdomen finely reticulated; coxæ green, front and middle femora æneous with greenish reflections posteriorly; hind femora green; tibiæ brown, with lighter colored bases and apices; tarsi whitish.

Habitat.—Koulikoro, Haut Senegal-Niger.

Described from four females and two males reared from *Bruchus quadrimaculatus* by Mr. J. Vuillet, after whom the species is named, and transmitted by Mr. A. Vuillet.

Type.—Cat. No. 15300, U.S.N.M.

[1] Mem. Carnegie Mus., vol. 1, 1904, p. 287 *et seq.*

BRUCHOCIDA ORIENTALIS, new species.

Female.—Length about 4 mm.; sheaths of ovipositor exposed 1 mm. Bronzy, with tints of green, the scape of antennæ reddish, pedicel green, rest of antennæ dark brown; first joint of funicle about one and one-half times as long as the pedicel, the following joints successively decreasing in length, the last somewhat longer than broad; very similar in sculpture to *B. vuilleti;* wings with white hair as far out as the apex of submarginal vein, beyond this the hairs dark, longer and more numerous than in *vuilleti* and the wings somewhat infuscated; front and hind coxæ bronzy; front and middle legs and middle coxæ reddish; hind legs darker with bronzy tints; tarsi white.

Three females Bangalore, India, reared from *Bruchus chinensis.* (L. C. Coleman, collector.)

Type.—Cat. No. 15301, U.S.N.M.

Easily separated from *B. vuilleti* by the color and the white hairs on the base of the wings.

TANAOSTIGMODES PORTORICENSIS, new species.

Female.—Length about 1.8 mm. Deep brown or blackish-brown; face with large punctures separated from each other by somewhat less than the width of a puncture; scape yellowish, pedicel light brown, rest of antennæ dark brown; first joint of funicle longer than the pedicel; extreme lateral edges of mesoscutum and prepectus somewhat lighter than rest of mesoscutum; parapsidal furrows indistinct except from point of juncture to apex of scutum; anterior of the furrows the surface very finely almost transversely rugulose; back of them the rugulæ irregular appearing almost as very fine crowded punctures or thimble-like punctures; axillæ with sculpture similar to that on rear of scutum but punctures in the outer portion much finer; base of scutellum with similar sculpture, rest with somewhat finer and longitudinally elongate sculpture making them appear as if in rows and the surface therefore somewhat longitudinally rugulose, especially medially; femora, except apices, brown; rest of legs yellowish; wings hyaline, veins brown, the postmarginal and stigmal subequal in length and shorter than the marginal.

Male.—Length about 1.6 mm. Similar to the female but the face below the antennæ medially about the color of the prepectus; joints of funicle (1–6) produced on one side, the first the most and the rest successively less so that the fifth and sixth are very slightly so; joints of funicle clothed with long whitish hairs; veins of wings yellowish.

Habitat.—Mayaguez, Porto Rico.

Type.—Cat. No. 15315, U.S.N.M.

Three females and one male with the additional data I. 27, 1910, and the number H 1623. (C. W. Hooker, collector.)

This species is the color of *T. tychii* Ashmead, but that species has no large punctures on the face; *T. mayri* Ashmead from Grenada described from the male apparently differs in having the face and pleuræ largely brownish-yellow and no mention is made of the excision of the sixth joint of the funicle and the funicle is said to have dark hairs.

COCCIDOXENUS, new genus.

Mandibles with a sharp tooth and a broad one at apex; the genus runs to couplet 10 in Ashmead's Classification of the chalcid flies in the tribe Ectromini; head thin, the eyes touching the posterior margin; eyes large, prominent, converging above, the lateral ocelli touching eye margins and separated from each other by about the diameter of one ocellus; front ocellus about five or six times its own diameter anterior of the others and not its own diameter from the eye margin on either side of it; antennæ in the female inserted a little above the mouth parts, but still below the level of the eyes, in the male inserted slightly above the level of the eyes; in the female the funicle 6-jointed, one ring joint, club 3-jointed, the component parts of the club distinct (see fig. 1); in the male the funicle 6-jointed, the joints of the funicle elongate and with a whorl of hairs near base and one near apex; vertex carinate; axillæ not quite meeting medially; hind tibiæ with two apical spurs; marginal vein almost punctiform, the postmarginal longer, the stigmal longer than the postmarginal.

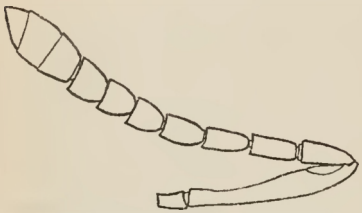


FIG. 1.—COCCIDOXENUS PORTORICENSIS. OUTLINE OF ANTENNÆ OF FEMALE.

This genus differs from *Anagyrus* by the scape not being swollen, the front narrow with the lateral ocelli touching eye margins, etc.; from *Taftia* by the narrow front with the lateral ocelli touching eye margins, the antennal fossa not carinate above, the shorter noncurved stigmal vein, etc.; from *Anusia* by the scape not swollen, the funicle not compressed, the axillæ not meeting medially, etc.

Type of the genus—Coccidoxenus portoricensis Crawford.

COCCIDOXENUS PORTORICENSIS, new species.

Female.—Length about 2 mm. Head greenish, with some purple reflections, mesoscutum purplish, scutellum and axillæ aeneous, abdomen basally bluish, rest of abdomen aeneous with greenish tints; face closely and minutely punctured, under a low magnification appearing as finely reticulately lineolate; face along inner orbits with a single row of punctures; antennæ reddish-testaceous, with conspicuous black hairs, the club black; mesoscutum finely transversely

lineolate; scutellum finely reticulately lineolate; both with setigerous punctures bearing long black hairs; legs yellowish, middle and hind coxæ brown; wings hyaline; sheaths of ovipositor extending slightly beyond tip of abdomen.

Male.—Length about 1.15 mm. Similar to the female, but mostly aeneous, the head greenish-blue, the pleuræ and the base of the abdomen with some greenish reflections; scape testaceous, rest of antennæ light brown.

Habitat.—San Juan, Porto Rico.

Many specimens reared from "the wax scale" by W. V. Tower.

Type.—Cat. No. 15093, U.S.N.M.

ANASTATUS FORMOSANUS, new species.

Female.—Length about 2.75 mm. Head and thorax varying tints of blue and green, with the portions of the mesoscutum with thimble-like punctures bronzy; face roughened, around ocellar triangle finely reticulately lineolate; ocelli in an equilateral triangle, the lateral ocelli about half the diameter of an ocellus from the eye margin; scape reddish, pedicel green, rest of antennæ dark brown; first joint of funicle longer than the pedicel; scutellum, axillæ, and anterior elevated median portion of mesoscutum with thimble-like punctures, rest of mesoscutum finely lineolate, the lines becoming obsolete toward rear; median portion with thimble-like punctures fully three times as long as from apex of this area to the tip of the mesoscutum; wings dusky with a light stripe near base and one about the middle of the marginal vein; marginal vein about twice as long as the postmarginal vein, this about twice as long as the stigmal; legs brown, with metallic tints and the coxæ green or bluish, the middle tibiæ whitish; abdomen finely reticulated, with a whitish band near base.

Male.—Length about 2 mm. Green, the scape and pedicel testaceous, rest of antennæ brown; pedicel not longer than broad; head and mesoscutum reticulately lineolate, the latter without thimble-like punctures; wings hyaline, marginal vein only slightly longer than the postmarginal; stigmal about half as long as the postmarginal; femora and hind tibiæ brown with green tints, front and middle tibiæ and all tarsi whitish; abdomen aeneous.

Habitat.—Taihoku, Formosa.

Bred from the eggs of *Biprorulus bibax* June, 1911, by T. Shiraki and sent by him under his No. 106 (female) and 108 (male).

Type.—Cat. No. 15103, U.S.N.M.

This species somewhat resembles *A. japonicus* Ashmead, but that species has, in the female, the portion of the mesoscutum with thimble-like punctures only about twice as long as the portion to the rear of it and the abdomen without the transverse band; in the male the scape is metallic and the middle tibiæ are dark.

Family PTEROMALIDÆ.

BRUCHOBIUS LATICEPS Ashmead.

Female.—Type, length about 2.5 mm. Green, with brassy tinges; head wider than thorax, head and thorax, including pleuræ and propodeum, with coarse thimble-like punctures, those on the mesonotum so coarse as to somewhat resemble irregular reticulations; antennæ 13-jointed, honey color, with three ring joints, the third subquadrate; first joint of funicle almost twice as long as pedicel, the following joints almost subequal in length, the second joint of funicle about two-thirds as long as first; pronotum sharply truncate anteriorly; propodeum completely covered with thimble-like punctures, with lateral folds, the spiracles large, elongate-ovate, situated basad; marginal vein short, about one-third as long as submarginal; postmarginal slightly longer than marginal; stigmal and marginal subequal in length; femora and bases of tibiæ reddish-honey color; rest of tibiæ and tarsi whitish; abdomen about as long as head and thorax combined.

Male.—Length about 1.75 mm. Similar to the female; antennæ with two ring joints, the third being elongated into a joint of the funicle, being as long as the pedicel, but not as long as the following joint of the funicle; abdomen with a large basal white spot.

The type material consists of four females and four males and is labeled "Washington, D. C., Nov. 12, 1896;" bred from *Bruchus quadrimaculatus*. (F. C. Pratt, collector.)

There are other specimens with the same record which were not included in the type material, and one of these on dissection shows the right mandible to be 4-toothed and the left 3-toothed.

BRUCHOBIUS COLEMANI, new species.

Female.—Length about 2.5 mm. Similar in color and sculpture to *B. laticeps* Ashmead, but the third ring joint transverse; marginal vein over half as long as the submarginal; postmarginal shorter than the marginal (about as 12:17); stigmal shorter than postmarginal (about as 8:12); stigmal knob enlarged; femora dark, the hind femora mostly greenish anteriorly.

Male.—Length about 2 mm. Similar to the female, the antennæ with two ring joints, the scape and pedicel reddish-honey color, funicle somewhat lighter, club darker; first joint of funicle as long as the second; legs reddish-honey color; hind femora somewhat darkened and with a small spot with metallic reflections; abdomen no longer than propodeum.

Habitat.—Bangalore, Mysore, India.

Type.—Cat. No. 15302, U.S.N.M.

Described from six females and four males from a series from *Bruchus chinensis*. (L. C. Coleman, collector.)

In this species also the right mandible is 4-toothed and the left 3-toothed.

ZACALOCHLORA, new genus.

Belongs to the tribe Rhaphitelini as defined by Ashmead; right mandible 4-toothed, left mandible 3-toothed, antennæ inserted above the level of the lower eye margins, 13 jointed, with three ring joints, the third subquadrate, the last three joints forming a club which is slightly enlarged; pronotum sharply angulated anteriorly; scutellum without a transverse line; propodeum with a median carina and a very short neck; lateral folds and spiracular sulci present; spiracles oval; marginal and postmarginal veins subequal in length, stigmal shorter.

Type of the genus.—*Zacalochlora milleri* Crawford.

In Doctor Ashmead's tables this genus runs to *Mormoniella,* which has two ring joints, the mandibles 4 and 3 toothed, and belongs to the Eutelini, where it occurs under the name *Nasonia.*

ZACALOCHLORA MILLERI, new species.

Female.—Length about 3 mm. Coppery green, head and thorax, including mesopleuræ and propodeum between lateral folds, with thimble-like punctures; pedicel longer than first joint of funicle; metapleuræ smooth; propodeum with a basal row of pits and a row separating the neck from the rest of the propodeum; propodeum laterad of the lateral folds smooth; wings hyaline; legs reddish-honey color; abdomen longer than the head and thorax combined.

Male.—Unknown.

Type-locality.—Yreka, California.

Type.—Cat. No. 15316, U.S.N.M.

Eight specimens received from the Bureau of Entomology, United States Department of Agriculture, with the record "Hopkins, U. S., No. 11413c, J. M. Miller, collector." This species is named after the collector.

TRICHOMALOPSIS, new genus.

Belongs to the tribe Rhaphitelini as defined by Ashmead; right mandible 4-toothed, left mandible 3-toothed, all teeth acute at apex; occipital foraminal depression margined; antennæ 13-jointed, with two ring joints, very similar in the two sexes, pedicel longer than first joint of funicle; parapsidal furrows incomplete; scutellum near apex with an indistinct transverse line due to the difference in punctures; propodeum with a distinct neck, lateral folds indistinct, due to the sculpture; a median carina present in some specimens; propodeal spiracles small, elongate, situated basad; marginal and postmarginal veins subequal in length, the stigmal shorter; hind tibiæ with one apical spur; abdomen subsessile, the petiole not extending beyond the neck of propodeum.

Type of the genus.—*Trichomalopsis shirakii,* Crawford.

TRICHOMALOPSIS SHIRAKII, new species.

Female.—Length about 2.25 mm. Green, head and thorax including propodeum, mesopleuræ and metapleuræ, with thimble-like punctures; face below insertion of antennæ with striæ converging toward mouth parts; scape and pedicel testaceous, rest of antennæ light brown; punctures entirely covering propodeum, and obscuring the lateral folds; wings hyaline, veins whitish; legs, except the green coxæ, testaceous, the tibiæ and tarsi more whitish; abdomen smooth, polished.

Male.—Length about 2 mm. Similar to the female except in secondary sexual characters.

Habitat.—Taihoku, Formosa.

Specimens bred from the pupæ of *Lema flavipes* May, 1911, by T. Shiraki and sent under his No. 19.

Type.—Cat. No. 15111, U.S.N.M.

The type female is without the median carina on the propodeum; the allotype male has traces of it; numerous paratype females have the carina distinct.

APLASTOMORPHA, new genus.

Belongs to the tribe Pteromalini as defined by Ashmead; mandibles each 4-toothed; antennæ 13-jointed, with three ring joints in the female and two in the male, the ring joints all transverse; in the female first joint of funicle slightly longer than the pedicel, the following joints successively slightly decreasing in length, the last subquadrate, the three joints of the club slightly enlarged; head not thin at vertex; propodeum without a neck, with a median carina, lateral folds not very distinct, represented basad by foveæ; spiracles small, oval; postmarginal vein as long as the marginal, the stigmal shorter; abdomen short, subappressed.

Type.—*Aplastomorpha pratti* Crawford.

This genus runs to *Neocatolaccus* in Ashmead's table, but that genus has appressed pubescence on the head and thorax, the head thin at vertex, the marginal vein much longer than the postmarginal, and the abdomen elongate.

APLASTOMORPHA PRATTI, new species.

Female.—Length about 2.25 mm. Green, head and thorax with fine, shallow, thimble-like punctures, and with sparse glittering white hairs; head slightly wider than thorax; face below antennæ with striæ converging toward mouth; scape and pedicel testaceous, rest of antennæ light brown; propodeum finely reticulated; mesopleuræ and metapleuræ, except edges, with sculpture similar to dorsum but coarser; wings hyaline, veins yellowish; coxæ green, femora, except apices, brown; rest of legs yellowish, the tibiæ with a slight reddish tinge.

Male.—Length about 1.75 mm. Similar to the female; abdomen brown with a green tinge and with a large basal yellowish-white spot.

Habitat.—Dallas, Texas.

Type.—Cat. No. 15314, U.S.N.M.

Specimens taken November, 1906, and with the additional data "U. S. D. A. No. 6076, bred from No. 3715, W. D. Hunter, collector."

The manuscript name given by Doctor Ashmead is adopted, but other material has been used as the type material; that in the hands of Doctor Ashmead was from *Bruchus quadrimaculatus* and collected at Washington, District of Columbia.

FAMILY EULOPHIDÆ.

CASSIDOCIDA, new genus.

Belongs to the tribe Tetracampini; funicle 6-jointed, no apparent ring joint, joints of club solidly fused; antennæ very similar in the two sexes, the scape in the male not swollen; eyes distinctly hairy; hind tibiæ with two apical spurs; marginal vein slender, about four times as long as the postmarginal; stigmal knob subsessile; parapsidal furrows distinct; median lobe of mesoscutum somewhat broader along anterior margin than long; metanotum visible, narrow; propodeum without carinæ, spiracles round; sheaths of ovipositor exserted, about as long as the abdomen.

The American Entomological Society possesses a specimen of the genus *Tetracampe* named by Doctor Foerster, and this differs in having the ovipositor concealed and the marginal vein only about twice as long as the postmarginal. The genus *Foersterella* has venation as in *Tetracampe* and the ovipositor concealed and in addition the scape of the male is greatly swollen.

The generic name is based on the name of the family to which the host belongs.

Type of the genus—Cassidocida aspidomorphæ, Crawford.

CASSIDOCIDA ASPIDOMORPHÆ, new species.

Female.—Length (excluding the exposed sheaths of ovipositor) about 1.75 mm.; sheaths of ovipositor about 0.75 mm. Blue-green, with purple reflections in certain lights; head and thorax finely lineolate and with setigerous punctures each with a fine, long, white hair; scape and pedicel yellowish, rest of antennæ light brown; first joint of funicle about as long as the pedicel; following joints somewhat shorter, almost subequal in length and slightly longer than broad; scutellum at apex, metanotum, and propodeum smooth; prepectus large, smooth; pleuræ smooth; wings hyaline; legs, including coxæ, translucent yellowish; abdomen smooth, shiny.

Male.—Length about 1.5 mm. Similar to the female, the antennæ lighter in color, somewhat shorter but very similar; sculpture of head and thorax more apparent than in female.

Habitat.—Bangalore, Mysore, India.

Type.—Cat. No. 15077, U.S.N.M.

Specimens received from Mr. L. C. Coleman, under his No. 181, with the record, reared from the larvæ of *Aspidomorpha miliaris*.

This is the species referred to by me in a previous paper[1] as a species of *Tetracampe?*.

FOERSTERELLA FLAVIPES Foerster.

There is in the collection of the United States National Museum an excellent series reared from the eggs of a species of the genus *Cassida* found on *Carduus arvensis* at Grib Skov, Sealand, Denmark, by Prof. J. P. Kryger.

PLEUROTROPIS FRATERNUS Motschulsky.

Eulophus fraternus MOTSCHULSKY.

I have examined the types of this, consisting of about 20 specimens on a card, and made the following notes on them: Face above and below V-shaped furrow with thimble-like punctures; pedicel longer than joint 1 of funicle which is subquadrate; joints 2 and 3 of funicle slightly broader than long, third appearing unless seen at exact angle as part of club; mesoscutum with similar sculpture; scutellum longitudinally rugulose; legs dark; tarsi white; mesoscutum at apex with two depressed somewhat fovea-like spots but these so sculptured like the rest of the scutum.

The United States National Museum possesses a series received from Mr. T. Shiraki with the data Taihoku, Formosa, from egg mass of *Paratenodera aridifolia*.

PLEUROTROPIS ANASTATI, new species.

Female.—Length about 1.3 mm. Dark olive green, face above and below V-shaped furrow down to level of insertion of antennæ and mesoscutum, with thimblelike punctures; antennæ green; scutellum with sculpture somewhat similar to that on mesoscutum but coarser and the reticulations elongate, making the sides of the scutellum appear indistinctly longitudinally striate; medially on scutellum the reticulations subquadrate and more indistinct than on sides; propodeum with two medial carinæ which diverge posteriorly and between them a single carina making the middle of the propodeum tricarinate; femora green, tibiæ brown with some green tinges, tarsi, except apices, white.

Male.—Length about 1.25 mm. Similar to the female except in secondary sexual characters and somewhat brassy in color.

Habitat.—Koulikoro, Haut Senegal-Niger.

[1] Proc. U. S. Nat. Mus., vol. 42, No. 1880, 1912, p. 8.

Type.—Cat. No. 15303, U.S.N.M.

Described from three females and one male reared from *Cerina butyrospermi* by Mr. J. Vuillet, together with *Anastatus vuilleti* Crawford on which it is probably a secondary parasite. The material was received from Mr. A. Vuillet of the Station Entomologique de Paris.

THRIPOSOMA, new genus.

Belongs to the Tetrastichini; form greatly flattened and *Thrips*-like, whence the name; antennæ with one minute ring joint; funicle three-jointed, the first joint subquadrate, the second and third transverse, the first shorter than the pedicel; antennæ subclavate, gradually enlarged from base of funicle to middle of club; mesoscutum without a median groove; scutellum with two delicate parallel furrows; propodeum with a median carina which is not very distinct; propodeal spiracles small, round, situated basad; marginal vein slightly thickened throughout its whole length; sheaths of ovipositor exposed for about one-third the length of the abdomen.

The flattened form readily distinguishes this genus from any other in the tribe.

Type of the genus.—Thriposoma grafi Crawford.

THRIPOSOMA GRAFI, new species.

Female.—Length about 1.50 mm. (to tip of abdomen); sheaths of ovipositor exposed 0.25 mm. Entirely very dark green, the legs brown with greenish reflections on femora and tibiæ; scape greenish, rest of antennæ brown; head finely reticulated, the face with scattered large punctures; mesoscutum and scutellum with reticulate lineolations, those on the scutellum appearing longitudinal; sculpture on propodeum resembling very shallow and indistinct thimble-like punctures, so shallow as to be distinct only in certain lights; wings hyaline, veins brown; abdomen finely reticulated.

Male.—Unknown.

Habitat.—Hollywood, California.

Three specimens with the following additional data: "In sunflower with aphids and thrips, 22.II. 12, Graf, collector, Chittenden (Bureau of Entomology, U. S. Dept. Agric.) No. 2177."

Type.—Cat. No. 15416, U.S.N.M.

The species is named after the collector.

ZAGRAMMOSOMA FLAVOLINEATA, new species.

Female.—Length about 2 mm. Head yellow, face with a narrow median black stripe, ocellar area black, rear of head with two vertical black lines, on lower posterior orbits a black mark roughly shaped

like a Y with the two upper points touching the eye margin; antennæ brown, the first joint of the funicle distinctly longer than the pedicel; dorsum of thorax and abdomen black; pronotum with two broad yellow stripes on disk and on each extreme side, so that they are not visible from above, a narrow yellow stripe; mesoscutum and scutellum, except broad lateral margins, yellow; parapsidal areas inwardly and axillæ each with a small yellow spot; outer margin of parapsidal areas yellow; two small spots on basal segment of abdomen and one on each lateral margin and venter of thorax, yellow; legs yellow, hind femora with a dusky band near apex; fore wings maculate (see fig. 2); thoracic notum finely reticulate.

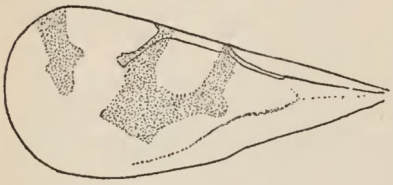


FIG. 2.—ZAGRAMMOSOMA FLAVOLINEATA. FORE WING OF FEMALE WITH STIPPLE TO SHOW INFUSCATED AREAS.

One specimen labeled "Colo., 1589."

Type.—Cat. No. 15390, U.S.N.M.

The face of the specimen is collapsed and sunken in, and face markings other than those described above, if any, can not be seen.

ZAGRAMMOSOMA CENTROLINEATA, new species.

Female.—Length about 2 mm. Pale yellow, pedicel with a dark brown spot above, distinctly shorter than the first joint of the funicle, second joint of funicle shorter than first; a spot at top of eyes, one at base of eyes continued on rear of head, two vertical lines extending from lateral ocelli down rear of head, a broad median line from front of pronotum to tip of abdomen, two narrow lines on each side of pronotum, one continued on mesopleuræ, the other continued on the disk of the parapsidal areas; disk of forewings each with a broad longitudinal brown stripe starting on the posterior margin near base and ending at the tip of the stigmal vein; apicad of this a narrow transverse stripe extending across wing; entire dorsum of thorax with minute thimble-like punctures; marginal vein almost colorless, stigmal vein brown.

Type-locality.—Los Angeles County, California.

Type.—Cat. No. 15391, U.S.N.M.

Two specimens from the type-locality with the additional data "Aug., (No.) 108°"; the note gives the host as *Gracilaria elongata* Linnæus; also one paratype labeled "Sonoma Co., Calif. (No.) 576"; the note gives the host as *Lithocolletes mediodorsella* Braun; all collected by Mr. Koebele.

In all the specimens the head is collapsed and the face sunken in, and the face markings, if any, can not be made out.

ZAGRAMMOSOMA NIGROLINEATA, new species.

Female.—Length about 1.25 mm. Lemon yellow; tip of scape and base of pedicel brownish; pedicel distinctly longer than first joint of funicle; second joint of funicle about as long as first; club distinctly longer than the two joints of the funicle combined; rear of head with a narrow dusky transverse line above level of lower eye margins, this line widened at eye margins; thoracic notum with a median dark line extending backwards to propodeum; a spot on each side on anterior margin of pronotum and one on posterior lateral angles, anterior margin of mesoscutum, inner edge of parapsidal areas, a spot on axillæ, lateral margins of scutellum, a spot just back and centrad of anterior wings, propodeum except extreme sides, spot at base of abdomen, and some suffusion on disk of abdomen, all brown; wings hyaline.

Type-locality.—Compton, California.

Two specimens mounted in balsam on separate slides and with the additional data "Chittenden (U. S. Dept. Agric. Bur. Entom.) number 2180, bred from material *Aleyrodes* sp., etc., Graf, collector."

Type.—Cat. No. 15362, U.S.N.M.

It is very probable that this species came from some lepidopterus leaf minor in the material in which the *Aleyrodes* were found.

This species differs from the others in the genus, in addition to the different pattern of markings, in having the pedicel longer than the first joint of the funicle.

SYMPIESIS METACOMET, new species.

Female.—Length about 2.5 mm. Green; face almost smooth; pedicel subquadrate; joint one of funicle distinctly longer than two, the following joints successively shorter, the last hardly longer than broad; pro-, meso-, and metanotum strongly, coarsely, reticulately rugose, the rugæ on the scutellum somewhat finer, those on the axillæ much finer; propodeum with a strong median longitudinal carina, with weak lateral carinæ and a transverse carina this last doubled for most of its length; basal pair of areolas rugulose; prepectus reticulately rugose; wings hyaline; legs testaceous, the hind coxæ with a large green spot; abdomen about as long as head and thorax together.

Male.—Unknown.

Habitat.—Auburndale, Massachusetts.

Two specimens from swamp white oak leaves infested with *Lithocolletes hamadryella.*

Type.—Cat. No. 15097, U.S.N.M.

SYMPIESIS MASSASSOIT, new species.

Female.—Length about 3 mm. Dark blue, with some greenish reflections; antennæ dark brown, the pedicel very short; first joint of funicle hardly longer than second; the third and fourth, successively slightly shorter, the fourth distinctly longer than broad; mesonotum, including axillæ, reticulately rugose, in part so fine as to almost resemble thimblelike punctures; metanotum medially punctured; propodeum with a median longitudinal carina; lateral carinæ indicated at rear; spiracles small; prepectus and anterior half of mesopleuræ with thimblelike punctures; wings hyaline; coxæ and femora aeneous, with bluish tinges; knees, tibiæ at bases and apices, and tarsi, testaceous; tibiæ medially brown; abdomen distinctly longer than the head and thorax together.

Male.—Length about 1.5 mm. Similar in sculpture to the female; the funicle of the antennæ four jointed, simple, the joints almost subequal in length.

Habitat.—Auburndale, Massachusetts.

Specimens with the record from mines of *Lithocolletes hamadryella* Clemens in swamp white oak leaves.

This species resembles *S. nigrifemora* Ashmead, but in that species the tibiæ are entirely light colored.

Type.—Cat. No. 15096, U.S.N.M.

SYMPIESIS MACULIPES, new species.

Female.—Length about 2.25 mm. Dark blue green, scape testaceous, rest of antennæ brown; pedicel less than half as long as first joint of funicle; following joints of funicle successively decreasing in length, the last only slightly longer than broad; mesonotum coarsely reticulated, the axillæ finely reticulately lineolated; metanotum with a median carinæ and a few rugulæ; propodeum with a median carina, a transverse and lateral ones, making it areolated; wings hyaline; prepectus almost smooth, the lower part and margins somewhat rugulose; coxæ dark, the posterior ones greenish, femora except apices black, rest of legs testaceous, the tibiæ slightly more brownish; abdomen not longer than head and thorax together.

Male.—Length about 2 mm. Similar in structure to the female; hind tibiæ slightly more brownish; funicle 4-jointed, the first three branched, the branches reaching almost to tips of antennæ; first three joints of funicle short, successively slightly increasing in length, the fourth fully as long as the first three combined; club slightly shorter than fourth joint of funicle.

Habitat.—Auburndale, Massachusetts.

Reared from mines of *Lithocolletes hamadryella* Clemens in leaves of swamp white oak together with *S. massassoit* and *S. metacomet* and other parasites.

This species somewhat resembles *S. uroplatæ* Howard, but that species has the legs light colored, with the hind femora somewhat brown.

Type.—Cat. No 15095, U.S.N.M.

SYMPIESIS BIMACULATA, new species.

Female.—Length about 4 mm. Dark blue-green, lower half of face purple, face reticulated, antennæ dark brown, the pedicel short, less than half as long as the first joint of the funicle; joints of funicle successively shorter, the last subquadrate; thoracic notum strongly rugoso-punctate, much more finely so on the parapsides and axillæ; metanotum and propodeum with similar, finer sculpture, that on the metanotum thimble-like; propodeum with a median carina, the lateral carinæ indicated; spiracles ovoid; prepectus with sculpture similar to that on dorsum; wings hyaline, with a small cloud at the base of the marginal vein and a large one at the tip of the stigmal vein, the latter extending backward almost half way across wing; coxæ and femora aeneous, with more or less greenish tinges, knees, tibiæ and tarsi yellowish; abdomen not longer than head and thorax combined.

Habitat.—Franconia, New Hampshire.

One specimen collected by Mrs. A. T. Slosson.

The manuscript name given to this species by Doctor Ashmead is adopted.

Type.—Cat. No. 15094, U.S.N.M.

Family MYMARIDÆ.

ANAGRUS GIRAULTI, new species.

Female.—Length about 0.5 mm. Head and abdomen brown, thorax yellow tinged with brown on the anterior middle of the dorsum; scape about two and one-half times as long as the pedicel; first joint of funicle about half as long as the pedicel; second joint of funicle about three times as long as first; third and fourth joints almost subequal in length, the third about as long as second; the fifth hardly appreciably shorter than the fourth; sixth slightly shorter than the fifth; club about twice as long as sixth joint of funicle; fore wings with about six rows of discal cilia at widest point, slightly concave medially along anterior margin; marginal cilia at apex of wing about one-third longer than greatest width of fore wing; those on posterior margin near apex about one-fourth longer than those apicad; cilia on posterior margin of hind wings about as long as those on apex of fore wings, over six times as long as width of hind wing.

Male.—Length about 0.5 mm. Similar to the female except in secondary sexual characters; first joint of funicle shorter than second, the third slightly longer than the second, joints four to six subequal

in length, each about as long as third, following joints successively slightly shorter.

Habitat.—El Monte, California.

Described from five females and one male with the additional data "Bred from *P. operculella* material, Oct. 21, 1912, J. E. Graf, collector."

Type.—Cat. No. 15402, U.S.N.M.

Since joints 2 and 3 of the funicle are subequal in length this does not fit in Girault's table,[1] but in general it has the habitus of *A. armatus* Ashmead, differing in antennal structure.

This species is named in honor of Mr. A. A. Girault, who has done a most excellent piece of work in the elucidation of the old species of the family Mymaridæ, as well as in describing numerous new forms.

[1] Trans. Amer. Ent. Soc., vol. 37, No. 3, 1911, pp. 297-298.

A FOSSIL FLOWER FROM THE EOCENE.

By Edward W. Berry,
Of the Johns Hopkins University, Baltimore, Maryland.

Flowers are by no means so common in the fossil state that new occurrences are without exceptional interest. If the flowers preserved in the Baltic and other amber deposits are omitted from the enumeration of this class of remains their number is very limited and their preservation is often not all that could be desired. For these reasons I am prompted to publish a preliminary description of a well-preserved flower from the Eocene of southern Tennessee collected some years ago by Prof. L. C. Glenn, of Vanderbilt University, and preserved in the collections of the United States National Museum.

I have been engaged for some years past under the auspices of the United States Geological Survey in a study of the wonderfully rich fossil floras of the Southern States, particularly that of the Lower Eocene, or Wilcox group of formations. The latter flora as known at the present time includes upwards of 250 species of subtropical, largely strand, types. Most of the species are new and the flora as a whole is unlike described American Eocene floras which come largely from the Rocky Mountain province. It is comparable with those of the European Eocene and with the existing flora of the West Indies, Central and northern South America. The specimen described in the following note is made the type of a new genus, since it is not referable with certainty to any of the existing genera of the family with which it shows the most affinity.

COMBRETANTHITES, new genus.

This genus is proposed for the following species which is based on a fossil flower referable to the Combretaceæ and very similar to the flowers of some of the species of the genus *Combretum*. To avoid any seeming inaccuracies the species is described in detail from the specimen even though this repeats some of the floral characters that run through the family.

COMBRETANTHITES EOCENICA, new species.

Peduncle stout, curved, about 4 mm. long. Calyx rather deeply 4 or 5 lobed, the lobes ovate in outline and with bluntly pointed tips. Corolla polypetalous of 4 or 5 petals alternating with the calyx lobes, long and narrow, seemingly pointed, about twice the length of the calyx lobes. Ovary inferior, style long and slender, probably with a single terminal stigma. Stamens 12 in number with long slender filaments, exserted. Anthers elongate elliptical, two-celled, dehiscing by longitudinal slits. The stamens may vary in length or their apparent variation may be simply a feature of preservation.

The present species is based on the exceptionally preserved flower shown natural size in figure 1 of the plate, lying across a leaf of *Cassia emarginata* Berry, the other markings on the leaf being those of a well-marked leaf-spot fungus. It is also to be pointed out that figures 1–3 are from photographs that have not been retouched in any particular.

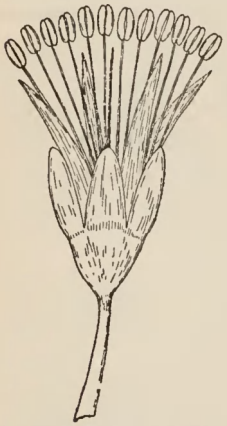


FIG. 1.—RESTORATION OF COMBRETANTHITES EOCENICA. ENLARGED FOUR TIMES.

I am not sure that appearances that I have interpreted as petals are correctly identified, but it is hard to imagine what else they can possibly represent. The single slender style is also a feature that may be simulated by a filament. As shown in the accompanying restoration the flower is polypetalous regular and perfect. It is represented as having a four-lobed calyx and four petals, although only three calyx lobes and two petals are distinctly seen in the specimen. If four is the correct number, then the stamens are three times as numerous as the petals. The reason for considering that these flowers were capitate or in crowded spikes is their small size, narrow petals, and exserted style and stamens—all characters shared by the flowers of the Mimosaceæ and Combretaceæ, the two families whose flowers are most like the fossil. In the Mimosaceæ the filaments are usually more slender and more elongated as well as more or less united, while they are free in the fossil. The anthers are also much smaller and less elongated in the Mimosaceæ. Most of the Combretaceæ have flowers very similar to the fossil although the stamens are usually reduced in number to twice the number of the petals or of the calyx lobes in the apetalous forms. However, some of the modern forms have thrice as many stamens as petals or calyx lobes. The most similar modern flowers in appearance that I have been able to find are those of *Combretum guanaiense* Rusby, from Bolivia, and in this the stamens are only eight in number and more exserted. I

have submitted the specimen to various botanists familiar with the flora of tropical America and compared it with a vast amount of recent material and am satisfied that it represents an Eocene member of the Combretaceæ, a family that was apparently well represented in the early Eocene, since I have described (in manuscript) from contemporaneous deposits the leaves of two species of *Combretum*, two species of *Terminalia*, one species of *Conocarpus*, and both the leaves and fruit of a species of *Laguncularia*. These all serve in a measure to substantiate one another and a certain amount of confirmatory evidence is furnished by the petrified wood described by Felix from the European Eocene as Combretacinium [1] and compared with the woods of modern forms of *Terminalia*, *Bucida*, etc.

Leaves of *Terminalia* and *Combretum* have also been described by various authors from the European Tertiary, tending to show the great similarity between the flora of Europe and that of southeastern North America in Eocene times and the tropical American character of European Eocene floras.

Formation and locality.—Wilcox Group of the Eocene, 1½ miles west of Grand Junction in Fayette County, Tennessee. (Collected by L. C. Glenn.)

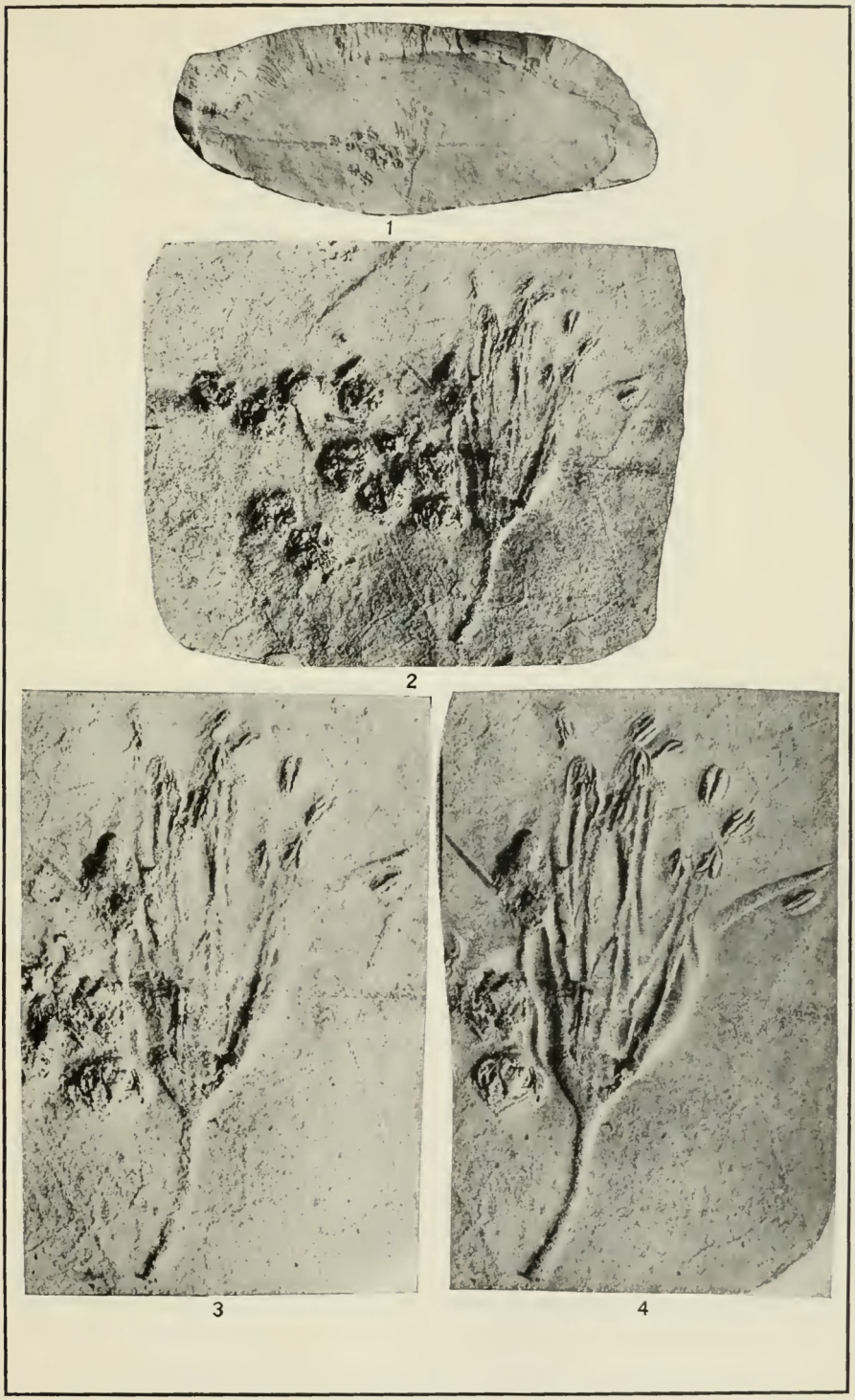
Holotype.—Cat. No. 34445, U.S.N.M.

EXPLANATION OF PLATE 21.

Fig. 1. Impression of *Combretanthites eocenica*, new genus and species, lying across a leaf of *Cassia*, natural size.
2. Same enlarged four times.
3. Same enlarged six times.
4. Same as figure 3, photograph retouched.

Figs. 1–3 are from photographs without retouching in any particular.

[1] Felix, Zeits. deutsch. geol. Gesell., vol. 46, 1894, p. 90, pl. 10, figs. 1a–c.



WILCOX (LOWER EOCENE) FOSSIL FLOWER.

FOR EXPLANATION OF PLATE SEE PAGE 263.

A SYNOPSIS, AND DESCRIPTIONS OF THE NEARCTIC SPECIES OF SAWFLIES OF THE GENUS XYELA, WITH DESCRIPTIONS OF OTHER NEW SPECIES OF SAWFLIES.

By S. A. Rohwer,

Of the Bureau of Entomology of the United States Department of Agriculture.

The following paper, which is a contribution from the Branch of Forest Insects, Bureau of Entomology, United States Department of Agriculture, contains a synopsis of the Nearctic species of the genus *Xyela* and descriptions of certain other sawflies. The types of all the new species are in the collections of the United States National Museum.

Family XYELIDÆ

Genus XYELA Dalman

Table to the Nearctic species of Xyela.

Females 1
Males 13
1. Antennal furrows incomplete but represented by elongate foveæ basally 2
   Antennal furrows complete to the ocelli 6
2. Clypeus not carinate to the apex and without a small median tooth. *salicis*, p. 266
   Clypeus carinate to the apex, with a small median tooth 3
3. Between the bases of the antennæ is a carina ..... *bakeri*, p. 267
   No carina between the bases of the antennæ 4
4. Clypeus with a large, sharp, triangularly shaped tooth; body pale .... *pini*, p. 267
   Clypeus with only a low, rounded tooth; body black 5
5. Area between the antennæ flat ..... *alni*, p. 268
   Area between the antennæ depressed ..... *winnemanæ*, p. 268
6. Clypeus with a large, sharp, triangularly shaped tooth 7
   Clypeus without a large, sharp, triangularly shaped tooth 9
7. A small tubercule between and above the bases of the antennæ .... *minor*, p. 269
   No such tubercule between the bases of the antennæ 8
8. Scutellum with a strong median furrow; head and mesonotum shining, very finely granular; ovipositor but little longer than the abdomen; mesepisternum pale ..... *pini*, p. 267
   Scutellum without a median furrow; head and mesonotum opaque, coarsely granular; ovipositor much longer than the abdomen; mesepisternum black ..... *luteopicta*, p. 269

9. Front between the antennal furrows with a broad, shallow depression. *errans*, p. 269
Front between the antennal furrows convex or flat. 10
10. Scutellum with strong impressed median line. *brunneiceps*, p. 269
Scutellum without an impressed median line. 11
11. Postocellar line subequal with the ocelloccipital line. *dissimilis*, p. 270
Postocellar line shorter than the ocelloccipital line. 12
12. Ovipositor color of the abdomen; body shining, finely granular. *slossonæ*, p. 270
Ovipositor paler than the abdomen; body opaque, coarsely granular. *nevadensis*, p. 271
13. Antennal furrows obsolete dorsally. 14
Antennal furrows complete to the ocelli. 19
14. Clypeus with a large, sharp, triangularly shaped tooth. 15
Clypeus without a large, sharp, triangularly shaped tooth. 16
15. Legs yellow; body variegated with black and yellow. *pini*, p. 267
Femora black; body black. *alni*, p. 268
16. Clypeus without a tubercule. *salicis*, p. 266
Clypeus with a tubercule. 17
17. Body and legs ferruginous. *similis*, p. 271
Femora dusky black or black variegated with yellow. 18
18. Hypopygidium regularly tapering to the apex. *minor*, p. 269
Hypopygidium with the sides gently concave. *bakeri*, p. 267
19. Clypeus with a large, sharp, triangularly shaped tooth. 20
Clypeus without a large, sharp, triangularly shaped tooth. 21
20. Hypopygidium broadly rounded. *pini*, p. 267
Hypopygidium narrowly rounded. *luteopicta*, p. 269
21. Clypeus truncate or nearly so. *californica*, p. 272
Clypeus with a low median tooth. 22
22. Middle fovea obsolete. *slossonæ*, p. 270
Middle fovea indicated. 23
23. Transverse median of the fore wings received in the middle of the first discoidal cell. *minor*, p. 269
Transverse median of the fore wings received beyond the middle of the first discoidal cell. *coloradensis*, p. 272

XYELA SALICIS, new species.

Female.—Length to the apex of the abdomen 3 mm.; length of the ovipositor 1.5 mm. Clypeus not carinate; anterior margin broadly rounded; supraclypeal area convex; middle fovea obsolete; antennal furrows obsolete dorsally; behind each lateral ocellus is a faint depression; postocellar furrow obsolete; postocellar line slightly longer than the ocelloccipital line; head and thorax opaque, finely granular; fourth and fifth antennal joints subequal, scutellum not impressed; stigma sharply oblique on the first transverse radius, about twice as long as its greatest width; sheath straight below, straight above until near the apex when it is sharply oblique. Black; antennæ, palpi, the femora beneath, tibiæ and tarsi and sheath piceous; wings hyaline, iridescent; venation pale brown.

Male.—Length 2.75 mm. Clypeus without a tubercule or a carina, anterior margin nearly truncate, very slightly produced in the middle; supraclypeal area convex; middle fovea obsolete;

antennal furrows obsolete dorsally; postocellar line slightly longer than the ocelloccipital line; postocellar furrow present, angulate anteriorly; postocellar area not defined laterally; fourth antennal joint slightly shorter than the fifth; head and thorax opaque, rather coarsely granular; scutellum not impressed; hypopygidium broadly rounded apically. Black; flagellum, tibiæ and tarsi piceous; wings hyaline, iridescent; venation pale brown.

Grahams Peak, Rio de los Pinos, Colorado. Described from 1 female and 25 males collected May 11, 1899, on *Salix* flowers, by C. F. Baker.

Type.—Cat. No. 15376, U.S.N.M.

XYELA BAKERI Konow.

Xyela bakeri Konow, Ent. Nachr., vol. 24, 1898, p. 327.
Xyela negundinis Cockerell, Can. Ent., vol. 39, 1907, p. 324.

The type of *Xyela negundinis* Cockerell agrees with the original description of *Xyela bakeri* and with specimens which have been determined as *bakeri*. The type of *negundinis* is in the United States National Museum and is Cat. No. 15214.

XYELA PINI, new species.

Female.—Length to apex of the abdomen 2.25 mm.; length of ovipositor 1.25 mm. Anterior margin of the clypeus with a broad, large, triangularly-shaped median tooth, the surface with a faint median tubercule; supraclypeal area convex; middle fovea obsolete; antennal furrows obsolete dorsally (in some of the paratypes the antennal furrows seem to be present although they are so strongly marked with brown that this may be the confusing point); postocellar furrow faintly indicated; postocellar line slightly shorter than the ocelloccipital line; fourth antennal joint subequal in length with the fifth; head and thorax subopaque, finely granular; scutellum longitudinally depressed; stigma about three times as long as its greatest width; sheath concave below, convex above, with the apex above strongly tapering to a sharp point. Yellowish; antennæ metathorax above and abdomen above piceous; a spot occupying the area of the middle fovea, antennal furrows, postocellar area, elongate spot on the vertex between the ocellus and the eye, posterior face of the head, large lateral spots on the mesoscutum, small median spots on the mesoscutum, and apex of the scutellum *rufo-ferruginous;* wings hyaline, iridescent; venation pallid brown.

Male.—Length 2.5 mm. Anterior margin of the clypeus with a large, sharp, triangularly shaped median tooth, the surface with an elongate tubercule; supraclypeal area subconvex; middle fovea obsolete; antennal furrows obsolete dorsally; postocellar furrow

indicated; postocellar area defined laterally by faint furrows; postocellar line subequal with the ocelloccipital line; fourth and fifth antennal joints subequal; scutellum with a longitudinal impressed line; hypopygidium broadly rounded apically. Yellow; markings as in the female.

Call, Texas. Two females and fifteen males collected February 28, 1905, by W. F. Fiske. Recorded under "Bureau of Entomology Number Hopk, U. S. 3433a," which is connected with a note saying that these insects literally swarmed about a single tree of *Pinus palustris*.

Type.—Cat. No. 15377, U.S.N.M.

XYELA ALNI, new species.

Female.—Length to the apex of the abdomen 3 mm.; length of the ovipositor 2 mm. Clypeus carinate to the apex with a small median tooth; supraclypeal area flat; middle fovea obsolete; antennal furrows obsolete dorsally; postocellar area not defined; postocellar line slightly longer than the ocelloccipital line; head and mesonotum subopaque, finely granular; fourth and fifth antennal joints subequal; stigma about twice as long as its greatest width; sheath below straight, with apex above sharply oblique. Black; palpi, antennæ and legs piceous; wings hyaline, iridescent; venation pale brown.

Male.—Length 2.75 mm. Clypeus with a median tubercule, the anterior margin with a large, triangularly shaped median tooth; punctuation and aulation of the head as in the female; hypopygidium regularly, rather broadly rounded to the apex. Black; palpi, flagellum, tibiæ and tarsi pale piceous; wings hyaline, iridescent; venation very pale brown.

Great Falls, Virginia. Described from 2 females and 4 males collected March 20, by Nathan Banks. Some of them labeled as coming from flowers of alder (*Alnus*).

Type.—Cat. No. 15378, U.S.N.M.

XYELA WINNEMANÆ, new species.

Female.—Length to the apex of the abdomen 3 mm.; length of the ovipositor 2 mm. Clypeus carinate to the apex and with a median tooth; antennal furrows obsolete dorsally; the middle fovea represented by a large, shallow depression; postocellar furrow well defined but the postocellar area is not defined laterally; postocellar line subequal with the ocellocular line; head and thorax shining, finely granular; fourth antennal joint slightly shorter than the fifth; stigma sharply tapering beyond the first transverse radius, about two and one-half times as long as its greatest width; sheath straight above and below, but the apex above sharply oblique; wings hyaline,

iridescent; venation pale brown. Black; palpi, mandibles, apices of femora and legs below femora pale piceous.

Plummers Island, Maryland. Described from 1 female collected March 4, 1910, by H. S. Barber.

Type.—Cat. No. 15379, U.S.N.M.

XYELA MINOR Norton.

Xyela minor NORTON, Trans. Amer. Ent. Soc., vol. 2, 1868, p. 349.

Type.—Collection American Entomogical Society.

XYELA LUTEOPICTA Cockerell.

Xyela luteopicta COCKERELL, Can. Ent., vol. 34, 1902, p. 194.

Type.—In the Philadelphia Academy of Natural Sciences.

Originally described from Las Vegas, New Mexico, but is represented in the United States National Museum collection by many specimens from Colorado (without definite locality).

XYELA ERRANS, new species.

Female.—Length to apex of the abdomen 3 mm.; length of the ovipositor 2.25 mm. Clypeus with a faint carina, the anterior margin slightly produced, in the middle a low rounded tooth; supraclypeal area flat; middle fovea obsolete; antennal furrows complete to beyond the anterior ocellus; postocellar area defined laterally by faint furrows; postocellar furrow obsolete; postocellar line subequal with the ocelloccipital line; fourth and fifth antennal joints subequal; head and thorax subopaque, finely granular; stigma gently tapering from the first transverse radius, about two and one-half times as long as the greatest width; sheath concave below, convex above, gradually tapering above and below. Rufo-ferruginous; mandibles, clypeus, faint lines on the vertex and a spot at the top of the eye, palpi, legs below the apices of the coxæ and tegula yellow; wings hyaline, iridescent; venation pallid brown.

North Carolina. Described from 1 female from the collection of C. V. Riley.

Type.—Cat. No. 15380, U.S.N.M.

XYELA BRUNNEICEPS, new species.

Female.—Length to the apex of the abdomen 3.5 mm.; length of the ovipositor 2.75 mm. Clypeus with a faint median carina, the anterior margin slightly produced from the middle into a broad low tooth; supraclypeal area convex; middle fovea obsolete; antennal furrows complete behind the anterior ocellus; postocellar furrow obsolete; postocellar line slightly shorter than the ocelloccipital line; fourth and fifth antennal joints subequal; head and thorax subopaque, finely granular; scutellum with a longitudinal impressed line; stigma

sharply tapering from the first transverse radius, about two and one-third times longer than the greatest width; sheath narrow, gradually tapering to the apex; head brunneus; mesoscutum with the exception of the two spots laterally, and pronotum except a median spot brunneus; spot on the pronotum, prescutum, spots on the mesoscutum, scutellum, metathorax, abdomen above and sheath dark piceous; legs rufo-ferruginous; wings hyaline, iridescent; venation pallid.

Sugar Loaf Mountain, Boulder County, Colorado. One female collected May 18, 1907, at an altitude of 8,000 feet, by S. A. Rohwer. Swept from the foliage of *Arctoclaphylus uva-ursi*.

Type.—Cat. No. 15381, U.S.N.M.

XYELA DISSIMILIS, new species.

Female.—Length to the apex of the abdomen 2.5 mm.; of the ovipositor 1.5 mm. Clypeus with a sharp median carina, anterior margin broadly rounded; supraclypeal area convex; middle fovea obsolete; antennal furrows complete to behind the anterior ocellus; postocellar area undefined laterally by furrows; postocellar furrow obsolete; postocellar line subequal with the ocelloccipital line; fourth antennal joint slightly shorter than the fifth; scutellum without a longitudinal impressed line; stigma about two and one-third times longer than its greatest width; sheath gently tapering to the apex. Black; antennæ piceous; clypeus, labrum, mandibles, palpi, head except antennal furrows, the ocellar and postocellar areas, elongate spots on the vertex, spot behind the middle of the eyes to the spot occupying the area of the middle fovea, spots on the pronotum, scutellum, prescutum, and middle of the scutum yellow; legs yellowish; wings hyaline, iridescent; venation pallid.

Banff, Alberta, Canada. Described from 1 female collected by N. B. Sanson.

Type.—Cat. No. 15382, U.S.N.M.

XYELA SLOSSONÆ, new species.

Female.—Length to the apex of the abdomen, 2.75 mm.; length of the ovipositor, 1.75 mm. Clypeus with a rather sharply defined carina, anterior margin produced into a low rounded tooth in the middle; middle fovea obsolete; antennal furrows complete to behind the anterior ocellus; postocellar line slightly shorter than the ocelloccipital line; postocellar area faintly defined laterally by furrows; postocellar furrow obsolete; head and thorax shining, finely granular; fourth antennal joint subequal in length with the fifth; scutellum not impressed; stigma rounded below, hardly twice as long as its greatest width; sheath stout, concave below, convex above, the apex above sharply convex. Ferruginous; antennæ, metathorax, abdomen above to the sheath piceous; antennal furrows, spot occupying the area which is usually occupied by the middle fovea, postocellar area

to elongate spots on the vertex between the ocelli and the eye, pronotum, sides of the mesoscutum rufo-ferruginous; tibiæ and tarsi rufo-ferruginous; wings hyaline, iridescent; venation pallid.

Male.—Length, 2.5 mm. Clypeus with an incomplete, low carina, anterior margin produced into a very low rounded tooth; middle fovea obsolete; postocellar furrow indicated; postocellar area bounded laterally by fine furrows; postocellar line shorter than the ocelloccipital line; head and thorax shining, very finely granular; fourth and fifth antennal joints subequal; scutellum not impressed; hypopygidium broadly rounded apically. Rufo-ferruginous; antennæ, metathorax, abdomen above piceous; mandibles, clypeus, orbits except spot above, postocellar area laterally, prescutum, scutellum, tegula and legs yellowish.

Biscayne Bay, Florida. Described from 1 female and 1 male collected by Mrs. A. T. Slosson, for whom the species is named.

Type.—Cat. No. 15383, U.S.N.M.

XYELA NEVADENSIS, new species.

Female.—Length to the apex of the abdomen, 3.25 mm.; of the ovipositor, 1.75 mm. Clypeus with a faint median carina; anterior margin in the middle produced into a low, broadly rounded tooth; supraclypeal area convex; middle fovea obsolete; antennal furrows complete to behind the anterior ocellus; postocellar furrow obsolete, postocellar area defined laterally by line-like furrows; postocellar line distinctly shorter than the ocelloccipital line; scutellum with a longitudinal impressed line; stigma not quite twice as long as its greatest width; sheath gently tapering to the apex; body subopaque, finely granular. Rufo-ferruginous; antennæ, metathorax and abdomen above piceous; clypeus, labrum, mandibles, inner orbits, four lines on the vertex, triangular spot on the front inclosing a dark spot located where the middle fovea should be, spots on inner margin of the mesoscutum, sheath, legs below the coxæ yellowish; wings hyaline, iridescent; venation pallid.

Nevada. Described from 1 female.

Type.—Cat. No. 15384, U.S.N.M.

XYELA SIMILIS, new species.

Male.—Length, 2 mm. Clypeus without a tubercule, anterior margin of the clypeus slightly produced into a broad rounded tooth; middle fovea indicated; antennal furrows obsolete dorsally; postocellar line subequal with the ocelloccipital line; postocellar area defined laterally by faint furrows; postocellar furrow obsolete; fourth and fifth antennal joints subequal; head and thorax shining, finely granular; scutellum not impressed; stigma about two and one-half times longer than broad; hypopygidium rather narrowly rounded

apically. Ferruginous; tergum rufo-piceous; wings hyaline, iridescent; venation pallid.

Call, Texas. Described from 1 male collected February 28, 1905, by W. F. Fiske and recorded under "Bureau of Entomology Number Hopk. U.S. 3433a."

Type.—Cat. No. 15385, U.S.N.M.

XYELA CALIFORNICA, new species.

Male.—Length 4.25 mm. Clypeus with a faint carina, the anterior margin without a median tooth, very nearly truncate; supraclypeal area flat; middle fovea represented by a tubercule; antennal furrows complete, meeting behind the anterior ocellus; postocellar furrow obsolete; postocellar area defined laterally by faint furrows; postocellar line distinctly shorter than the ocelloccipital line; fourth and fifth antennal joints subequal; head and thorax shining, finely granular; stigma strongly tapering beyond the first transverse radius; not quite twice as long as its greatest width; hypopygidium broadly rounded apically. Pale yellow; metathorax above and the abdomen above piceous; antennæ pale ferruginous; triangularly shaped spot occupying the area of the middle fovea, antennal furrows basally, two spots on the postocellar area, elongate spots on the vertex between the ocellus and the eye; spots on the sides of the mesoscutum and a small spot on the pronotum rufo-ferruginous; tarsi rufo-ferruginous; wings hyaline, iridescent; venation pale brown.

Alameda County, California. Described from 1 male collected in June by D. W. Coquillett.

Type.—Cat. No. 15386, U.S.N.M.

XYELA COLORADENSIS, new species.

Male.—Length 3 mm. Clypeus with a median tubercule, anterior margin produced in the middle into a low, rounded tooth; supraclypeal area flat; middle fovea indicated; antennal furrows complete to behind the anterior ocellus; postocellar area defined laterally by fine furrows; postocellar furrow obsolete; postocellar line subequal with the ocelloccipital line; fourth and fifth antennal joints subequal; head and thorax opaque, closely granular; scutellum not impressed; stigma about two and one-half times as long as its greatest width; hypopygidium broadly rounded apically. Black; antennæ, clypeus, labrum, palpi, head except spot occupying the area of the middle fovea, antennal furrows, postocellar area, ocellar area, posterior orbits, elongate spots between the ocelli and the eyes which are black, prescutum, large median spot on the scutum and the scutellum yellow; legs below the coxæ reddish yellow; wings hyaline; stigma pallid brown; venation pallid.

Colorado. One male from the C. F. Baker collection.

Type.—Cat. No. 15387, U.S.N.M.

Family MEGALODONTIDÆ.

Genus PAMPHILIUS Latreille.

PAMPHILIUS (PAMPHILIUS) GREENEI, new species.

This species is allied to *ocreatus* (Say) but the third joint of the antenna is shorter than the fourth and the tibiæ and tarsi are darker (in *ocreatus* the third antennal joint is slightly longer than the fourth).

Female.—Length 10 mm. Anterior margin of the clypeus truncate, its surface shallowly, irregularly reticulate under a fine granulation; lateral supraclypeal area polished, impunctate; frontal crest strong; supraclypeal area gently convex; middle fovea elongate, poorly defined but breaking through the crest; antennal furrows complete to the vertex, breaking strongly through the crest; anterior ocellus surrounded by forrows which are V-shaped and join the postocellar furrow above; postocellar line about three-fourths as long as the ocellocular line; postocellar area rectangular, about one-third longer than wide; antennæ normal, the third joint about one-fourth shorter than the fourth; thorax, legs, and venation normal; sheath broadly rounded below, straight above; apex broadly rounded. Ochraceous, paler beneath; ocellar area, spot on the postocellar area, two spots on the vertex, four spots on the mesoscutum, a line on the anterior margin of the pronotum, two lines on the sides of the metathorax and abdomen meeting at the apex of the abdomen, *piceous;* antennæ except scape beneath, tibiæ except the anterior pair beneath and tarsi black; wings hyaline, vitreous; venation dark brown.

Castle Rock, Pennsylvania. Described from 1 female collected June 13, 1909, by Charles T. Greene, for whom the species is named.

Type.—Cat. No. 15312, U.S.N.M.

Superfamily ORYSSOIDEA.

Genus ORYSSUS Latreille.

ORYSSUS ABIETIS Rohwer.

Oryssus abietes ROHWER, Proc. U. S. Nat. Mus., vol. 43, No. 1925, 1912, p. 153.

By typographical error the second *i* was made into an *e*. The name should be *abietis* and not *abietes*.

Superfamily TENTHREDINOIDEA.

Family TENTHREDINIDÆ.

Subfamily ALLANTINÆ.

The oriental members of this subfamily contain some peculiarities in venation which are rather difficult to account for and which seem to indicate that the contraction of the second anal cell of the fore wing is not yet a stable character. It seems to show that the third anal vein is undergoing an evolution which tends to the loss of its apical

portion and also tends to make the posterior portion less contracted and of the character found in the Tenthredininæ, and also shows how it may have given rise to certain of the more elongate Blennocampini. Examples of this may be found within the genera *Xenapates* and *Allantidea* where the third anal vein is entirely without the basal constriction and where the second anal cell is of the type found in the Tenthredininæ, but is separated from the first anal cell by the oblique cross vein. The following new genus adds another to the list which shows many peculiarities. In this new genus the third anal vein is almost entirely obliterated close to the margin of the wing just before it unites with the second and third anal veins. This gives the anal cell the appearance of Blennocampini with the exception that there is produced backwards a short stump near where the third anal should join the second anal. Why this curious condition should be found only in oriental members of this group is not known. It is not in the least unlikely that similar conditions will be found in other subfamilies; if so, these can be treated at some other time. Characteristic of this subfamily is the shape of the head, more especially in the clypeal region where the clypeus has the sides converging apically, the basal portion of the clypeus being well between the inner margins of the eyes, and not as in Blennocampini where the basal portion of the clypeus is inserted lower down on the face, the apical margin extending to or beyond a line drawn tangent to the lowest portion of the orbits; also in Blennocampini the clypeus is usually more nearly parallel sided.

ALLANTOPSIS, new genus.

Belongs to the subfamily Allantinæ, to the tribe Allantini where it is more closely related to *Allantidea*, but may be readily separated from this last-mentioned genus by the nearly truncate clypeus and narrower posterior orbits. In some respects, namely, the obliteration of the apical portion of the third anal vein, it recalls Blennocampini, but in all the body characters it is more closely allied to the Allantinæ.

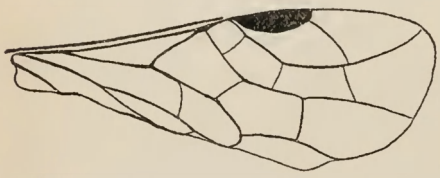


FIG. 1.—ANTERIOR WING OF ALLANTOPSIS THORACICA ROHWER.

Anterior margin of the clypeus, truncate or nearly so; inner margins of the eyes converging to the clypeus; malar space wanting; posterior orbits narrow, about half as long as cephal-caudad diameter of the eye; lateral ocelli well below supraorbital line; antennal furrows present; antennæ short and stout, pedicellum much longer than apical width, the third antennal joint much longer than the fourth; the apical joints short, somewhat wider than the basal joints; thorax and legs, as in Allantini; venation of the anterior wings, as in the accompanying figure; posterior wings like *Allantus;* claws, cleft.

Type.—Allantopsis thoracica Rohwer.

ALLANTOPSIS THORACICA, new species.

Male.—Length 6 mm. Labrum, short, scarcely projecting beyond the clypeus, anterior margin narrowly rounded; clypeus very slightly arcuately emarginate; supraclypeal area narrow, gently convex, subtriangular in outline; supraclypeal and antennal fovcæ confluent; middle fovea elongate, oval in outline, deep, walls sloping; antennal furrows, sharply defined; ocellar depression, heart-shaped; postocellar line shorter than ocellocular line; postocellar area broadly defined by sharp furrows about one-fourth wider than long; postocellar furrow bent anteriorly to unite with the furrow from the ocellar basin; antennæ, hairy, the third joint nearly as long as fourth and fifth combined, the third and fourth joints, oblique apically, so their inner margins are much shorter than the outer; head and thorax, shiny, with a few setigerous punctures; longer spur of the anterior tibiæ, curved; hypopygidium broadly rounded apically. Black; thorax above and most of the mesopleuræ, rufous; four posterior coxæ, trochanters, base of the posterior tibia and the base of the posterior basitarsis, yellow or yellowish white; the femora and anterior legs, dark piceous; head and thorax clothed with dense gray hair; venation dark brown, except in the lighter colored portions of the wings, where it is yellowish; wings dusky, subhyaline, a band from the base of the stigma and the basal portion of the wings, yellowish.

Lebong, India. One male, collected June, 1909, received from the Imperial Entomologist of Pusa, India.

Type.—Cat. No. 1446, U.S.N.M.

Genus ATHLOPHORUS Burmeister.

ATHLOPHORUS FORMOSACOLA Rohwer.

By oversight the color of the scutellum was omitted in the original description.[1] It is for the most part pale ferruginous, the rest black. In Enslin's table to the species of *Athlophorus*,[2] *formosacola* runs to *javanus* Enslin from which it may be separated, according to the description by the entirely black mesonotum, and different colored legs.

Subfamily TENTHREDININÆ.

Genus TENTHREDELLA Rohwer.

TENTHREDELLA CAROLINA, new species.

Allied to *Tenthredella lobata* (Norton), but the coarsely punctured mesonotum and the black metepisternum will readily separate *carolina* from *lobata*.

Female.—Length 11 mm. Labrum long, broadly rounded apically; clypeus deeply, subsquarely emarginate, lobes broad, subtruncate;

[1] Proc. U. S. Nat. Mus., vol. 39, 1911, p. 477. [2] Tijd. voor Ent., 1912, June, p. 121.

supraclypeal area flat; antennal furrows strong, complete; ocellar basin small, well defined; postocellar furrow well defined, angulate anteriorly; postocellar area somewhat wider than long; postocellar line about two-thirds as long as ocellocular line; third antennal joint much longer than the fourth; mesonotum opaque with close, fine punctures; scutellar appendage coarsely punctured; stigma gently tapering to the apex; second cubital cell shorter on both the radius and cubitus than the third; receiving the first recurrent vein near the middle; third cubital cell receiving the second recurrent vein near the basal fourth; legs normal; sheath straight above, convex below, the apex rather narrowly rounded. Black; clypeus, labrum, spot on the mandibles, posterior margin of the eyes, inner margin of the eyes, posterior margin of the pronotum, tegulæ, 4 anterior legs beneath from the apices of the femora, the bases of the posterior tibiæ beneath, and sides of the propodeum yellow; wings hyaline, behind the bases of the stigma strongly dusky; venation black.

Biltmore, North Carolina. Described from 1 female collected June 27, 1912, by W. L. McAtee.

Type.—Cat. No. 15244, U.S.N.M.

TENTHREDELLA FISHERI, new species.

Allied to *Tenthredella angulifera* (Norton), but the yellow on the mesonotum and the black pectus will readily separate it from this species. In some characters this agrees with the description of *ventralis* Say, but there is not sufficient evidence to prove that this is Say's species.

Female.—Length 10.5 mm. Labrum short, anterior margin broadly rounded; clypeus arcuately emarginate, the lobes truncate; supraclypeal foveæ small, punctiform; supraclypeal area flat; antennal furrows complete but not sharply defined; ocellar basin shallow, V-shaped above the anterior ocellus; postocellar furrow straight, well defined; postocellar area nearly quadrate; postocellar line a little more than half as long as the ocellocular line; third antennal joint longer than the fourth; mesonotum shining, with a few scattered, well defined punctures; stigma tapering to the apex; second cubital cell distinctly shorter than the third; legs normal; sheath slightly concave above, slightly convex below, broadly rounded apically. Black; clypeus, labrum, mandibles except piceous apices, face below antennæ, two spots above the antennæ, cheeks, posterior margin of the head, inner margin of the eyes extending to the vertex and uniting with a band on the posterior margin of the head, two small spots on the posterior margin of the postocellar area, spot on sides of the pronotum, posterior margin of the pronotum, tegulæ, lateral margin of the prescutum, two spots on the scutum just behind the prescutum, large spot on the scutellum, scutellar lobe, vertical spot on the

anterior part of the mesepisternum, a longitudinal spot on the posterior part of the mesepisternum, posterior part of the mesepimeron, spot on the metepisternum, sides of the propodeum, transverse median spot on the posterior margin of the propodeum, metapostscutellum, and median, longitudinal line on the tergum, ventral aspect of the tergum and sternum, yellow; legs black; 4 anterior legs beneath yellow; most of the 4 anterior tibiæ and tarsi yellow; posterior trochanters and the base of the posterior femora beneath, most of the posterior tibiæ basally, yellow; wings hyaline, iridescent, costa yellowish; venation black.

Plummers Island, Maryland. Described from 3 females, the type collected July 7, 1907, by A. K. Fisher, for whom the species is named; 1 paratype collected July 21, 1907, by A. K. Fisher; the other paratype collected May 30, 1908, by W. L. McAtee.

Type.—Cat. No. 15245, U.S.N.M.

Subfamily ATHALIINÆ

Genus ATHALIA Leach.

ATHALIA LUGENS INFUMATA (Marlatt).

Through the kindness of the Imperial Entomologist of Pusa, India, a specimen of this subspecies has been sent to me for study. It was collected at Lebong, India, September, 1908, which adds a new locality for this form.

Subfamily PHYMATOCERINÆ.

Genus TOMOSTETHUS Konow.

TOMOSTETHUS NIGRANS Konow.

A female which can not be separated from European specimens of this species was collected at Lebong, India, at an altitude of 5,000 feet, in September, 1908, and forwarded to me for study by the Imperial Entomologist of India.

Subfamily SELANDRIINÆ.

Genus PROSELANDRIA Rohwer.

PROSELANDRIA PERUVIANA, new species.

Of the species placed in *Proselandria*, the species here described is more closely allied to *glabra* (Kirby), but it may be separated from this last-mentioned species by the black antennæ and in having the mesepisternum white above. Judging from the description the species is related to *Stromboceros obscurus* Konow, but the black hind femora and minor structural characters will readily separate it from Konow's species.

Female.—Length 7 mm. Labrum narrowly rounded apically; clypeus convex, the lateral angles broadly rounded, the anterior

margin nearly truncate; inner margin of the eyes strongly converging toward the clypeus; supraclypeal area flat; supraclypeal foveæ poorly defined; middle fovea deep, punctiform, circular in outline; frontal foveæ punctiform, circular in outline, slightly above the middle fovea; antennal furrows represented by broad, shallow depressions above the frontal foveæ, ocellar basin obsolete ventrally but indicated dorsally by the ridges converging behind the anterior ocellus; postocellar area defined laterally by elongate furrows; postocellar furrow obsolete; postocellar line slightly shorter than the ocellocular line; antennæ long and slender, pedicellum about twice as long as the apical width, third antennal joint about one-fourth longer than the fourth; thorax normal; stigma slightly broader near the subangulate base, gently rounded to the apex; third cubital cell decidedly longer than the second; transverse median beyond the middle of the discoidal cell; legs normal; sheath very narrow, straight above, truncate apically, oblique below to the rounded apex. Black; clypeus, labrum, pronotum, tegulæ, first perapteron, anterior margin of the prepectus, dorsal two-thirds of the mesepisternum, four anterior legs except a spot at the apex of the femora above to the apices of the tibiæ and the intermediate tarsi, and the trochanters white; propodeum and abdomen except the two apical segments reddish yellow; wings dusky hyaline; venation black.

Rio Charape, Peru. Described from 1 female collected September 12, 1911, by C. H. T. Townsend.

Type.—Cat. No. 15311, U.S.N.M.

Genus STROMBOCEROS Konow.

Subgenus NEOSTROMBOCEROS Rohwer.

The type of this subgenus has the clypeus arcuately emarginate. To use the character of the clypeus as generic or subgeneric will make it necessary to add a new subgenus, which at present seems unwise. The original description should, therefore, be amended to read: Clypeus truncate or arcuately emarginate.

STROMBOCEROS (NEOSTROMBOCEROS) METALLICA Rohwer.

This species is evidently related to *Stromboceros cenchralis* Konow, which Enslin says is a synonym of *albicomus* Konow, but may be separated from *cenchralis* by the shape of the sheath. Konow describes the sheath of *cenchralis* as "subacuminate." The sheath of *metallica* is truncate apically.

STROMBOCEROS (NEOSTROMBOCEROS) CÆRULEICEPS (Cameron).

Clypeus truncate. Enslin considers *cæruleiceps* (Cameron) to be synonymous with *lævis* Konow. He may be correct; I have not seen the type of either species, but a species which agrees with the

original description of *cæruleiceps* and comes from approximately the same locality differs from the original description of *lævis* in having the clypeus truncate. Konow describes the clypeus of *lævis* thus: "Brevi, punctato, apice late emarginato."

The following characters may be useful in the determination of this species: Supraclypeal area rectangular in outline, flat; middle fovea large, walls sloping, quadrate in outline; frontal foveæ small, punctiform, circular in outline; antennal furrows ending in punctiform foveæ just above and inside of the frontal foveæ; a deep, large depression in front of the anterior ocellus, a furrow from anterior ocellus to the poorly defined postocellar furrow; sheath broad, straight above, broadly rounded apically, sharply tapering below.

STROMBOCEROS (NEOSTROMBOCEROS) ASSAMENSIS, new species.

In Enslin's table of the Oriental species of *Stromboceros* this runs to *lævis* Konow and *congener* Konow. It differs from both of these in having the apex of the femora yellowish and in the different conformation of the head.

Male.—Length 6.5 mm. Clypeus, truncate; supraclypeal area, rectangular in outline, slightly convex above; middle foveæ, deep, punctiform, circular in outline; frontal foveæ, punctiform, circular in outline; antennal furrows, faint, shallow; ocellar basin represented by a depression which is open below and V-d above; postocellar area completely defined by furrows, about one and one-half times as wide as long; postocellar line a little more than half as long as ocellocular; pedicellum, longer than wide; third antennal joint, about one-third longer than fourth; stigma, gently rounded below, transverse radius, nearly interstitial with the third transverse cubitus; first transverse cubitus, obsolete; hypopygidium, narrowly rounded; tarsal claws, cleft. Black; head with a faint bluish tinge; labrum, posterior margin of pronotum, first perapteron, apices of coxæ, trochanters, apices of femara, and tibiæ (except apex) yellowish white. Venation, dark brown; wings, subhyaline.

Khasi Hills, Assam; one to three thousand feet. One male collected March 17, 1907. Received from the Imperial Entomologist of Pusa, India.

Type.—Cat. No. 1676, U.S.N.M.

Subfamily NEMATINÆ.

Genus PTERONIDEA Rohwer.

PTERONIDEA PULCHELLA, new species.

In Marlatt's revision of North American Nematinæ this runs to *populi* Marlatt. It is separated from that species in not having the antennal furrows strongly depressed above the crest, in the shape of the ocellar basin and other characters.

Female.—Length 7.5 mm. Clypeus deeply, arcuately emarginate, lobes subtruncate; supraclypeal area triangular in outline, strongly convex; supraclypeal foveæ deep, confluent with antennal foveæ; middle fovea circular in outline; walls sloping; crest sharply defined centrally, not broken; ocellar basin U shaped, the legs slightly diverging toward the crest, V-d posteriorly; antennal furrows obsolete; shallow depressions laterally; postocellar furrow not sharply defined; postocellar area not defined laterally; postocellar line much longer than the ocellocular; antennæ tapering, third and fourth joints subequal; stigma short, rounded below; cerci long, tapering; sheath broad, slightly convex above, apex narrowly truncate and obliquely rounded to base; inner tooth of claws shorter than the outer. Black; labrum, palpi, tegulæ, coxæ except above (basally), trochanters, four anterior tibiæ and tarsi (except black spot on apex of median tibiæ above), and basal third of hind tibiæ, whitish; angles of the pronotum, and femora (except apex of hind pair) rufo-ferruginous; abdomen (except the two basal tergites), cerci and sheath bright cherry red; wings hyaline, iridescent; venation, including stigma, black; costa yellowish. The above description of the color is from a fresh specimen.

Cabin John, Maryland. One female collected April 28, 1912, by M. C. van Duzee.

Type.—Cat. No. 14797, U.S.N.M.

PTERONIDEA VANDUZEEI, new species.

Related to *Pteronidea mendica*, but may be separated from this species by the triangular-shaped middle fovea and low ocellar basin

Female.—Length 5.5 mm. Clypeus angularly emarginate, lobes rounded; supraclypeal foveæ confluent with antennal foveæ; supraclypeal area convex; middle fovea triangular, breaking through the crest; antennal furrows sharply defined, biangulate; ocellar basin well defined, triangular in outline, the base (which is the crest) being much longer than the sides; depression behind the anterior ocellus V-shaped, the legs of the V forming furrows behind the lateral wall of the ocellar basin; postocellar furrow angulate anteriorly, not sharply defined; postocellar area well defined, about two and a half times as wide as the lateral length; postocellar line shorter than the ocellocular; third antennal joint distinctly shorter than the fourth; stigma broader near base, rounded below; sheath straight above, rounded from apex, rather broad. Greenish (in life); palpi, apices of the mandibles, antennæ, area inside of antennal furrows above crest, mesonotum except sutures, apex of scutellum, metanotum, abdomen centrally above, and the tarsi, *black;* wings hyaline; venation black; stigma and costa pallid.

Chain Bridge, Virginia. One female collected April 26, 1912, by M. C. van Duzee, for whom the species is named.

Type.—Cat. No. 14796, U.S.N.M

Genus PRISTIPHORA Latreille.

PRISTOPHORA XANTHOTRACHELA, new species.

Related to *Pristophora pallicoxa* Rohwer, and may be separated from that species by the shorter third antennal joint, elongate middle fovea, black supraclypeal area, and other minor characters.

Female.—Length 5.5 mm. Labrum truncate apically; clypeus very slightly, arcuately emarginate; supraclypeal foveæ punctiform, deep, confluent with antennal foveæ; supraclypeal area narrow, convex; middle fovea deep, elongated; antennal furrows obsolete; postocellar furrow obsolete; postocellar area defined laterally by punctiform foveæ, about five times as wide as long; postocellar line distinctly longer than the ocellocular; antennæ longer than head and thorax, tapering; third antennal joint about one-fifth longer than fourth; head below the supraorbital line coarsely granulate; thorax shining, sparsely punctured; stigma short, broadest a little basad of the middle, tapering apically; first transverse cubitus wanting; third cubital cell a little longer than the apical width; sheath rather broad, slightly convex above, rounded from the upper apex to the base. Black; apex of the clypeus, labrum, mandibles (except piceous apices), palpi, pronotum broadly, tegulæ, four anterior legs, posterior legs (except a spot on dorsal apices of femora, apical fourth of tibiæ and the tarsi which are black) and venter bright yellow; wings hyaline, iridescent; venation, including stigma, dark brown; costa yellowish brown.

Cabin John, Maryland. One female collected April 29, 1912, by M. C. van Duzee.

Type.—Cat. No. 14798, U.S.N.M.

FOSSIL COLEOPTERA FROM FLORISSANT IN THE UNITED STATES NATIONAL MUSEUM.

By H. F. Wickham,

Professor of Entomology in the State University of Iowa, Iowa City.

INTRODUCTION.

In furtherance of a plan for completing the study of all the accessible fossil Coleoptera from the Miocene shales of Florissant, I have been intrusted with the unworked material in this group contained in the collections of the United States National Museum. Several interesting novelties have been met with in examination of the specimens, the most remarkable of which is the beautifully preserved example of *Miostenosis lacordairei*, apparently most closely related to a tribe of Tenebrionidæ not now occurring in North America. The present report does not exhaust the material, but contains descriptions and figures of most of the species of immediate importance, the balance of the collection, consisting principally of more obscure insects, can be handled better in a comparative study with others now in hand from different sources.

SYSTEMATIC LIST OF SPECIES STUDIED.

CARABIDÆ.

Pterostichus walcotti Scudder.
Amara veterata Scudder.
powellii Scudder.

DYTISCIDÆ.

Agabus florissantensis, new species.

SILPHIDÆ.

Anisotoma sibylla, new species.

STAPHYLINIDÆ.

Aleocharopsis caseyi, new species.
secunda, new species.
Quedius chamberlini Scudder.
Staphylinus vulcan, new species.
Philonthus marcidulus Scudder.
Stenus morsei Scudder.
Miolithocharis lithographica, new species.

CUCUJIDÆ.

Lithocoryne arcuata, new species.

CRYPTOPHAGIDÆ.

Cryptophagus bassleri, new species.

TEMNOCHILIDÆ.

Tenebroides corrugata, new species.

BYRRHIDÆ.

Nosotetocus debilis Scudder.
Amphicyrta inhæsa Scudder.
Byrrhus romingeri Scudder.

BUPRESTIDÆ.

Anthaxia exhumata, new species.

SYSTEMATIC LIST OF SPECIES STUDIED—Continued.

LAMPYRIDÆ.

Chauliognathus pristinus Scudder.
Podabrus wheeleri Wickham.

LUCANIDÆ.

Lucanus fossilis, new species.

SCARABÆIDÆ.

Atænius patescens Scudder.
Aphodius granarioides, new species.
Macrodactylus pluto Wickham.
Diplotaxis aurora, new species.

CERAMBYCIDÆ.

Leptura antecurrens, new species.
ponderosissima, new species.

CHRYSOMELIDÆ.

Systena florissantensis, new species.

BRUCHIDÆ.

Bruchus dormescens, new species.
exhumatus Wickham.

TENEBRIONIDÆ.

Miostenosis lacordairei, new species.
Blapstinus linellii, new species.
Platydema bethunei, new species.

RHYNCHITIDÆ.

Rhynchites subterraneus Scudder.

OTIORHYNCHIDÆ.

Evopes veneratus Scudder.

CURCULIONIDÆ.

Geralophus antiquarius Scudder.
saxuosus Scudder.
fossicius Scudder.
repositus Scudder.
lassatus Scudder.
retritus Scudder.
Coniatus evisceratus Scudder.
Cleonus exterraneus Scudder.
fœrsteri Scudder.
Dorytomus williamsi Scudder.
Rhysosternum longirostre Scudder.
Cryptorhynchus profusus Scudder.
Balaninus minusculus Scudder.

DESCRIPTIONS OF GENERA AND SPECIES.

Genus PTEROSTICHUS Bonelli.

PTEROSTICHUS WALCOTTI Scudder.

A specimen referred here is slightly smaller than the measurements given by Scudder. The elytron shows the large ocellate punctures along the eighth stria which are common among recent species but which were not mentioned in the original description of the present insect.

Cat. No. 59644, U.S.N.M.

Genus AMARA Bonelli.

AMARA VETERATA Scudder.

The fossil referred to this species is in rather poor condition. It exceeds the measurements given by Scudder by about 1 millimeter, but is not otherwise tangibly different. Length, 8.75 mm.

Cat. No. 59645, U.S.N.M.

AMARA POWELLII Scudder.

One specimen, agreeing well with figures and description.

Cat. No. 59646, U.S.N.M.

Genus AGABUS Leach.

AGABUS FLORISSANTENSIS, new species.

Plate 23, figs. 1, 2.

Preserved in ventral view and much carbonized so that most of the sutures and details of minute structure are lost. Form ovate, sides not parallel. Line of demarcation between head and prothorax not distinguishable, but the latter is broader posteriorly, as in most of the species of the genus. Hind leg with the third and fourth tarsal joints shorter than the second and fifth, claws rather long, curved and equal. Length, 11.35 mm.; width of elytra, about the middle, 6.30 mm.

Type.—Cat. No. 59632, U.S.N.M.

One specimen. This insect is somewhat similar in form to *Agabus* (*Gaurodytes*) *austinii*, but is more obtuse behind. It is also much larger, equaling in size any of the specimens of *A. lugens* in my collection. The generic reference seems fairly safe, the facies agrees with *Agabus*, so do the ventral sclerites as far as shown, while the claws are entirely unlike those of our other genera of large Dytiscids to which the specimen might otherwise be presumed to belong, although they agree closely with *Agabus*. The tarsal joints are also proportioned as in this genus. The coxal processes are less divergent than in the recent forms with which I have compared this species, but they are evidently somewhat shifted, as will be seen from their position in the figure. On account of the peculiar preservation of the specimen in hand the outlines have a haziness of definition defying close delineation. The figures are therefore more diagrammatic than usual, and the vestiture of the hind tarsus must be considered as a conventional representation, not as a copy. In the original, the hair prints are too obscure for reproduction in the camera lucida.

Genus ANISOTOMA Illiger.

ANISOTOMA SIBYLLA, new species.

Plate 24, figs. 5–8.

Preserved in part profile. Head rather large, slightly deflexed, pronotum regularly but not strongly arched on the disk, elytral disk more arched and not continuing the thoracic curve. No sculpture can be distinguished upon the head and thorax, but the elytra are marked with rather distant shallow striæ, showing traces of lightly impressed moderately large punctures, these punctures separated by considerably more than their own diameters. Legs rather long, front tibia broadened at tip and spinose on the anterior margin, middle tibiæ wanting, hind tibiæ about straight, more slender than the anterior, with apparently three rows of short spines on the face,

serially arranged so as to give a striate effect. Antenna with the first joint concealed, the second and third subequal but with the latter a little more slender, fourth, fifth, and sixth gradually a little broader, seventh much larger, eighth small, ninth about the size of the seventh, tenth similar to the ninth, eleventh a little narrower and rounded at the tip. Length, 3.35 mm. Height, at base of elytra, 1.70 mm.

Type.—Cat. No. 59633, U.S.N.M.

One specimen. In general build, it seems nearer *A. valida* than to any of the other recent North American species, but differs in sculpture and in leg structure. The antenna exactly answers the characters of the genus, as will be seen by reference to the figure.

ALEOCHAROPSIS, new genus.

This name is proposed for a magazine genus to contain fossil forms of an Aleocharinid facies but of undetermined affinities. The type is *A. caseyi*, described below, which has a general likeness to some of the large recent Aleocharini, notably to *Maseochara*, but differs in the shorter antennæ, the thoracic outline and the long setæ of the pronotal disk. It agrees with the genera related to *Maseochara* and *Baryodma* in the short elytra and the long blunt strongly margined abdomen, with apparently seven exposed segments, the basal portion being uncovered because of the brevity of the wing covers.

ALEOCHAROPSIS CASEYI, new species.

Plate 22, fig. 4.

Form elongate and rather slender, subparallel. Head not very well preserved, the shape distorted. Eye apparently small but not distinctly shown. Antennæ, one of which is complete, only as long as the head, moderately incrassate distally. Prothorax, as preserved, nearly one and a half times as broad as long, broader at apex than at base, a long seta in each anterior angle, sides regularly arcuate, the greatest width slightly in front of the middle, all the angles obtuse. Elytra strikingly small, about as long as the prothorax, the length of each elytron approximately equal to one and one-third times its own breadth. Abdomen longer than all the rest of the body, distinctly margined at sides, the apical appendages presumably indicated by a cloud in the position usually occupied by these structures. Sculpture of the head, prothorax, and elytra probably very fine, since no definite characters can be made out except a few scattered punctures which may belong to the stone, the abdominal segments minutely scabrous, distinctly and rather strongly hairy along the posterior margins and with a few somewhat longer hairs projecting from the sides. Length, exclusive of apical cloud, 10.80 mm.; of head, 1.40 mm.; of prothorax, about the same; of elytra, a very little more. Width of elytra, conjointly, 2.40 mm.

Type.—Cat. No. 59634, U.S.N.M.

I can not see that this is related to any of the Staphylinidæ described by Scudder. Perhaps the most striking feature is the small elytra which remind one of *Sunius* in the Pæderini. I believe that the shape of the prothorax is correctly given in the description, and that the lobate structure at the base of this segment is a displaced piece, though in some lights it appears continuous with the thoracic disk, and in that event the prothorax would be broader toward the base than in front of the middle.

The insect is named for Col. Thomas L. Casey, of Washington, District of Columbia

ALEOCHAROPSIS SECUNDA, new species.

Plate 22, figs. 5, 6.

Less elongate than *A. caseyi*. Head, as preserved, a little longer than broad. Antenna short, reaching slightly beyond the prothoracic apex, first joint large, the third hardly longer than the second, remainder, to the ninth, more or less strongly transverse, extreme apex indistinct. Prothoracic width equal to about one and one-half times the length, form somewhat distorted so that the shape of the sides is not determinable. Elytra, conjointly, broader than the prothorax, which they distinctly exceed in length, apices truncate, the sides subparallel. Abdomen, at base, about as broad as the elytral apices, tapering thence to the tip. Legs moderate or rather short. Sculpture not visible at any point, except on the abdomen, where it consists of fine punctures giving rise to rather long moderately close-set hairs. Like *A. caseyi*, this insect has a long seta (not shown in the figure) inside of each anterior prothoracic angle. Length, to tip of middle abdominal projection, 9.90 mm. Width, across elytra, 2.25 mm.

Type.—Cat. No. 59635, U.S.N.M.

One specimen. Compared with *A. caseyi*, this insect is readily known by the relatively longer elytra. The difference in abdominal appearance may be due to accidental expansion or contraction. This one shows the last segment to be apparently tridentate, but under high power the middle process is seen to be double. It can not be *Tachinus sommatus* (to which, at first sight, it has some resemblance) because of the difference in antennal structure.

Genus QUEDIUS Stephens.

QUEDIUS CHAMBERLINI Scudder.

A single example is presumed to belong here. In view of the fact that the original figure of this species was not made from the type and that the two later figures [1] differ in thoracic proportions to such an extent as to preclude the possibility of their representing a single species, the identification is open to some doubt.

Cat. No. 59647, U.S.N.M.

[1] Mon. U. S. Geol. Surv., vol. 40, pl. 5, figs. 10 and 11.

Genus STAPHYLINUS Linnæus.

STAPHYLINUS VULCAN, new species.

Plate 22, fig. 7.

Preserved in dorsal view. Form elongate, more like that of *Ocypus* than of *Staphylinus*, head suborbicular as in the group containing the recent *S. badipes*. Antennæ rather short and but slightly enlarged distally, the first to third joints elongate, the second shorter than either the first or third, the remainder transverse, the last a little longer and rounded at the tip. Eyes not definable as such, but not prominent nor disturbing the contour of the head. Prothorax about equal to the head in size, base and apex subequal, sides apparently regularly arcuate each way from about the middle, the angles not well defined but obtuse and not prominent. Elytra about one and a half times as long as the prothorax, humeri ill-defined, sides somewhat rounded, the pair (as preserved) probably overlapping a little along the suture which is not distinctly marked. Abdomen with the sides subparallel to the anterior margin of the fifth segment, thence tapering to the tip. Terminal processes obscure. Legs moderate, the front pair stouter, the tarsus (in this specimen, which is therefore presumably a male) strongly dilated. The sculpture of the insect is not well shown, but appears to have been a subscabrous punctuation. A few well defined hair prints on the cheeks indicate vestiture of a type similar to that now seen on *S. badipes*. Length, exclusive of the terminal appendages, 13.50 mm.; of the head, 2.20 mm.; of the prothorax, a little less; of the elytra, 2.65 mm.; of antenna, from margin of head, 2.75 mm. Width of head, 2.10 mm; of elytra, 2.30 mm.; of the abdomen across the fourth exposed segment, 2.45 mm.

Type.—Cat. No. 59636, U.S.N.M.

This insect, known from a single specimen, has the slender form of an *Ocypus*, but I have preferred to place it in *Staphylinus* on account of the shape of the head and the antennal structure, both of these features allying it with *S. badipes*, to which it has been compared. In the specimens of *Ocypus* at my command, the antennæ are much more slender. It is a somewhat larger insect than Scudder's *S. lesleyi*, from these shales, and that species is described as having a subtriangular head, which would put it in a different group. From *S. vetulus* Scudder, the new species differs in being much smaller and more slender.

Genus PHILONTHUS Curtis.

PHILONTHUS MARCIDULUS Scudder.

A specimen with reverse, showing underside and antennæ, is assigned here with some doubt. It is a little larger than the measurements given by Scudder, reaching the length of 13.75 mm.

Cat. No. 59648, U.S.N.M.

Genus STENUS Latreille.

STENUS MORSEI Scudder.

Plate 22, fig. 3.

A fairly good specimen of a Staphylinid in this collection agrees in all respects with the figure and description of *Bledius morsei* Scudder. However, I refer it with some confidence to *Stenus* and believe that Scudder erred in his generic assignment. All the visible characters of his figure are those of *Stenus*, the coarse sculpture (Scudder speaks of granulations, but I presume that his specimen, like mine, was a reverse), the long abdomen with seven plainly visible segments, the slender legs and antennæ, none of which features are in the least like *Bledius armatus*, with which he compares his insect. I figure the specimen in hand, since it gives a somewhat different view of the species.

It is interesting to note in this connection that Scudder was inclined to refer *Stenus prodromus* Heer (from Aix) to *Bledius*. In this he is not followed by Handlirsch, who lists several other *Steni* from the Tertiaries of Europe.

Cat. No. 59637, U.S.N.M.

MIOLITHOCHARIS, new genus.

Resembles *Lithocharis* (*L. corticina*) in general form and differs in the rounded head, much less quadrate prothorax, and particularly in the lack of long setæ on the edges of the head, prothorax, and abdomen. The type is *M. lithographica*, described below, which seems best assigned near *Lithocharis* by the antennal structure, the form of the body, and by the uniform sculpture of fine punctuation accompanied by a covering of short delicate hairs.

MIOLITHOCHARIS LITHOGRAPHICA, new species.

Plate 22, figs. 1, 2.

Form moderately elongate. Head about as long as broad, ovate, the hind angles rounded, eyes not defined. Antennæ longer than usual in the Staphylinidæ of Florissant, reaching to within about one-third of the prothoracic base, the first joint large and apparently about as long as the next two, the second scarcely shorter than the third, which is longer than the fourth, fifth still a little shorter, sixth to tenth more transverse, submoniliform, eleventh longer, oval, the incrassation of the terminal joints not strong. Prothorax a little shorter than the head, subquadrate but broader than long, the angles rounded. Elytra about one-fourth longer than the prothorax, conjointly a little more than one-fifth wider than long, tips truncate, sides subparallel. Abdomen a little longer than the rest of the body, subparallel at sides to about the middle, thence tapering to the tip. Legs

moderate in length, rather slender. Sculpture of head, prothorax, and abdomen, as far as shown, almost uniform, consisting of a fine, microscopic, not very close punctuation with a clothing of short fine hairs. Length, 6.25 mm. Width across elytra, 1.25 mm.

Type.—Cat. No. 59638, U.S.N.M.

This finely preserved insect can not be referred to any of the species described by Scudder. It is absolutely unlike his *Lithocharis scottii*, the antennæ alone serving to differentiate the two. Only a single specimen is known.

Genus LITHOCORYNE Scudder.

LITHOCORYNE ARCUATA, new species.

Plate 24, figs. 3, 4.

Resembles *L. gravis* from the Florissant shales, but differs in size, sculpture, and the form of the prothorax. General shape similar to that of *L. gravis*, prothorax with the perfect side regularly arcuate throughout, the front angles prominent and sharp. Head distinctly closely and subconfluently but not deeply punctured, the prothorax at sides similarly but somewhat more strongly punctured, the median area much less distinctly and more finely so. Elytra with the basal area less strongly punctured than the thoracic sides, the punctures forming vague series but fading out toward the apex. Length, 4.75 mm. Width across the elytra at middle, 2 mm.

Type.—Cat. No. 59639, U.S.N.M.

One specimen. A comparison of the figure of this species with the figure and description of *L. gravis* will show several differences. The prothoracic side is regularly arcuate in *L. arcuata*, but nearly straight, except near the apex, in *L. gravis*. The sculpture is different, since Scudder describes the prothorax of his species as being covered with minute but not crowded nor prominent granulations. If his example were a reverse, this would mean that the punctuation of that part, in the obverse, would be rather fine and well separated, while in *L. arcuata* it is rather coarse and very much crowded. There is a very serious discrepancy between the description and figure of the antennæ in Scudder's work, but I have assumed the former to be correct, in which case the antennæ of *L. gravis* and *L. arcuata* are similar excepting the proportions of the club joints. In my species the terminal articulation is truncate, possibly due to distortion.

Genus CRYPTOPHAGUS Herbst.

CRYPTOPHAGUS BASSLERI, new species.

Plate 24, figs. 1, 2.

Preserved in ventral view. Form rather short, head broad, antenna 11-jointed, the first joint large, second and third narrower and successively shorter, fourth to seventh subequal, submoniliform, shorter than the third, eighth apparently partially decomposed,

judging from its shape and texture, ninth to eleventh forming a rather long and distinct club. Prothorax injured on the left side, the right is furnished with two subgranular tooth-like projections, sides in front and behind these processes oblique to apex and base. Elytra slightly broader than the prothorax, sides subparallel to behind the middle, thence arcuate to tip, inflexed margin long and rather broad. Length, 2.40 mm. Width of elytra, 1.20 mm.

Type.—Cat. No. 59640, U.S.N.M.

One specimen, which seems to be a good *Cryptophagus*. The basal antennal joint is less swollen than in the numerous recent species examined. The sculpture is obliterated and the legs can not be made out. The species is named after Dr. R. S. Bassler, of the United States National Museum.

Genus TENEBROIDES Piller.

TENEBROIDES CORRUGATA, new species.

Plate 23, fig. 3.

Preserved in ventral view. Body elongate, head somewhat roughened beneath. Prothorax distinctly broader than long, front margin concave, basal nearly straight, sides nearly straight and divergent from base to a point in front of the middle, thence arcuately narrower to apex, which is the same width as the base. Front angles acute. Elytra showing only the epipleural portion, which is transversely corrugated, as shown in the figure. Metasternum long, side piece narrow, subcuneiform. Posterior coxæ transverse, approximate. Abdominal ventral segments subequal, except the last, which is somewhat shorter. Length, 6.55 mm. Greatest width of elytra, 2.25 mm.

Type.—Cat. No. 59641, U.S.N.M.

One specimen. By the form, and what can be seen of the sternal, coxal and abdominal structure, this insect agrees well with the genus in which I have placed it, the size being about equal to that of our smallest living North American species. The corrugation of the elytral epipleuræ, which seemed at first to be a disturbing element, is shown, in less degree, by several of our native forms. I have found evidence of it in *T. mauritanica, T. castanea, T. laticollis, T. marginata,* and *T. semicylindrica.*

Genus NOSOTETOCUS Scudder.

NOSOTETOCUS DEBILIS Scudder.

One specimen, length, 4.50 mm., width, 3.25 mm. These measurements correspond with those of Scudder, but the outline is a little different.

Cat. No. 59649, U.S.N.M.

Genus AMPHICYRTA Erichson.

AMPHICYRTA INHÆSA Scudder.

Two specimens, not differing in size nor other appreciable detail from Scudder's description and figure.

Cat. No. 59650, U.S.N.M.

Genus BYRRHUS Linnæus.

BYRRHUS ROMINGERI Scudder.

One specimen, agreeing almost exactly with the original in size.

Cat. No. 59651, U.S.N.M.

Genus ANTHAXIA Eschscholtz.

ANTHAXIA EXHUMATA, new species.

Plate 23, figs. 4, 5, 6.

Preserved in dorsal view. Form similar to that of the recent *A. æneogaster*, but somewhat less obtuse posteriorly. Head broad and short, anterior outline slightly concave. Antennæ extending about to the hind margin of the prothorax. Prothorax a little more than twice as wide as long, sides prominent, the right showing the squarish truncation, which is so well marked in *A. æneogaster*, anterior margin arcuately, rather weakly lobed at middle, hind margin sinuate each side. Elytra at humeri a little broader than the thoracic base, tapering to apex, which is a little truncate. The entire upper surface of the body shows the same type of sculpture as in *A. æneogaster*—a coarse reticulation (fig. 6). In the fossil these reticulations are slightly larger on the prothorax than on the elytra and considerably larger than on the head. Length, 7 mm.; of elytron, from humerus to apex, 4.90 mm. Width of prothorax, 2.90 mm.; of one elytron at middle, 1.50 mm.

Type.—Cat. No. 59642, U.S.N.M.

One specimen. This insect goes well into the genus *Anthaxia* by all the visible features. As far as can be told, it was not very unlike the species with which it has been compared in the foregoing description, but has a slightly differently shaped head and elytra. *A. æneogaster*, in the sense understood by Dr. George Horn, extends across the continent from Maine to British Columbia and southward to the mountains of Southern California, including in its range the territory formerly inhabited by *A. exhumata*. The figures will show the relative coarseness of reticulation in the two species.

Genus CHAULIOGNATHUS Hentz.

CHAULIOGNATHUS PRISTINUS Scudder.

Here I refer a specimen from the Lacoe collection, which answers the description of the above species in what I regard as the chief essentials. The abdomen is similarly though less strongly elongate,

the elytral proportions are very nearly the same, those of the head almost exactly so. Length of this example, 10.60 mm.; of elytra, 6 mm.; of head, 1.50 mm. Width of elytron near middle, 1.55 mm.; of head, 1.75 mm.; of abdomen, 3 mm.

Cat. No. 59652, U.S.N.M.

Genus PODABRUS Westwood.

PODABRUS WHEELERI Wickham.

Two specimens in rather poor condition.

Cat. No. 59653, U.S.N.M.

Genus LUCANUS Linnæus.

LUCANUS FOSSILIS, new species.

Plate 23, fig. 7.

Represented by an elytron, a scutellum and a few fragments of tissue belonging to the prothoracic disk. The elytron is proportioned almost exactly as in the recent *L. dama*. The sculpture, however, is much rougher, somewhat coarser than in *L. placidus*, and in the specimen is granulate, so that the object is probably in reverse. The scutellum is similar in shape to that of *L. placidus* and, as in that species, is smoother at the tip, this latter character being less marked in *L. fossilis*. Length of elytron, 18.50 mm.; width, 11 mm.

Type.—Cat. No. 59643, U.S.N.M.

One specimen. The generic reference is made upon the proportions, form, texture and sculpture of the elytron, after comparison with recent species. It is possible that the fragment belonged to some large Scarabæid.

Genus ATÆNIUS Harold.

ATÆNIUS PATESCENS Scudder.

A specimen in very soft shale is referred here, although it exceeds the measurements given by Scudder a little.

Cat. No. 59654, U.S.N.M.

Genus APHODIUS Illiger.

APHODIUS GRANARIOIDES, new species.

Plate 25, fig. 1.

Preserved as a reverse, in dorsal view. Form somewhat resembling the recent cosmopolitan *A. granarius*, but at once separable therefrom by the narrower elytral sutural interval. Head somewhat distorted, clypeus only sparsely and rather finely punctate, anteriorly subtruncate, front angle of one side rounded, that of the other side apparently prominent, but I believe the prominence is due to displaced mouth parts, since there is some evidence of a demarcation matching the opposite curve. Prothorax very nearly twice as broad

as long, sides rather regularly arcuate, apex and base subequal, front margin a little arcuately prominent at middle, base nearly straight, anterior angles similar to those of the head, posterior angles obtuse, surface of disk not very closely sculptured with irregularly placed distinct rounded punctures which become smaller (or less well preserved) at the sides and anteriorly. Scutellum small, subtriangular. Elytra incomplete along the margins and with the apices broken off but with distinct sculpture in the form of regular striæ (eight of which show on the better side), sharp and well impressed, the striæ with regular rounded punctures separated by not much more than their own diameters. Interspaces broad, impunctate. Legs wanting. Length, as preserved, 6.10 mm., actual length in life probably about 6.25 mm. Width across humeri at most prominent part, 2.60 mm.

Type.—Cat. No. 59655, U.S.N.M.

One specimen which is larger than *Atænius patescens* and differs from it in sculpture. Since the fossil is in reverse, the striæ and punctures described above are represented by ridges and granules. It is easily separable from the other known Florissant species by the characters given.

Genus MACRODACTYLUS Latreille.

MACRODACTYLUS PLUTO Wickham.

Two specimens are contained in the collection, one of which allows us to supplement the observations made upon the type by display of the left antenna. This organ is composed, as far as can be made out in the somewhat indistinct preservation of the articulations, of seven joints, besides the club, the scape large, the stem-joints subequal in length excepting the third which is rather longer. The club is not spread.

Cat. No. 59656, U.S.N.M.

Genus DIPLOTAXIS Kirby.

DIPLOTAXIS AURORA, new species.

Plate 25, fig. 2.

Represented by an elytron about the size of that of the recent *D. brevicollis* LeConte, which occurs in the same general region. The punctuation is fairly coarse for this genus, more so than in the species cited, the punctures moderately closely placed and regular, slightly smaller toward the apex. Besides the smooth sutural margin, the elytron is marked with four double series of regular punctures, inclosing as many smooth longitudinal lines, as in most recent species of *Diplotaxis*. Length of elytron, 9.50 mm.; greatest breadth of same, 4 mm.

Type.—Cat. No. 59657, U.S.N.M.

One specimen. I feel quite satisfied with the generic reference. The fossil is more coarsely sculptured than *D. brevicollis*, with which it is comparable in size, resembling some of the Arizona species in its heavy punctuation. Since the specimen is a reverse, the punctures are represented by corresponding elevations.

Genus LEPTURA Serville.

LEPTURA ANTECURRENS, new species.

Plate 25, fig. 3.

Preserved in profile. A small-headed form, evidently of a type similar to the recent *L. sexmaculata*. Eye large, extending the full width of the head. Antennæ of moderate length, the last four joints subequal, the remainder more or less obscured except the second and third, which show the ordinary proportions of the group, the second being short, the third several times as long, all visible joints more or less roughened and pubescent or hairy, the basal three more strongly. Front of head apparently finely and closely punctate and granulate. Prothorax, in side view, strongly tapering from the base, the back scarcely or not at all arched, sculpture weak and indefinable. Elytron narrowed at the tip which is shortly truncate but not spinose nor dentate, the surface rather strongly punctate, punctures crowded at base, becoming less so (separated by about their own diameters) at middle and sparse toward the apex, each puncture carrying a well-defined hair. Toward the apex, these hairs are approximately five times as long as the diameter of the punctures. Abdomen with no definable sculpture. Only one leg is visible, this incomplete and indicating that these organs were short. Length, 10.25 mm.; of elytron, 6.85 mm.; of antenna, from presumed point of attachment to tip, along chord of arc, 6 mm.

Type.—Cat. No. 59658, U.S.N.M.

One specimen. Not very closely allied to any of the North American forms with which I am acquainted. The use of the generic term *Leptura* is to be understood in its broad sense, though I see no characters which would invalidate the reference in a more restricted acceptance. The appearance of carination on one of the antennæ is due to some adventitious circumstance, since careful examination shows that the carina runs off on to the stone.

LEPTURA PONDEROSISSIMA, new species.

Preserved in profile. A specimen in poor condition, but with the anterior portion of the body fairly well preserved and showing one antenna and a front leg is at hand. Form of a heavy Lepturoid type, sculpture of all parts obliterated by the rather coarse grain of the stone on which it is outlined. Leg heavy, femur stout, tibia slightly curved,

tarsus distinctly longer than the tibia. Antenna short, extremely stout, the joints near the apex as broad or broader than long. Length of the fragment, 14.75 mm.; of head and prothorax about 4.50 mm.; of the fore tibia, 2.65 mm.; of the fore tarsus, 3.50 mm.; of antenna, straightened, about 8 mm.

Type.—Cat. No. 59659, U.S.N.M.

By the heavy antennæ, this species reminds one of the recent *L. brevicornis*, but it is probable, allowing for possible flattening through pressure, that they were even broader than in that insect. The antenna and the tibia both show some signs of carination, but I believe these marks are accidental or due to some peculiarity in the decomposition of the exoskeleton. It will be readily recognized, among fossil forms, by the stout antennæ. Quite probably, this insect is not strictly congeneric with our recent Lepturæ. Owing to the poor condition of the type, and its hazy outlines, I have not attempted to figure it.

Genus SYSTENA Chevrolat.

SYSTENA FLORISSANTENSIS, new species.

Plate 25, fig. 5.

Preserved in ventral view. Form rather stout for this genus, but not especially so. Head moderate, width equal to about one and one-half times the length, eyes not definable, antennæ filiform, slender, not showing the basal joints, but the remainder are subequal in length among themselves, except that the distal five are somewhat shorter than those nearer the head. Prothorax transverse, slightly narrowed anteriorly, the sides slightly arcuate, anterior margin faintly emarginate, posterior apparently lobed, but the appearance may be due to the tip of the prosternum being bent out straight instead of resting in the normal position. Anterior coxæ well separated, but their other boundaries not certainly defined. Meso and metasternal side pieces similar to those of recent Systenæ, as will be seen by reference to the figure, middle and hind coxæ transverse, the former obliquely so, both pairs well separated. Metasternum broad. Abdomen with the first and last visible segments longer than the intermediate, but the first is not excessively lengthened. Legs lacking, except one posterior femur which is only moderately thickened. Length, 6.30 mm.

Type.—Cat. No. 59660, U.S.N.M.

One specimen. The generic reference is open to some question, the most dubious feature, in my estimation, being the antennal structure. These organs are imperfectly preserved, but may possibly have been only 10-jointed, while in *Systena* there are 11 joints. In other respects, the generic correspondence is sufficiently close. The insect had well-developed functional wings, which are seen partly unfolded and extending beyond the elytral apices.

Genus BRUCHUS Linnæus.

BRUCHUS DORMESCENS, new species.

Plate 25, fig. 4.

Form short and stout, sculpture almost effaced except that the elytra are marked with fine shallow striæ which seem to be composed of series of very elongate punctures. Head and thorax not separable in this specimen, the former may be bent under and hidden. The posterior prothoracic margin is apparently only regularly arcuate instead of being lobed. Antennæ with eight exposed joints, strongly serrate. Posterior thigh without visible tooth, hind tibiæ strongly arcuate and with the tip prolonged into a spine-like point. Length, 3.75 mm.

Type.—Cat. No. 59661, U.S.N.M.

In form, this species may be compared with the recent *B. discoideus*, but the sculpture is of a weak type, judging by the elytral striæ. The antennæ are quite different though of a type common in this genus which is remarkable for the diversity of structure offered by these organs.

BRUCHUS EXHUMATUS Wickham.

One specimen, agreeing with the type and showing, in addition, the antenna, which I have figured elsewhere.

Cat. No. 59662, U.S.N.M.

MIOSTENOSIS, new genus.

Recalls the Palæarctic genus *Stenosis* in form, and agrees with it in antennal structure, but differs in the coxæ and the shape of the intercoxal process of the first ventral abdominal segment. In this new genus the anterior and middle coxæ are closely approximate, though apparently not actually contiguous, while the hind coxæ meet on the median line. The metasternum is moderately elongate and the intercoxal process of the first ventral is sharp and short. The type and only known species is *M. lacordairei*, described below.

MIOSTENOSIS LACORDAIREI, new species.

Plate 26, fig. 1.

Form elongate, narrow, in general resembling *Arræoschizus*, *Stenosis*, or *Dacoderus*. Head subrectangular, longer than broad. Eyes rather large. Antennæ eleven jointed, joints submoniliform but transverse, third longer than the second or the fourth, distal articulations not forming a distinct club, terminal joint small but distinct and probably free. Prothorax broadest in front of the middle, arcuately narrowed, slightly to apex and more so to the base, anterior angles acute but not projecting. Front and middle coxæ rounded,

small, approximate, hind coxæ transverse, femora moderately stout subclavate, tibiæ simple, straight, the anterior shortest, middle a little longer, posterior still longer, spurs entirely wanting, hind tarsi more slender than the others. First abdominal segment longest, the three following subequal among themselves, fifth short, sutures nearly straight. Under side of head granulate, more densely toward the sides, under surface of pro- and mesothorax similarly but more strongly and less densely sculptured, metasternum and abdomen still less granulate. Elytra only showing for a short distance along one edge and not displaying any markings. Length, from front of labrum to abdominal apex, 7.60 mm. Width, at point half way between the middle and hind coxæ, 2.40 mm.

Type.—Cat. No. 59663, U.S.N.M.

Known from a well-preserved specimen in reverse, showing the under side only, the granules, therefore, represent punctures. In this punctuation the insect bears a rather close resemblance to *Stenosis brentoides* Rossi (*angustata* Herbst), of southern Europe, a Corsican specimen having served as the basis of comparison. It seems that *Miostenosis* must be an intermediate or ancestral type, with affinities toward the Stenosiini on one hand and the Dacoderini on the other. It has the eleven jointed antennæ of the Stenosiini, with a coxal structure somewhat approaching *Dacoderus* as far as the front and middle members are concerned, but differs from both in the hind pair. It is evidently heteromerous, though the claws do not show on any of the tarsi. The eyes are distorted and give no good clue to the affinities. The Stenosiini proper are not represented by recent North American species though they are abundant in Europe, Asia, and the Mediterranean region of Africa, with a few generic types occurring in Madagascar, South America, and Australia. The genus *Arœoschizus*, fairly well represented to-day in our Southwestern States, has been separated from this group by Colonel Casey, to form a distinct tribe, the *Arœoschizinæ*. I think that *Miostenosis* is not as closely related to *Arœoschizus* as to *Stenosis*. It differs from my examples of both genera in the short terminal segment of the abdomen and in the relatively long penultimate segment.

This very interesting insect is dedicated to the great French master, Lacordaire.

Genus BLAPSTINUS Latreille.

BLAPSTINUS LINELLII, new species.

Plate 26, figs. 6–9.

Represented by a specimen in dorsal aspect. Form rather elongate for this genus, subparallel. Head somewhat distorted in shape, the labrum bent up so as to be freely exposed, this part broader than

long and truncate anteriorly, top of head closely, rather finely, but distinctly punctured, the punctures barely separated but not confluent to any extent. Eye rather small but not much more so than usual in this genus. Antennæ about reaching the base of the prothorax, second joint short, third distinctly longer than the fourth, eighth somewhat broadened, and, with the ninth, tenth, and eleventh, forming a distinct but not abrupt club, these last three joints being still wider than the eighth. The eleventh joint seems to have been more or less ovate, but is broken on one antenna. The prothorax is somewhat distorted but is about twice as broad as the length along the median line, more coarsely punctured than the head but much less closely, the punctures separated by at least their own diameters and often by more, surface hairy. The sides are apparently rather regularly arcuate, the base distinctly broader than the apex, which is arcuately emarginate. Elytra subparallel at sides, pointed at tip, humeri distinct, surface with faint evidences of about eight fine punctured striæ, the punctures weak and only evident in good light, the interstitial spaces plainly but not deeply punctate, and hairy. Length, 6.75 mm.; of elytron, 4.40 mm. Width across elytra near humeri, 2.65 mm.

Type.—Cat. No. 59664, U.S.N.M.

This insect goes well into *Blapstinus*, with which it agrees in form, antennal structure, sculpture, and especially in vestiture. The legs are not shown. The abdominal segmentation is only faintly indicated through the elytra. The eye seems more anterior than in the recent Blapstini, and reaches the margin of the head, but this may be due to spreading and flattening. Comparing it with recent forms, I should place it in the neighborhood of *B. elongatus*, but without implying any close relationship between them.

I have named this beetle in memory of the late Martin L. Linell.

Genus PLATYDEMA Laporte.

PLATYDEMA BETHUNEI, new species.

Plate 26, figs. 2–5.

Preserved in dorsal view, lacking the legs, except a small portion of one member. Form rather elongate for this genus. Head rather finely, closely, and quite regularly punctured. Antenna showing ten joints, another being presumably missing, first joint stout, second small, third elongate, fourth longer than the fifth, distal joints gradually enlarging to form a rather narrow club. Palpus showing a terminal subtriangular joint. Prothorax injured on one edge, but nearly twice as broad as long, perfect side arcuate, most prominent near the middle, very little narrowed at base, front angle prominent and acute, hind angle damaged but apparently sharp, base and apex both nearly straight except near the angles, disk rather finely,

distinctly, and closely punctate, a little more densely toward the sides. Scutellum subtriangular. Elytra distorted by pressure and with the tips broken off, but showing the sculpture very nicely, each with eight entire striæ, well impressed and sharp, the bottom of the striæ with slightly irregularly spaced elongate punctures, interstices nearly or quite smooth. A distinct and rather long scutellar stria is present in addition to the entire ones described above. Length of fragment, 8.50 mm.; if complete it would probably reach between 9 and 10 mm.

Type.—Cat. No. 59665, U.S.N.M.

This specimen seems well referable to *Platydema*, though the size is large compared with most of the recent forms. In life, *P. bethunei* probably had the facies of *P. subcostatum*, but was larger. Several of the recent Mexican species reach a length of 8 mm., and at least one (*P. 15-maculatum*) measures up to 9 mm. The scutellar stria is distinct in recent forms, and may be well demonstrated by our common *P. excavatum*. The genus is already known from the Tertiaries, *P. geinitzi* having been described from the upper Oligocene of Rott, in the Siebengebirge.

I name this beetle after Dr. Charles J. S. Bethune, of Guelph, Ontario, Canada.

Genus RHYNCHITES Herbst.

RHYNCHITES SUBTERRANEUS Scudder.

An obverse and reverse in good condition, showing dorsal view, are referred to this species with which they agree in every essential noted by Scudder. However, the head, between and behind the eyes, and the entire discal surfaces of prothorax and elytra are clothed with long slender curved hairs, not closely placed nor arranged in series. Unfortunately the antennal club of this specimen is crossed by a front leg, obscuring the basal joints, so I am unable to determine whether this part is composed of three or of four joints. Length, exclusive of rostrum, 5.25 mm.; of rostrum, 2.75 mm.; of elytra, 3 mm. Width of elytron, 1.65 mm.

The specimens bear the United States National Museum accession number 38133.

Cat. No. 59666, U.S.N.M.

Genus EVOPES Scudder.

EVOPES VENERATUS Scudder.

Two specimens in side view, agreeing fully with the original description and figures.

Cat. No. 59667, U.S.N.M.

Genus GERALOPHUS Scudder.

GERALOPHUS ANTIQUARIUS Scudder.

Five examples, all assigned here with some doubt on account of their poor condition.

Cat. No. 59668, U.S.N.M.

GERALOPHUS SAXUOSUS Scudder.

One specimen.

Cat. No. 59669, U.S.N.M.

GERALOPHUS FOSSICIUS Scudder.

Three examples.

Cat. No. 59670, U.S.N.M.

GERALOPHUS REPOSITUS Scudder.

Three specimens.

Cat. No. 59671, U.S.N.M.

GERALOPHUS LASSATUS Scudder

Four examples.

Cat. No. 59672, U.S.N.M.

GERALOPHUS RETRITUS Scudder.

One example.

Cat. No. 59673, U.S.N.M.

Genus CONIATUS Germar.

CONIATUS EVISCERATUS Scudder.

One specimen, closely corresponding to the figures and description of the type, except that it is a trifle smaller. Length, exclusive of rostrum, 3.75 mm.; of rostrum, 0.80 mm. Height of body, 1.80 mm.

Cat. No. 59674, U.S.N.M.

Genus CLEONUS Schönherr.

CLEONUS EXTERRANEUS Scudder.

One specimen, referred here on account of its size, is represented in ventral view and shows the abdominal and sternal structures of the genus, as far as they can be made out. The suture between the first and second abdominal segments is strongly sinuate, the third and fourth segments together are slightly longer than the second at its sides. The middle coxæ are rather narrowly separated, the hind ones more widely so.

Cat. No. 59675, U.S.N.M.

CLEONUS FŒRSTERI Scudder.

Represented by one good specimen in side view, a reverse. Three poor examples of undersides are referred here with some doubt.

Cat. No. 59676, U.S.N.M.

Genus DORYTOMUS Germar.

DORYTOMUS WILLIAMSI Scudder.

A single example, in reverse, is contained in the collection. It is somewhat smaller than the Scudder type and I can not be sure that the elytral interspaces were hairy. The abdominal sutures are as in recent *Dorytomus*, the first only slightly curved at middle. The sides of the meso and metasterna are strongly granulate in the present specimen (representing corresponding punctuation) this sculpture also extending on to the first and second abdominal segments but becoming evanescent on those following. The rostrum is slightly more arcuate than in the type figure, but this character is variable in the genus. Length, excluding rostrum, 3.45 mm.; of rostrum, on chord of arc, 1.75 mm. Height of body about 2 mm.

Cat. No. 59677, U.S.N.M.

Genus RHYSOSTERNUM Scudder.

RHYSOSTERNUM LONGIROSTRE Scudder.

Three specimens, all side views. Two are in fine preservation, the other is much poorer.

Cat. No. 59678, U.S.N.M.

Genus CRYPTORHYNCHUS Illiger.

CRYPTORHYNCHUS PROFUSUS Scudder.

Two specimens.

Cat. No. 59679, U.S.N.M.

Genus BALANINUS Germar.

BALANINUS MINUSCULUS Scudder.

A beautiful specimen of this genus, referred here, differs slightly in measurements from the type as described by Scudder. In view of the known variation in modern species it does not seem wise to give the present example a different name. Total length, excluding rostrum, 4.25 mm.; of rostrum, along chord of arc, 2.20 mm.

Cat. No. 59680, U.S.N.M.

EXPLANATION OF PLATES.

PLATE 22.

Fig. 1. *Miolithocharis lithographica.*
2. *Miolithocharis lithographica*, antenna.
3. *Stenus morsei.*
4. *Aleocharopsis caseyi.*
5. *Aleocharopsis secunda.*
6. *Aleocharopsis secunda*, antenna.
7. *Staphylinus vulcan.*

PLATE 23.

Fig. 1. *Agabus florissantensis.*
2. *Agabus florissantensis*, hind tarsus.
3. *Tenebroides corrugata.*
4. *Anthaxia exhumata.*
5. *Anthaxia exhumata*, thoracic reticulations.
6. *Anthaxia æneogaster*, thoracic reticulations.
7. *Lucanus fossilis.*

PLATE 24.

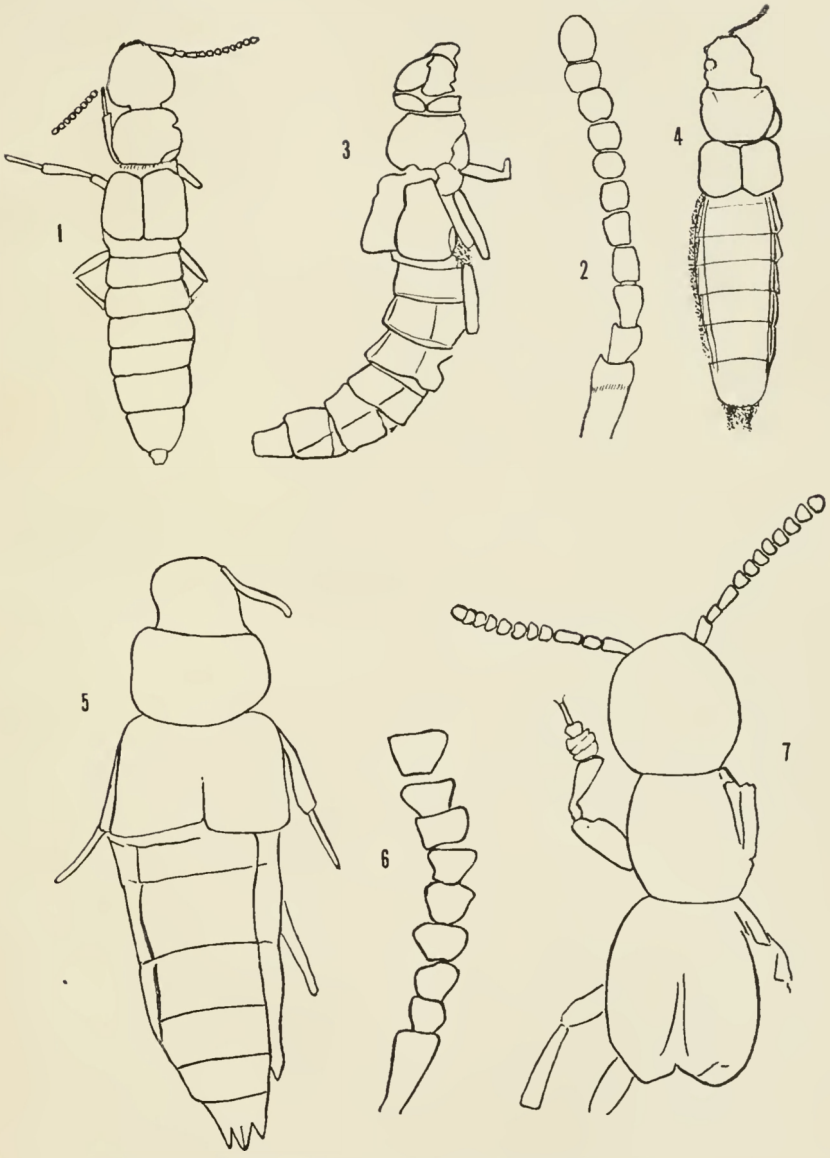
Fig. 1. *Cryptophagus bassleri.*
2. *Cryptophagus bassleri*, antenna.
3. *Lithocoryne arcuata.*
4. *Lithocoryne arcuata*, antenna.
5. *Anisotoma sibylla.*
6. *Anisotoma sibylla*, antenna.
7. *Anisotoma sibylla*, front leg.
8. *Anisotoma sibylla*, hind leg.

PLATE 25.

Fig. 1. *Aphodius granarioides.*
2. *Diplotaxis aurora.*
3. *Leptura antecurrens.*
4. *Bruchus dormescens.*
5. *Systena florissantensis.*

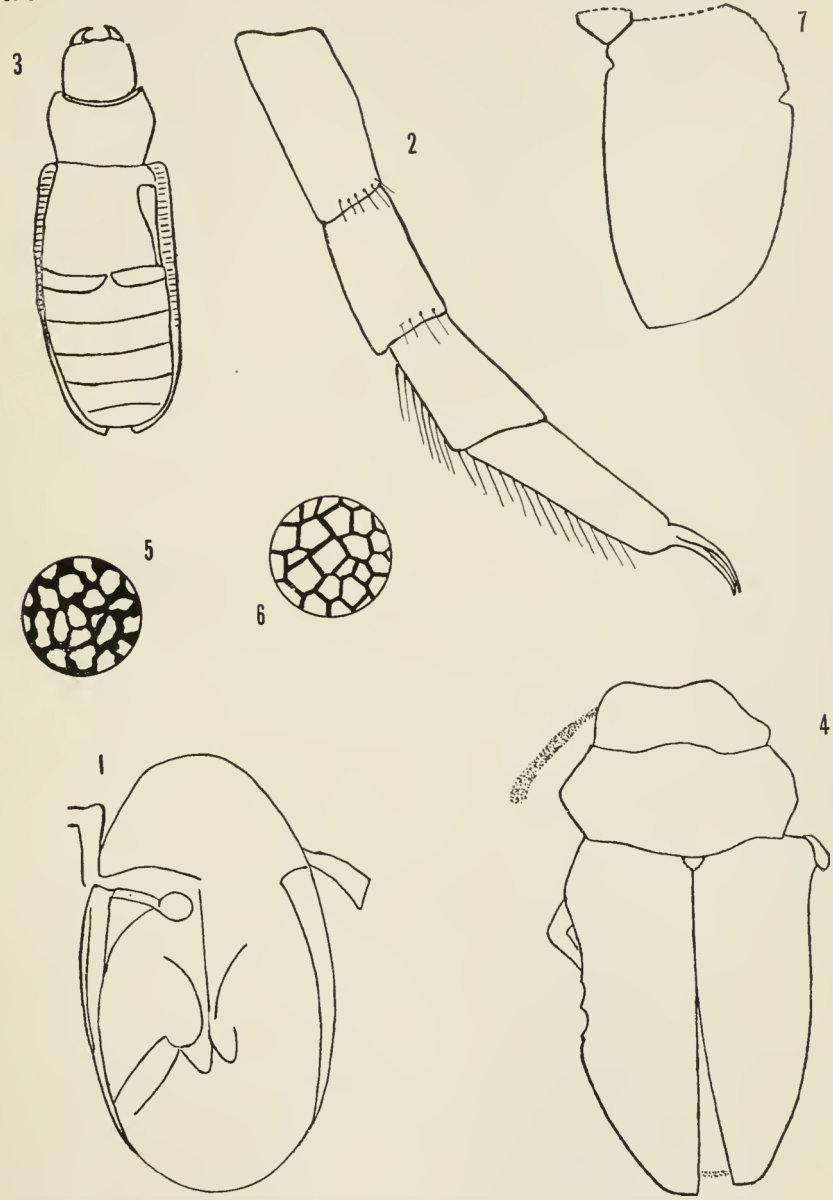
PLATE 26.

Fig. 1. *Miostenosis lacordairei.*
2. *Platydema bethunei.*
3. *Platydema bethunei*, antenna.
4. *Platydema bethunei*, elytral stria.
5. *Platydema bethunei*, prothoracic punctuation.
6. *Blapstinus linellii.*
7. *Blapstinus linellii*, antenna.
8. *Blapstinus linellii*, unbroken antennal tip.
9. *Blapstinus linellii*, vestiture.



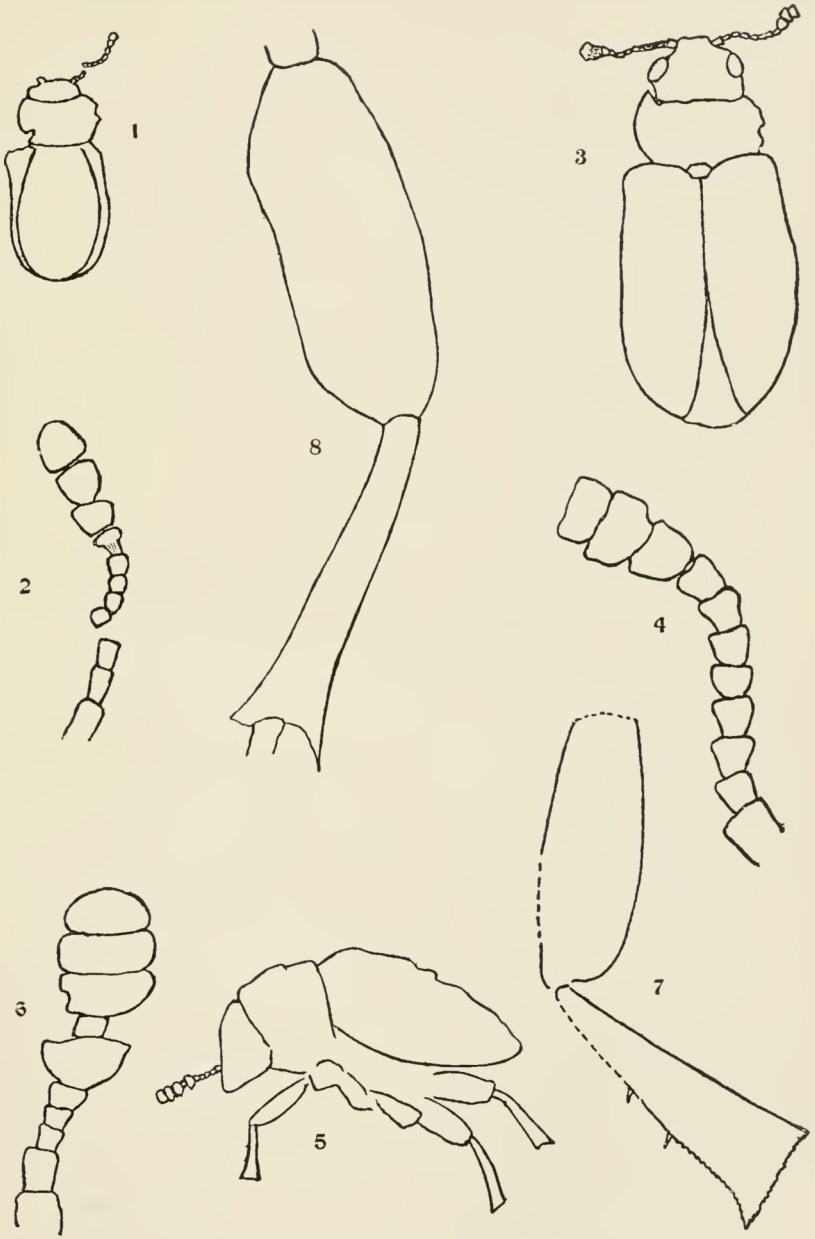
FOSSIL COLEOPTERA FROM FLORISSANT.

FOR EXPLANATION OF PLATE SEE PAGE 303.



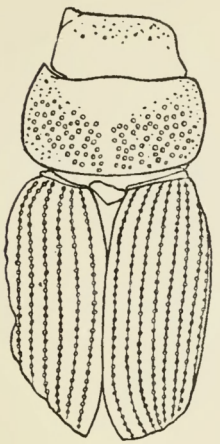
FOSSIL COLEOPTERA FROM FLORISSANT.

FOR EXPLANATION OF PLATE SEE PAGE 303.

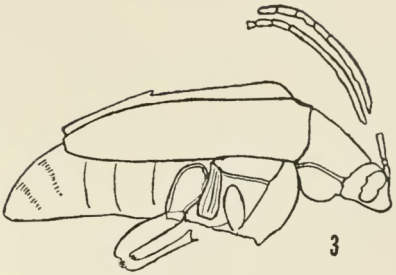


FOSSIL COLEOPTERA FROM FLORISSANT.

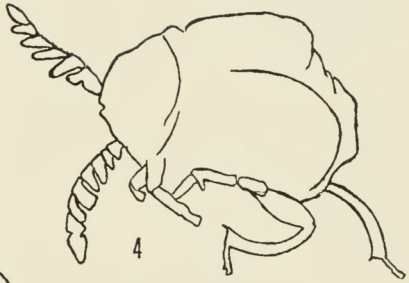
FOR EXPLANATION OF PLATE SEE PAGE 303.



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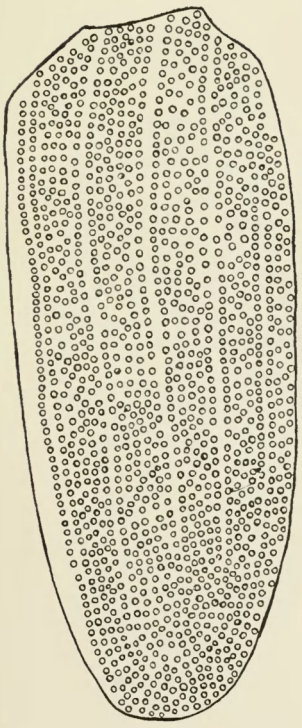


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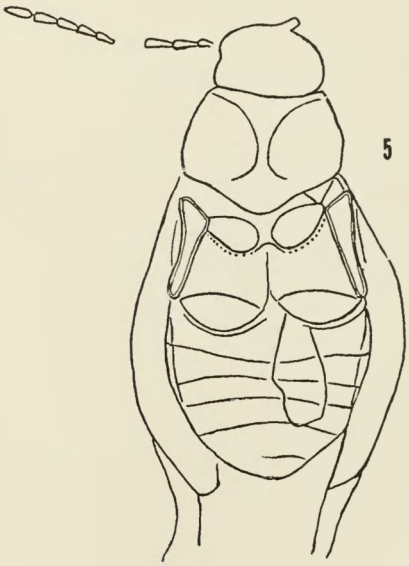


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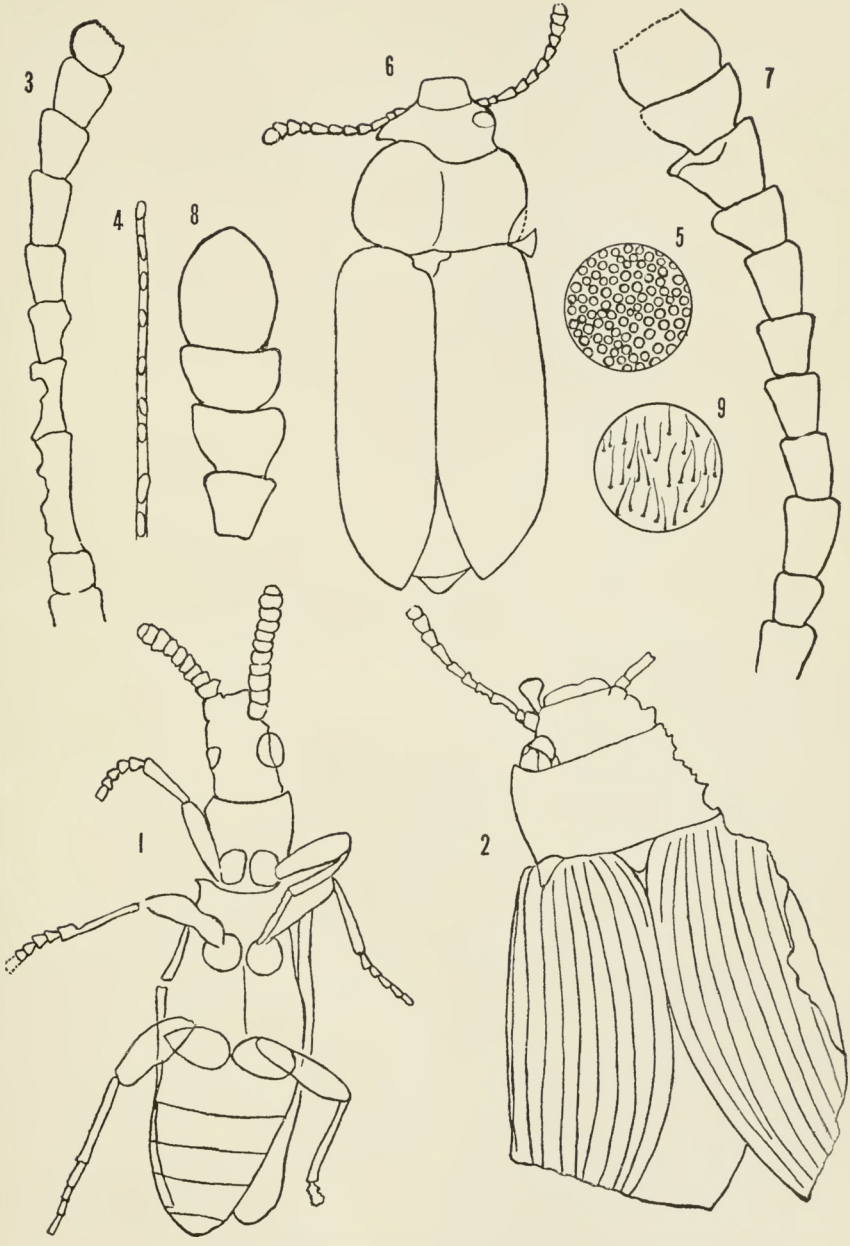
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FOSSIL COLEOPTERA FROM FLORISSANT.

FOR EXPLANATION OF PLATE SEE PAGE 303.



FOSSIL COLEOPTERA FROM FLORISSANT.

FOR EXPLANATION OF PLATE SEE PAGE 303.

[SCIENTIFIC RESULTS OF THE PHILIPPINE CRUISE OF THE FISHERIES STEAMER "ALBATROSS," 1907–1910.—No. 27.]

THE PHILIPPINE MOLLUSKS OF THE GENUS DIMYA.

By Paul Bartsch,

Assistant Curator, Division of Mollusks, United States National Museum.

During the cruise of the United States Fisheries steamer *Albatross* in the Philippines a number of mollusks belonging to the genus *Dimya* were obtained at several of the deep-sea stations which are here described.

Most of the known members of this genus are fossils, only two having been described as now existing species. These are *Dimya argentea* Dall[1] from the West Indies and *Dimya corrugata* Hedley[2] dredged off New South Wales.

To these two additional species are now added.

DIMYA FILIPINA, new species.

Plate 28, figs. 1–4.

Shell heavy, inequivalve, of variable outline, depending upon the nature of the support to which the basal valve is attached. Outside of upper valve brown, marked by strong closely spaced overlapping concentric laminations which are free at their edges. These laminations are present on the prodissoconch and increase steadily in size from this to the edge of the adult shell. Radiating sculpture entirely wanting. In the lower valve which is much stronger than the upper, the laminations assume the form of moderately strong corrugations. In this the external surface is marked with radiating zones of chestnut brown which are about one-third as wide as the light area that separates them. The interior of the shell is pale buff; the material of this color forms a thin layer in the dorsal valve which readily flakes away, exposing a chestnut colored basal layer. Resilium resting in a strongly excavated pit in the dorsal valve, bending under a little shelf

[1] Bull. Mus. Comp. Zoöl., vol. 12, 1886, p.228. [2] Mem. Austr. Mus. Sydney, vol. 4, 1902, pp. 308–309.

in the ventral valve. On each side of the resilium, bending outward and downward, is the provincular area, which in the ventral valve is lightly raised and transversely feebly notched; in the dorsal it is impressed, bearing slender cross bars. Muscular scars very large. Edge of shell outside of pallial line roughened on the dorsal third.

The type and about 68 loose valves, mostly upper, Cat. No. 246281. U.S.N.M., were dredged at station 5217, in 105 fathoms, off Anima Sola Island (lat. 13° 20′ N.; long. 123° 14′ 15″ E.), on coarse gray sand bottom; bottom temperature, 63.1°; density at bottom, 1.02496. The measurements of the type are as follows: Lower valve, altitude 11 mm., latitude 12 mm.; diameter at ventral edge 5 mm.; dorsal valve, altitude 9 mm., latitude 10 mm., thickness probably 1 mm.

DIMYA LIMA, new species.

Plate 27; Plate 28, figs. 5 and 6.

Shell large but much thinner than *Dimya filipina*, white with a silvery nacreous suffusion. In adult shells the edge beyond the pallial ridge curves up and lends the shell a dished appearance. Lower valve very thin at the point of attachment, where it is quite translucent; the rest of its exterior, excepting the extreme edge, which is hyaline, is milk white and polished, showing fine, irregular lines of growth. The exterior of the upper valve is almost smooth during the early stages, but sculptured with roughened irregular flake-like squamations (not strong laminations as in *filipina*), and a few well incised, irregularly spaced, radiating lines on the latter two thirds. Interior bluish white, the edge outside of the pallial line nacreous. Resilium resting in a small pit, which is partly roofed over by a thin shelf, dorsally, in both valves. Radiating outward and downward on each side of the resiliar pit is the provincular area, which appears in both valves as a transversely roughened ridge, fusing ventrally with the considerably thickened pallial border. The latter is crossed by strongly impressed radiating grooves in the upper valve, that correspond to an equal number of raised threads in the lower valve.

The type and many other specimens were dredged at station 5533, off Balicasag Island (lat. 9° 27′ 15″ N.; long. 123° 31′ 48″ E.), in 432 fathoms, on green mud and sand bottom; bottom temperature 53°.3. All of these were attached to shells of *Lima* (*Callolima*) *smithi* Bartsch. The type, Cat. No. 256977, U.S.N.M., measures: Altitude 13.5 mm., latitude 15.5 mm.

Additional specimens were obtained at the following stations:

On LIMA (CALLOLIMA) SMITHI Bartsch.

Station 5124, off Point Origon (lat. 12° 52′ 00″ N.; long. 121° 48′ 30″ E.), in 281 fathoms, on soft green mud bottom. Cat. No. 256978, U.S.N.M.

On LIMA (CALLOLIMA) DALLI Bartsch.

Station 5135, off Jolo Light (lat. 6° 11′ 50″ N.; long. 121° 08′ 20″ E.), in 161, fathoms on fine coral sand bottom; bottom temperature 57°.4. Cat. No. 254980, U.S.N.M.

Station 5198, off Baliscasag Island (lat. 9° 31′ 50″ N.; long. 123° 39′ 45″ E.), in 220 fathoms, on green mud bottom; bottom temperature 53°.9; density of water at bottom 1.02500. Cat. No. 256975, U.S.N.M.

Station 5371, off outer Tayabas Light (lat. 13° 49′ 40″ N.; long. 121° 40′ 15″ E.). Sounding not made; depth taken from chart which says 83 fathoms. (This is probably incorrect, for all the other Giant Limas were taken at much greater depth.) Bottom, green mud. Cat. No. 254978, U.S.N.M.

Station 5503, off Macubalan Point Light, Mindanao (lat. 8° 36′ 26″ N.; long. 124° 36′ 08″ E.), in 226 fathoms, on green mud bottom; bottom temperature 53° .3. Cat. No. 254976, U.S.N.M.

Station 5516, off Point Tagolo Light, Mindanao (lat. 8° 46′ 00″ N.; long. 123° 32′ 30″ E.), in 175 fathoms, on globigerina bottom; bottom temperature 54°.3. Cat. No. 254974, U.S.N.M.

Station 5519, off Point Tagolo Light, Mindanao (lat. 8° 47′ 00″ N.; long. 123° 31′ 15″ E.), in 182 fathoms, on globigerina and sand bottom; bottom temperature 54°.3. Cat. No. 254979, U.S.N.M.

On cinders and empty bottom.

Station 5243, off Uvian Island (lat. 6° 50′ 55″ N.; long. 126° 14′ 35″ E.), in 281 fathoms, on gray mud bottom; bottom temperature 63°.6; density at bottom, 1.02468. Cat. No. 229321, U.S.N.M.

Station 5282 yielded some loose valves, off Malavatuan Island (lat. 13° 53′ 00″ N.; long. 120° 26′ 45″ E.), in 248 fathoms, on dark gray sand; bottom temperature 47°.4; density at bottom, 1.02517. Cat. No. 230109, U.S.N.M.

EXPLANATION OF PLATES.

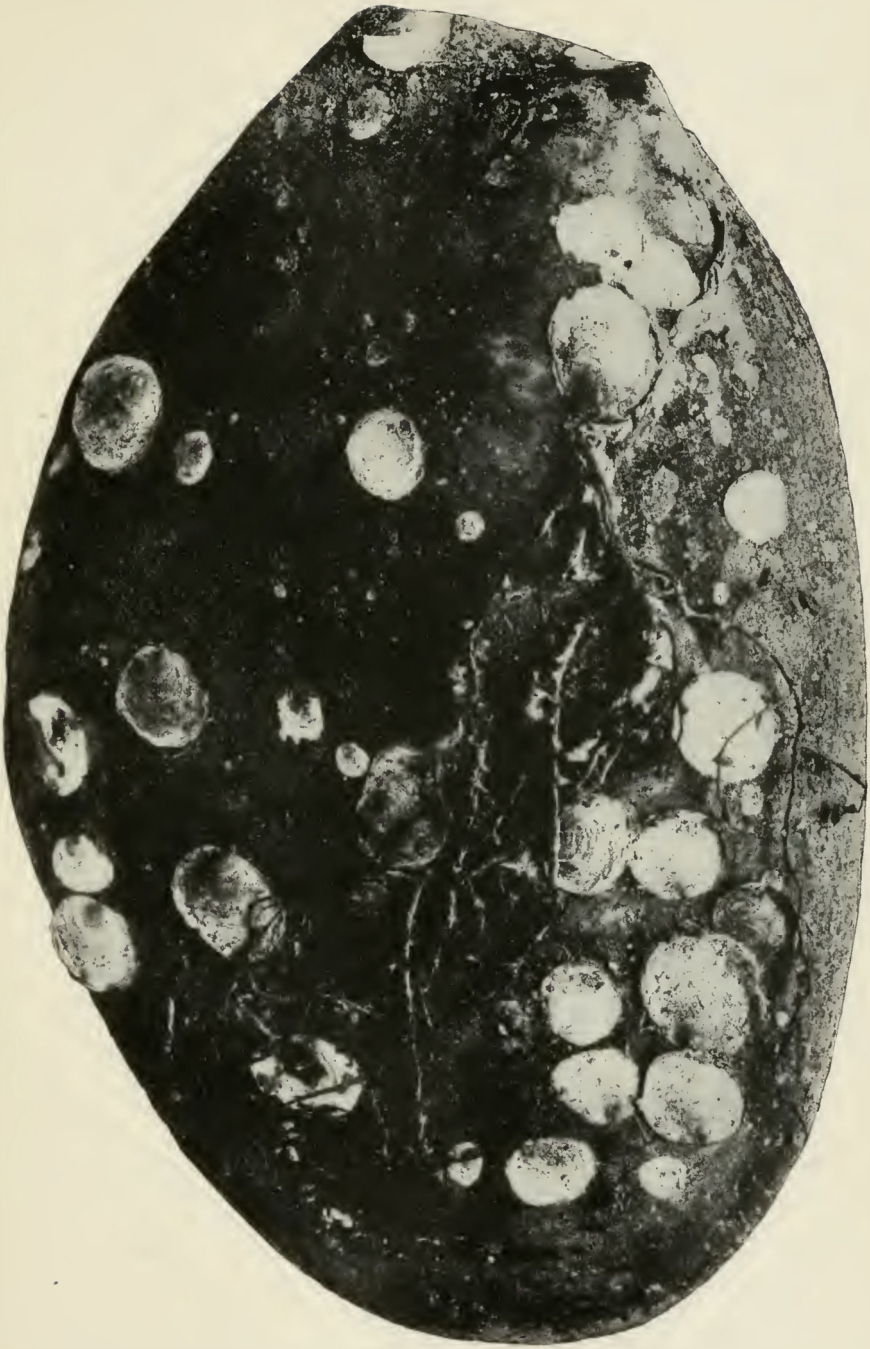
PLATE 27.

Dimya lima Bartsch on *Lima (Callolima) smithi* Bartsch. The specimen with the arrow is the type.

PLATE 28.

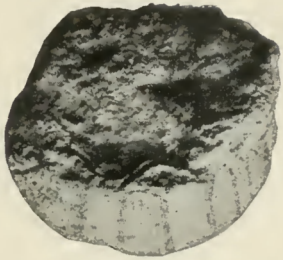
All figures enlarged three diameters.

Fig. 1. *Dimya filipina*, external view of lower valve.
2. *Dimya filipina*, external view of upper valve.
3. *Dimya filipina*, internal view of upper valve.
4. *Dimya filipina*, internal view of lower valve.
5. *Dimya lima*, internal view of upper valve.
6. *Dimya lima*, internal view of lower valve.

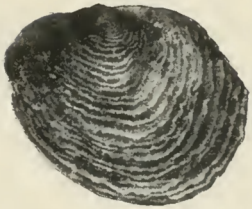


DIMYA LIMA ON LIMA SMITHI.

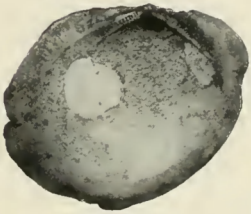
FOR EXPLANATION OF PLATE SEE PAGE 307.



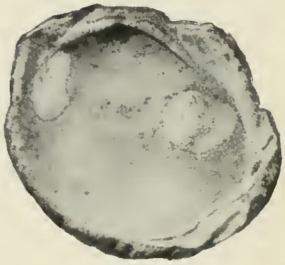
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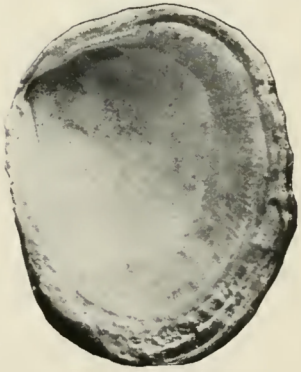
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6

NEW DIMYAS FROM THE PHILIPPINES

FOR EXPLANATION OF PLATE SEE PAGE 307.

DESCRIPTIONS OF NEW HYMENOPTERA, NO. 7.

By J. C. Crawford,
Associate Curator, Division of Insects, United States National Museum.

Most of the species described in this paper are of economic importance, and for reference in economic literature their early description is desirable. The series from the species of *Agromyza* is noteworthy in view of the number of species previously described as parasites of the species of that genus. In this paper, in all cases where both sexes of a species are described, that last described is the allotype.

Superfamily VESPOIDEA.

POLISTES RUBIGINOSUS Lepelletier

Polistes perplexus Cresson.
Polistes generosus Cresson.

A large nest of this species containing many males was collected at Rosser, Texas, September 25, 1905, by Messrs. F. C. Bishoff and C. R. Jones. In addition to many normally colored males there were also several of each of the color variations described by Mr. Cresson under the two names listed above as synonyms. This nest made it possible to establish the synonomy and confirm the suspicion voiced by Mr. Cresson in his original descriptions of the two color variations of the male.

Superfamily CYNIPOIDEA.

AGLAOTOMA TEXANA, new species.

Female.—Length 1.5 mm. Black, shiny, almost impunctate except for a few scattered setigerous punctures; face elongate, produced below the eyes; antennæ testaceous, with the club dark-brown, reaching about the metanotum; scape short, hardly longer than wide and only slightly longer than second joint of antenna; third joint about as long as joints 1 and 2 together; scutellum, except elevation, rugose; the elevation long oval, smooth except a few large punctures along edge and a large fovea at apex; propodeum rugose; wings hyaline, veins light colored; legs, including coxæ, reddish testaceous; abdomen black, smooth, and shiny; the extreme base reddish.

Male.—Length 1.5 mm. Similar to the female except in secondary sexual characters, the antennæ being much longer than the insect itself, measuring over 2 mm.; the third joint of antennæ much longer than joints 1 and 2 combined, and about equal in length to joints 4 and 5 combined; joints 4–15 almost subequal in length.

Type-locality.—Dallas, Texas.

Described from three females and three males collected by F. C. Pratt, and recorded under Bureau of Entomology note number, Hunter Nos. 1611–27 and 1611–6.

Type.—Cat. No. 15543, U.S.N.M.

EUCOILA HUNTERI, new species.

Female.—Length about 1 mm. Dark brown, smooth and polished, with the femora lighter brown and the tibiæ and tarsi reddish-testaceous; antennæ brown, the scape and pedicel thickened, the scape very short, hardly longer than the pedicel and this only slightly longer than broad; third and fourth joints of antennæ slender, the third about as long as the second; joints 5 to 13 thickened, somewhat longer than broad and forming the club; elevation of scutellum concave, as broad as long and more triangular than ovoid in shape, with a row of pits just inside margin and a large fovea near the center; the upper part of the scutellum supporting the disk, smooth, the lower part rugose.

Male.—Unknown.

Type-locality.—Dallas, Texas.

Two specimens recorded under Bureau of Entomology note number, Hunter No. 2988, and with the additional note that it was bred from puparium of a miner on cotton leaves, 5.19.12; A. Rutherford, collector.

Type.—Cat. No. 15544, U.S.N.M.

This species runs in the table by Dalla Torre and Kieffer [1] to the genus *Eucoila*, sens str. It differs from *E. ruficornis* Ashmead and *E. alaskensis* Ashmead by the short third and fourth joints of the antennæ, by having the fovea on the scutellum discal instead of apical, as well as the broad subtriangular disk of scutellum.

This species is named in honor of W. D. Hunter, who is in charge of the branch of investigations from which this material was received.

PSILOSEMA PRATTI, new species.

Female.—Length about 1.25 mm.; black, shiny, impunctate, with sparse hairs; head produced behind the eyes, almost quadrate; antennæ dark brown; propodeum finely rugose, with two parallel median longitudinal carinæ; wings hyaline, the marginal fringes

[1] Das Tierreich, Lief. 24, Cynipidæ, 1910.

very long; wing veins light honey color; legs dark brown; abdomen smooth, shiny, rugose at extreme base.

Male.—Length 1.25 mm. Similar to the female except in sexual characters.

Type-locality.—Dallas, Texas.

Described from 8 specimens reared from manure by F. C. Pratt, after whom the species is named.

Type.—Cat. No. 15545, U.S.N.M.

Superfamily CHALCIDOIDEA.

Family CHALCIDIDÆ.

HONTALIA MAGNIFICA, new species.

Female.—Length about 7.5 mm.; ovipositor about 4.5 mm. Head above blue, face and cheeks greenish; thorax green with some coppery and bluish reflections, the scutellum with bluish in the bottoms of the punctures; abdomen æneous with greenish reflections; viewed laterally the lower spine of the head as long as the upper and along the dorsal surface the elevation crenulate; from above the outer and inner edges of the projection are strongly reflexed so that the flattened portion appears sunken; head and thorax with very large well-separated punctures, those on the mesoscutum about a puncture width apart; extreme base of mesoscutum smooth; punctures on scutellum larger and closer; propodeum at each side with a blunt spine at about the middle; propodeum with a median and lateral longitudinal carinæ which extend to the apex of the neck of the propodeum, the latter being at the sides of the neck; between the median and each lateral carina another carina extending from the base of the propodeum about half its length, making the propodeum 5-carinate; wings yellowish; fore and mid legs rufous, their coxæ green, hind legs green, their tarsi reddish; venter spined in front of each hind coxæ; hind coxæ longer than hind femora; petiole, seen from above, having the lateral margins carinate, and between these three carinæ making it from above 5-carinate; ventral spine of petiole about half its length; first abdominal segment about half of the length of abdomen; rest of segments except apical margins very finely punctured; sheaths of ovipositor longer than abdomen.

Type-locality.—Cabima, Panama.

One specimen collected May 27, 1911, by August Busck.

Type.—Cat. No. 15546, U.S.N.M.

This species differs from *H. cærulea* Cameron in color and in the number of carinæ on the propodeum and petiole and in having the ovipositor longer than the abdomen; *H. cameroni* Ashmead is figured as having three carinæ on the propodeum and four on the petiole.

PARENIACA, new genus.

Belongs to the tribe Dirhinini and has the habitus of *Eniaca*, from which it differs by having a pair of small subtriangular teeth below the large cornutions of the head (see fig. 1); funicle with eight joints, the first shorter than the pedicel, often subquadrate and therefore more or less ring like.

Type.—*Pareniaca schwarzi* Crawford.

This genus differs from *Dirhinus* in having the head 4-cornuted and in the pedicel being longer than the first segment of the funicle; it differs from *Hontalia* in habitus, in the nonmetallic color, in having the ovipositor not exserted, in the absence of an elongate spine ventrally on the first abdominal segment (petiole), etc.

PARENIACA SCHWARZI, new species.

Female.—Length about 4.5 mm. Black, with a slight aeneous tinge, head and thorax coarsely rugoso-punctate; antennæ, fore and mid legs, except coxæ, rufous; pedicel longer than second joint of funicle; first joint of funicle distinctly longer than broad, shorter than the second joint, about as long as the third joint of funicle; fourth joint longer than broad, fifth and following subquadrate; wings yellowish; tegulæ reddish; hind femora on lower edge near base inwardly with a tubercle; sternum in front of hind coxæ with two triangular projections; first segment of abdomen (petiole) transverse, with four dorsal carinæ between the lateral carinate (viewed from above) edges; second segment with eight or nine carinæ which are about three times as long as the first segment, reaching almost to the middle of the segment, this and following segments finely punctured at apex.

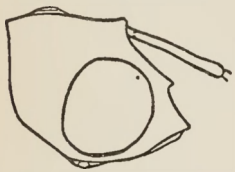


FIG. 1.—PARENIACA SCHWARZI. SIDE VIEW OF HEAD OF FEMALE.

Type-locality.—Santa Rita Mountains, Arizona.

One female collected by E. A. Schwarz, after whom the species is named.

Type.—Cat. No. 15547, U.S.N.M.

(HONTALIA) PARENIACA RUFICORNIS (Cameron).

In this species the first abdominal segment (petiole) is slightly longer than broad and has four dorsal carinæ; the second segment has about six or seven carinæ which do not extend half the length of the segment. The species is readily distinguished by the infuscate fore wings with subhyaline spots on the apex and on the front and posterior margins. In the United States National Museum there is a male from Cacao, Trece Aguas, Alta Vera Paz, Guatemala (Schwarz and Barber, collectors).

PARENIACA BUSCKI, new species.

Male.—Length about 2.25 mm. Black, the antennæ except the light reddish scape, dark reddish-brown; the fore and mid femora brown, their tibiæ lighter, hind legs black; head and thorax rugosopunctate; first joint of funicle hardly as long as broad; second joint about as long as pedicel; wings yellowish, more so on the disk, so that the apical margin from the marginal vein outward and around on rear of wing to a point about opposite apex of marginal vein appears lighter; first abdominal segment longer than broad, with three dorsal carinæ, second segment with about three or four carinæ no longer than first segment and not more than one-fourth as long as second segment; second segment smooth apically.

Type-locality.—Cabima, Panama.

One specimen collected by August Busck, after whom it is named, May 27, 1911.

Type.—Cat. No. 15548, U.S.N.M.

(HONTALIA) PARENIACA KIRBYI (Ashmead).

The specimen deposited in the United States National Museum is a female instead of a male. It has the first abdominal segment slightly longer than broad, with three dorsal carinæ, the second segment with about eight carinæ which are about as long as first segment and about one-fourth as long as the second segment; the first joint of the funicle is shorter than the second and this is shorter than the pedicel.

Family PTEROMALIDÆ.

POLYCYSTUS FOERSTERI, new species.

Female.—Length about 2 mm. Head and thorax somewhat brassy green, the abdomen blue-green; head and thorax with somewhat irregular thimble-like punctures, those on the head finer, those on middle lobe of mesoscutum the coarsest; scape and pedicel greenish, rest of antennæ brown, with a slight greenish tinge; joints of funicle almost subequal in length and almost subquadrate; first joint of funicle shorter than pedicel; propodeum smooth, with strong median and lateral carinæ, and basad about midway between median and each lateral carina a fovea; wings hyaline; postmarginal vein shorter than marginal but distinctly longer than stigmal; legs, except the green coxæ, honey color; petiole about as long as hind coxæ; abdomen short, smooth, the basal segment at apex medially incised.

Male.—Length about 1.5 mm. Similar to the female but the head more blue, the face bluish-purple; antennæ, except club, flavous; enlarged apical joint of palpi yellowish; legs, except coxæ, light yellow in color.

Type-locality.—Lafayette, Indiana.

Described from a series of 18 specimens reared from *Agromyza angulata* by P. Luginbill, and recorded under Bureau of Entomology, United States Department of Agriculture, note number, Webster No. 9700.

Type.—Cat. No. 15549, U.S.N.M.

This species is named in honor of Arnold Foerster, whose work is the foundation of the modern classification of the Chalcidoidea.

CERCOCEPHALA ATROVIOLACEA, new species.

Female.—Length about 3 mm. Black, smooth and polished, the head with a purple luster, the thorax above with bluish and greenish luster, the abdomen with a purple luster; head oblong, the mandibles enlarged, reddish, 4-toothed at apex; ridge between antennæ broad, flattened, projecting, anteriorly truncate at a right angle, the extremity rounded; funicle 6-jointed, the first joint subquadrate, the pedicel about as long as joints one and two combined; antennal fossæ carinate exteriorly, just outside these fossæ a vertical slightly depressed area, about the width of the fossa, and finely vertically striate; propodeum basally finely transversely striate; elsewhere smooth; wings hyaline with a brown band at stigmal vein which does not extend apicad of the stigmal vein but extends basad of the base of the stigmal vein for somewhat more than the length of the stigmal; stigmated spot on submarginal vein without a tuft of hairs; legs concolorous with the body, the anterior tibiæ and all tarsi reddish testaceous.

Male.—Unknown.

Type-locality.—Las Vegas Hot Springs, New Mexico.

Described from seven specimens reared from Piñon cones infested by an undescribed genus of Scolytidæ, and recorded under Bureau of Entomology, Department of Agriculture, note number 9487.

Type.—Cat. No. 15550, U.S.N.M.

The large size, entirely dark color, the flattening of the dorsal aspect of the ridge between antennæ and the rounding off of its anterior angle distinguish this species.

Family EULOPHIDÆ.

DEROSTENUS AGROMYZÆ, new species.

Female.—Length about 0.87 mm. Similar in color and sculpture to *D. punctiventris*, but the wings without any stigmal cloud and none of the tibiæ annulate; all femora, except apices, aeneous.

Male.—Length about 0.70 mm. Similar to the female, except in secondary sexual characters; the scape somewhat flattened and dilated in front, the dilated portion thin.

Type-locality.—Lafayette, Indiana.

Host.—Agromyza angulata.

Described from a series of 17 specimens reared by P. Luginbill and recorded under Bureau of Entomology, United States Department of Agriculture, note number, Webster No. 9700.

Type.—Cat. No. 15551, U.S.N.M.

DEROSTENUS ARIZONENSIS, new species.

Female.—Length about 1.12 mm. Similar in color and sculpture to *D. punctiventris,* but the wings without a stigmal cloud, the hind tibiæ with a small spot near base, or this a complete annulus but no broader than the yellow basad of it; front tibiæ with a narrow black stripe beneath; mid tibiæ with a mark similar to that on posterior tibiæ or both the front and mid tibiæ almost immaculate.

Male.—Length about 0.7 mm. Similar to the female, except in secondary sexual characters, but the spot on the hind tibiæ very small.

Type-locality.—Tempe, Arizona (type female); Chandler, Arizona (allotype male). Paratypes from both localities.

The 14 specimens were reared from *Agromyza* in alfalfa and are recorded under Bureau of Entomology, United States Department of Agriculture, note numbers, Webster No. 7215 (type female) and 8771 (allotype male). The paratypes from Tempe bear the number 7215 and the one from Chandler the number 8771.

Type.—Cat. No. 15552, U.S.N.M.

The spot on the hind tibiæ is as variable in the male as it is in the female.

This species comes near (*Entedon*) *Derostenus diastatae* Howard and *D. agromyzæ* Crawford, but the former has a wide annulus on the hind tibiæ and the abdomen weakly sculptured, and the latter has the tibiæ immaculate.

DEROSTENUS VARIIPES, new species.

Female.—Length about 0.75 mm. Similar in color and sculpture to *D. punctiventris,* but the wings without a stigmal cloud, and the front and middle legs, except coxæ, entirely pallid; hind femora, except apices, aeneous, the hind tibiæ not annulate.

Male.—Unknown.

Type-locality.—Lafayette, Indiana.

Host.—Agromyza pusilla.

Described from one specimen reared by P. Luginbill and recorded under Bureau of Entomology, United States Department of Agriculture, note number, Webster No. 6395.

Type.—Cat. No. 15553, U.S.N.M.

The immaculate front and middle legs distinguish this species.

ENTEDON THOMSONI, new species.

Female.—Length about 2 mm. Green, the legs, except coxæ, white; face both above and below V-shaped furrow, without coarse punctures, smooth and shiny, along inner orbits with a few setigerous punctures; scape whitish at base; funicle and club somewhat compressed; joints of funicle elongate, the first the longest; vertex finely lineolately reticulate, at rear sharply carinate; mesonotum irregularly reticulate, the middle lobe coarsely so, the scutellum somewhat more finely so, the lateral lobes much more finely; propodeum with a few weak wrinkles and at base medially a small V-shaped carina with the point caudad; median carina obsolete; wings hyaline; petiole shorter than hind coxæ.

Male.—Length about 1.5 mm. Similar to the female except in secondary sexual characters; scape enlarged and flattened; median carina on propodeum distinct; propodeum more wrinkled than in female, and in part subreticulately wrinkled.

Type-locality.—Lafayette, Indiana.

Described from 13 specimens reared from *Agromyza angulata* by P. Luginbill and recorded under Bureau of Entomology, United States Department of Agriculture, note number, Webster No. 9700.

Type.—Cat. No. 15554, U.S.N.M.

This species is named in honor of the eminent hymenopterist, C. G. Thomson, whose careful work has done so much to aid the student of the Chalcidoidea.

PLEUROTROPIS UTAHENSIS, new species.

Female.—Length about 2.5 mm. Green, with brassy tints, more apparent on head, the abdomen, except basally, bronzy; head both above and below V-shaped furrow with thimble-like punctures; funicle 2-jointed; first joint of funicle longer than pedicel, the second shorter than pedicel; mesoscutum and scutellum rugosely reticulated, the scarlike continuations of the parapsidal furrows smooth; propodeum normal—that is, with two median carinæ which posteriorly diverge; lateral carinæ present, posteriorly these join oblique carinæ, which join at the side the carina surrounding the superior half of the short propodeal neck; the median carinæ join these oblique carinæ slightly posterior of a point midway between the lateral carinæ and the point where the oblique carinæ join the apical carina; propodeum, except for carinæ, smooth, polished; wings hyaline; legs, except tarsi, greenish; abdomen, except basal segment, finely reticulated.

Male.—Length about 2 mm. Similar to the female; funicle 3-jointed.

Type-locality.—Salt Lake City, Utah.

Holotype female reared from *Agromyza parvicornis* in corn leaves, and recorded under Bureau of Entomology, United States Department of Agriculture, note number, Webster No. 8819; allotopotype male and four males and one female paratopotypes from *Cephus* sp.; also 2 females and one male paratypes from Kimball, Utah, reared from *Cephus* sp. (Webster No. 6681); all specimens collected by C. N. Ainslie.

Type.—Cat. No. 15555, U.S.N.M.

CIRROSPILUS FLAVOVIRIDIS, new species.

Female.—Length about 1 mm. Brilliant green, with yellow markings; face mostly yellow, below each eye a purple spot extending on to back of head; antennæ yellow, the apical half of scape, the pedicel and the club brownish; dorsal aspect of pronotum, except a median green spot, lateral margins of middle lobe of mesoscutum, outer margin of each lateral lobe of mesoscutum, axillæ, except a green spot on disk, scutellum along parallel furrows on disk, and posterior margin of scutellum, lateral margins of metanotum, tegulæ, legs except coxæ and a stripe on front and mid femora and basal half of hind femora, which are brown, all yellow; the yellow markings on the meso- and metanotum form two yellow stripes; mesonotum, metanotum, and propodeum, except medially where it is smooth, with close, almost thimble-like punctures; wings hyaline, veins pallid; abdomen dark brown, the lateral margins yellowish.

Male.—Length about 0.8 mm. Similar to the female but with more yellow on the head and abdomen, the dark on the abdomen being confined to a large discal spot, and the ventral surface with more yellow; legs entirely yellow.

Habitat.—Salt Lake City, Utah.

Six specimens reared from *Agromyza* by C. N. Ainslie and recorded under Bureau of Entomology, United States Department of Agriculture, note numbers, Webster No. 8819 (the type), in corn leaves, probably *A. parvicornis*, and 6639 (the allotype and all paratypes), the latter from *A. pusilla* on cowpeas.

Type.—Cat. No. 15556, U.S.N.M.

The face is collapsed, and markings, if there are any others, can not be seen.

NEW SPECIES OF SILURIAN FOSSILS FROM THE EDMUNDS AND PEMBROKE FORMATIONS OF WASHINGTON COUNTY, MAINE.

By Henry Shaler Williams,
Of Cornell University, Ithaca, New York.

INTRODUCTION.

In preparing the Eastport folio of the United States Geological Survey for publication the more characteristic fossils of the Silurian formations there mapped were selected for illustration. Among them the following were new, and as the folio is an inconvenient place for publishing descriptions of new species, the following paper will describe and illustrate a few of the more common and characteristic new species found in the Edmunds and Pembroke formations of Washington County, Maine. The type-specimens of all of these new species are in the collections of the United States National Museum, and the catalogue numbers under which they are registered are indicated in the following descriptions. For greater precision the Geological Survey locality numbers and my own numbers given to individual specimens are also noted wherever necessary.

The species from the Edmunds formation are:

Whitfieldella edmundsi.
Chonetes edmundsi.
Chonetes cobscooki.
Brachyprion shaleri.
Palaeopecten cobscooki.
Palaeopecten transversalis.
Tolmaia compestris.
Pterinea (? Tolmaia) trescotti.

The Pembroke species are:

Chonetes bastini.
Camarotoechia leightoni.
Actinopteria bella.
Actinopteria fornicata.
Actinopteria dispar.
Lingula scobina.
Grammysia pembrokensis.
Lingula minima var. *americana.*
Modiolopsis leightoni.
Modiolopsis leightoni var. *quadrata.*
Nuculites corrugata.
Leiopteria rubra.

On plate 30, illustrating the Pembroke fauna, are also included figures of *Dalmanella lunata* (Sowerby), and on plate 31, *Eurymyella shaleri* var. *minor,* Williams, the type of which was described from the Eastport formation,[1] (formation No. V), and figures of *Platy-*

[1] Proc. U. S. Nat. Mus., vol. 42, p. 387, pl. 49, fig. 9.

chisma helicites (Sowerby) and *Grammysia triangulata* (Salter), species found typically in the Ludlow formation of Great Britain.

In a paper entitled "Correlation of the Paleozoic Faunas of the Eastport Quadrangle, Maine,"[1] I described briefly the subdivision of the rocks of the Eastport quadrangle into six formations, speaking of them as formations I, II, III, etc., and mentioned some of their characteristic fossils. In the course of preparing the Eastport folio, the following names have been adopted for these several divisions, viz:

Formation No. I = Quoddy shale.
Formation No. II = Dennys formation.
Formation No. III = Edmunds formation.
Formation No. IV = Pembroke formation.
Formation No. V = Eastport formation.
Formation No. VI = Perry formation.

As indicated in the paper above referred to, the formations I to V, inclusive, are of Silurian age, and formation VI is Devonian.

FOSSILS OF THE EDMUNDS FORMATION.

BRACHIOPODA.

Genus WHITFIELDELLA Hall and Clarke.

WHITFIELDELLA EDMUNDSI, new species.

Plate 29, figs. 1, 2, 3, 4.

Cf. 1839. *Atrypa didyma* SOWERBY, Sil. Syst., p. 614, pl. 6, fig. 4.

Description.—Shell small; valves about equally convex, subpentagonal, about as wide as long; beak, small; front with a furrow in each valve reaching nearly to the beak; furrow on pedicle valve slightly longer and wider than that on the brachial valve. Brachidium of two cones opposed as in *Merista*, each cone composed of 8 or 9 coils. The connecting loop unknown. No medium septum in the brachial valve. Dimensions of figured specimen 13.2 mm. wide by 11.9 mm. from beak to front; another specimen 12.7 mm. by 11.6 mm.

Formation and locality.—Edmunds formation, Burnt Cove, east shore, south of Cunningham Mountain, Edmunds Township, Washington County, Maine, loc. No. 5.5 1.5 B.

Cotypes.—Cat. No. 58944 U.S.N.M.

Comments.—This small species resembles very closely in exterior form and size the species figured and described by Sowerby under the name *Atrypa didyma* (*Terebratula didyma* Dalman).

Sowerby's description is:

> Nearly globose; beaks small; front emarginate, with a furrow in each valve reaching nearly to the beaks. Length, five lines; width the same.

[1] Bull. Geol. Soc. America, vol. 23, pp. 349, 356.

Our species is, however, less globose and smaller than Sowerby's figure of *Atrypa didyma*. The surface is smooth except for concentric growth lines on the outer half of the shell. The interior of the pedicle valve (see fig. 4) shows the disposition of the dental plates and muscular scars as represented by Davidson's[1] figure of the enlarged interior of a pedicle valve of "*Meristella didyma*" which resembles *Hyattella* and *Meristina* more than *Whitfieldella* Hall. The scar on the brachial valve is linear and there is a hinge plate; whether cleft or not is not evident, but there is no medium septum. The spiral ribbons are arranged in two cones opposed as in *Merista* and *Hyattella*. There appear to be at least 8, perhaps 9, coils each side. None of the specimens show with distinctness the jugum and central lamellæ, but the parts preserved are well represented by the figures given by Davidson of the spirals of "*Meristina didyma*."[2]

From these observations it is evident that our species represents the form originally described by Sowerby under the name *Atrypa didyma* Dalman.

From the fact that it does not have the prominent beak of the Gotland specimens,[3] a form which was included under the same name by Davidson[4] it does not seem clear that the British form figured by Sowerby is specifically the same with *Terbratula? didyma* Dalman. It is also uncertain what may be the interior characters of Sowerby's original specimens. Under these circumstances a new specific name is appropriate, although there are not in evidence characters by which the Maine species may be specifically distinguished from the form described and figured by Sowerby. The specific name *Whitfieldella edmundsi* is therefore proposed for this species.

Generically it is difficult to assign the species strictly to any one of the genera in use. The absence of a medium septum from the brachial valve technically excludes it from *Whitfieldella* which was erected with the species *Atrypa nitida* Hall as type. *Meristina* Hall and *Whitfieldia* Davidson also are defined as having a median septum in the brachial valve. *Hyattella* Hall, closely related to *Whitfieldella* Hall, has no median septum. In this dilemma and until fuller knowledge of the characters are ascertained I will provisionally refer the species to Hall's genus *Whitfieldella*, recognizing Davidson's reference of Sowerby' species to *Meristina* and using the term *Whitfieldella* in the larger sense as the name "proposed as a substitute for the term *Meristina* in its current application to species not congeneric with *M. maria*."[5]

[1] Sil. Brach., pl. 12, fig. 9.
[2] Brit. Pal. Brach., suppl., pl. 4, figs. 23 and 23a.
[3] Hall and Clarke Pal. New York, vol. 8, pt. 2, pl. 11, figs. 14, 15.
[4] Brit. Sil. Brach., pl. 12, figs. 4, 8.
[5] Pal. New York, vol. 8, pt. 2, p. 60.

The *Atrypa didyma* described by Sowerby is smaller than the species as afterwards identified by Davidson. The dimensions given by Sowerby are: length, 5 lines; width the same, whereas Davidson gives the dimensions of the two specimens cited as 11 by 10 and 10 by 10 lines. The dimensions of two specimens of *Whitfieldella edmundsi* are 5½ by 6 and 6 by 5½ lines, or approximately the size of Sowerby's specimens from the Aymestry. Our species approaches in form more nearly that of Davidson's specimen, figures 6 and 7, from the Wenlock than the Aymestry form figured by Sowerby. The species as figured by Hall and Clarke and named *Whitfieldella didyma* Dalman approaches more nearly Davidson's figure 4, also a Wenlock form, but the figure does not show a furrow in the brachial valve. Sowerby describes his species as having a furrow in each valve. Davidson includes in his definition those with furrow in each valve and those with "valves regularly and moderately globose."

In form and size (external) *W. edmundsi* resembles most closely *Atrypa nucleolata* Hall, which is listed by Schuchert as *Whitfieldella*(?) *nucleolata*. In *Whitfieldella*, however, there is a distinct median septum in the brachial valve supporting a concave hinge plate. There may be a simple pointed process terminating the loop as in that genus but the termination is missing in all our specimens. The probability that it is simple is inferred from the cast of a single perforation in center between the inner ribbons of the spiral coil.

Atrypa nucleolata was regarded by Hall as very closely approaching *A. nitida* and distinguishing characters mentioned are its less elongate form, and the more conspicuous furrow in the dorsal valve of the Coralline species, and in the description furrows on both valves are recognized, though not always present. These resemblances are of external characters, and the close relationship existing between *A. nitida* Hall and *A. didyma* Dalman was recognized by both Davidson and Hall and Clarke, the difficulties arising in determining the internal characters. I have no evidence by which to distinguish the internal characters under dispute. One of our specimens exhibits the spiral brachial supports and the loop running interiorly connecting the two inner arms but the exact nature of their termination is not evident. The species therefore comes within the definition of *M. didyma* Dalman in its external and so much of internal character as can be made out. It may be identical with *A. nucleolata* Hall, but if so that name is probably a synonym for *M. didyma* (Dalman). Generically, I am inclined to believe, it should remain in the same genus with *Meristina tumida*. In one specimen I find a broad jugum and accessory plates parallel to the first volution of the brachia, like *Athyris*. The characters require further study.

Genus CHONETES Fischer de Waldheim.

CHONETES EDMUNDSI, new species.

Plate 29, figs. 6, 7, 8, 9.

Description.—The typical characters may be defined as follows, namely: Size, small, rarely wider than 12 mm. and generally less than twice as wide as long; pedicle valves convex, arching up from the cardinal border abruptly at the umbonal region, and flattened at the cardinal angles; body of shell swollen; brachial valve flattened, concave; radii occasionally bifurcating, but over body of shell radii simple to near front; radii on the ears near the cardinal border much finer and fainter than over body; 60 to 90 radii can be counted at the margin, the larger total number due mainly to increase in the number of fine radii on the flattened cardinal angles; spines four on each side of the beak, the outer ones larger than the inner; in an occasional large specimen five spines have been counted.

Formation and locality.—Edmunds formation: Calcareous shales about one-half mile south of Field Point on west shore Cobscook River (loc. No. 8.21.1A); west side of Burnt Cove (loc. No. 5.51.5A); Field Point (loc. No. 8.1.8A); extreme northwest corner of cove, near outlet of Roaring Lake, southern part of Edmunds (loc. No. 7.42.6A), all in Edmunds Township, Washington County, Maine.

Cotypes.—Cat. Nos. 58945, 58946, U.S.N.M.

Comments.—*Chonetes edmundsi* Williams. In the fauna of 5.51.5A is found a *Chonetes* which presents some of the features of *C. striatella,* but is distinctly smaller. Only four specimens have been seen (Nos. M1483.1,2,3 and M1158).

Specimen No. M1158 is the mold of the exterior of a pedicle valve the front edge of which is wanting, so that the length is estimated. Dimensions are 10 by 6 mm. The umbo is not elevated and the convexity of the umbonal region is slight. There appear to be 4 spines each side the middle, which in the specimen appear to be short. The ears are flattened, and on them the radii occasionally bifurcate and are about 40 at the margin.

Specimen No. M1483.1 is the exfoliated mold of, probably, a pedicle valve; the spines on the cardinal margin are indistinct, but faint traces of 3 of the 4 are evident on the left side. The beak is not projecting, and the umbonal region at the margin is little elevated, but the central part of the shell is roundly swollen and the ears flattened. The radii are about 40 at the margin, and they occasionally dichtomise in growth. Dimensions are 11½ by nearly 7 mm.

Specimen No. M1483.2 is a partly exfoliated pedicle valve, without any trace of the spines visible, and the portion of shell present appears to be perforated by some borings and is smooth. This may be the

original state or the surface worn off by attrition. The mold of the interior shows faint radii, apparently more numerous than on the other specimens. Some of the radii bifurcate. They are too indistinct to be counted, but over the central part they are arranged more closely together than on the corresponding surface of the other specimens. The dimensions are 13 by 10 mm. The umbonal portion is low, but the beak is slightly pointed. The body is at first flattened, tapering off gradually to the cardinal angles, but is swollen in the center and arched over toward the front. The specimen is imperfect, but the cardinal angle appears to have been slightly mucronate, and the characters thus suggest its relationship to the form described as *Leptæna lævigata*, or *Chonetes lepisma*, by Sowerby. I refer it provisionally to *Chonetes lepisma*.

Specimen No. M1483.3 is a mold of the exterior of a pedicle valve showing the spines faintly, 4 in number. The umbonal region is depressed and the center part swollen slightly, with a broad shallow furrow down the center. The sides flatten toward the cardinal angles. The radii, which occasionally bifurcate, are quite distinct over the right half of the specimen, 25 of which can be counted from the cardinal angle to the central line, making (if the same on the other half) 50 radii. The dimensions are 12 by 7½ mm.

Chonetes edmundsi H. S. Williams, types. The specimens M1158, 1483.1 and 3 present closely similar characters, and to the types I apply the name *Chonetes edmundsi*. They are longer than typical specimens of *Chonetes cornuta* Hall, and have a greater number of radii. They also resemble *Chonetes tenuistriata* Hall, but have less number of radii. They also closely resemble the forms from the Pentland Hills referred to *Chonetes striatella* by Davidson, of which Davidson says, "*the Scottish specimens being much smaller than those which occur in England and in Sweden*" (p. 21), as is also shown by the figures,[1] of which the dimensions given in the description are, length 2, width 3 lines.

While it is probable that this Pentland species is the same as our *Chonetes edmundsi*, my definition is based upon our specimens, and I assign to it a new specific name, which may include the small forms referred to *Chonetes striatella* by Davidson.

Another series of the same form coming from loc. No. 8.1.8A is numbered M1556.1–4.

Specimen No. M1556.1, a mold of the exterior of a pedicle valve, dimensions 11 by 6 mm., shows well-developed umbones, arching up rapidly from the cardinal margin, with broad convex body and the sides exhibiting only a small flattened area at cardinal angles. The radii, of which there are about 80 at the margin, bifurcate more

[1] Pl. 3, figs. 14, 14*a* and 14*b*.

frequently than in the lot just described. The hinge area is covered so that the spines are not in evidence.

Specimen No. M1556.2 is an external cast of the exterior of a pedicle valve 9 by 5½ mm., showing 4 spines on each side. The beak is inconspicuous, but the body rises abruptly from the hinge margin, forming a convex body with cardinal angles not much flattened, a slight narrow depression along the middle. Radii are over 60 but not 80.

Specimen No. M1556.3 is the mold of exterior of a brachial (?) valve, dimensions 12 by 6½, radii about 60, bifurcating frequently and early, as do all the specimens from this locality.

Specimen No. M1556.4 is a similar shell, but imperfect and a little smaller, showing the same size and form as specimen from 5.51.5A except in having a less flattened area at the cardinal angle, the rise from the cardinal border is more rapid and the radii bifurcate more frequently and earlier, increasing the number of radii at the margin.

Specimens Nos. M1547.1–3 comprise another set from loc. No. 7.42.6A. M1547.1 is a somewhat distorted pedicle valve 11 by 6 mm. The radii are not distinct over the whole surface, but will reach about 80 in number. No evidence of the spines can be seen; the body rises abruptly from hinge area and the cardinal angles are but slightly flattened.

Specimen No. M1547.2, dimensions about 10 by 7mm, somewhat distorted convex and with distinct flattened area at cardinal angle, body convex, about 65 radii.

Specimen No. M1547.3, a specimen of pedicle valve distorted slightly and showing general characters of No. 1547.2.

Specimen No. M1554 is an imperfect pedicle valve, dimension about 10 by 5 mm., radii about 60, one spine base evident; convex, broad body with but slight flattening at ears.

Specimen No. M1516, probably the interior of a brachial valve slightly convex, regularly so in specimen, but as interpreted a concave valve. Radii as near as can be estimated about 55, bifurcating occasionally.

Specimens Nos. M1555.1–5 are from loc. No. 5.33.8A; 1 and 2 are quadrate low, convex forms which appear to be pedicle valves; dimensions No. 1, 9 by 7 mm.; No. 2, 9½ by 6½ mm.; beaks low, narrow, and rising gradually from hinge area, with broad flattened area at angles, and the body only moderately convex; radii often dichotomizing twice before reaching the front and resulting in a full hundred at border, the lateral ones faint and finer than over body. These come very close to Hall's *Chonetes tenuistriata* from the Arisaig. The specimens Nos. 1 and 2 are a little longer proportionately than Hall's figure; 3, another crushed specimen probably had near the

same character when perfect and two others more or less crushed and imperfect show like characters.

In the fauna of locality No. 8.21.1A two types of *Chonetes* appear, the first of which presents the typical character of *Chonetes edmundsi* as seen in the lower faunas, where it is the only representative of the genus *Chonetes*. This series is numbered M1156. 1 to 9.

Specimen No. M1156.1, dimensions 11½ by 7mm., has the umbonal region strong and arching up directly from the hinge area, arching over to the front, making the central portion of the body swollen and the cardinal angles flattened. Four spines are visible on right side, larger at outer end and incurved. The radii occasionally bifurcate, are somewhat finer on ears, and at front are about 80 in number.

Specimen No. M1156.2, dimensions about 13 by 8 mm., is a mold of exterior of pedicle valve and shows 5 spines each side. The 10 or 12 radii at the extreme cardinal corners are very fine, and with the others will make over 90, but the form and the size of radii over the body of shell are not distinguishable more than varietally from the other specimens.

Specimen No. M1156.3 is a smaller specimen, 9 by 6 mm., a pedicle valve. There are about 60 evident radii and those on the ears indistinct; if in same proportion to other shells they would number to 75 or 80. The shell is a mold of the interior. This shows the typical form of *C. edmundsi*, except it is a little longer proportionate to width, possibly due to crushing.

Specimen No. M1156.4, dimensions 9½ to 5½ mm., arched and swollen central part, with the ear portions less flattened, presenting the form of the larger more typical form. This has the radii of same size, only occasionally bifurcated and making, if all could be counted, about 75 to 80 at edge.

Specimen No. M1156.5 is a specimen of the other species which I identify with the forms of *C. novascotica* Hall seen in the Waldron, of which mention will be made later.

Specimen No. M1156.6 is a larger and somewhat distorted form, the edges of which are indistinct and the reference is doubtful. It has the general character of *C. edmundsi* except it is larger; width 14½ by length 9 mm., and the radii will reach over 90.

Specimen No. M1156.7, mold of interior of brachial valve, dimensions 13 by 7½ mm. and radii 75–80. This valve is concave and in the mold shows the gradual arching without prominence of umbonal part seen in the pedicle valve.

Specimen No. M1156.8 is a more perfect mold of interior of brachial valve, concave but slightly so, showing nearly flat in the specimen. Radii are 65–75 in number.

Specimen No. M1156.9 is a typical pedicle valve, dimensions 11 by 6½ mm., abruptly arching from the hinge area; body convex, ears

flattened; radii only occasionally bifurcated and that mostly near edge, and total about 80. These all retain the typical characters of the species *Chonetes edmundsi* with certain fluctuations.

Although this species is found associated with *C. novascotica*, it differs from the latter in the greater convexity of the pedicle valve, deeper concavity of brachial valve, and the radiating lines on the surface are much finer, rarely over 80 and often scarcely 60. The species is of the type of *C. striatella* Dalman, but differs from that form (as seen typically at Eastport in the fauna 5.33.8B) in its smaller and shorter form and in its less lateral extension. The average size is about 8 by 13 mm., whereas a small form of typical *C. striatella* is 9 by 15 (M1420.7), another (M1420.4) is 9½ by 18½. The rays are about the same size as in *C. striatella*, as are also the cardinal spines, and the species may be taken as representing the form represented by Davidson's smaller figure 25*a* and by De Konnick's figures 5*a*, *b*, *c*, *d*, of shorter form with proportions 14–22. The ordinary proportions given by De Konnick are 100; 182; 27; 8 as compared with the 100; 157; 40; 9, the more swollen form.

CHONETES COBSCOOKI, new species.

Plate 29, fig. 5.

Cf. 1860. *Chonetes novascotica* HALL, Canadian Nat. Geol., vol. 5, p. 144, fig. 2.

Shells are flattened with the front often a little arching, but the umbonal portion is always low and but slightly rising above the cardinal margin. The brachial valve is nearly flat, slightly concave. The spines are 5 or 6 on each side and slender, curved inward, outer ones longer than inner. The radii bifurcate frequently over the whole surface and at two or three points in course of growth, resulting in a nearly uniform fine size of radii which at the front reach a number as great as 150 or 200.

In the typical specimens of this locality the arching over at the front is slight and the form is therefore flattened-convex. A central radius is occasionally present with double the size of the ordinary radii, running from the beak to the front without bifurcation. Specimens are seen on the slabs as small as 11 mm. broad and 7 or 8 mm. long, and one specimen is 17 broad by 9 long. The lateral growth does not reach double the length, though the width is generally three-quarters greater than the length.

Formation and locality.—Edmunds formation, calcareous shales south of Field Point, west shore Cobscook River, Edmunds Township (loc. 8.21.1A).

Holotype.—Cat. No. 58949, U.S.N.M.

Comments.—The dimensions of Hall's figures of the type of *Chonetes nova scoticus* are, breadth 20½ at the hinge margin and 22 in middle of shell and 15 mm. from beak to front. The form called *Chonetes*

tenuistriata Hall is 10 by 10¼ by 6 mm. It is said to be "more finely striated than the preceding," i. e., *C. nova scoticus*. Our shells from 8.21.1A appear to have "greatest width near the middle," which agrees with the original figure and is inserted in the description of the species so identified from the Waldron shale.[1] Our specimens are, however, very little convex, and not noticeably, "more ventricose than *C. cornuta* of the Clinton," though considerably larger than the original type as figured.

Specimens in the Cornell University Museum (originally belonging to the Jewett collection and marked "*Chonetes cornuta* Hall" from the Clinton formation New Hartford, New York, Cat. No. 2197) show considerable variation in size. Dimensions of the smallest specimens are 5 by 3 mm., the largest 15 by 8 mm. The radii are very similar to those of Maine specimens of the same size, are in the larger specimens over 100 at the margin, and the median radii are double strength, as said to be characteristic of some of the specimens from Arisaig and particularly of the specimens from Waldron called *Chonetes nova scoticus*. The form of *C. cornuta* varies but the specimens referred to are none of them fully twice as broad as long, though nearly so.

The original specimen figured by Hall of *C. nova scoticus* has not the strong central radii, but in the text "a stronger and more elevated stria," it is said, "often marks the median line from the beak to base of ventral valve."[2] It is difficult to determine what morphological characters belong to these specific names as used. The definition of *C. tenuistriata* makes it to be more finely striated than *C. nova scoticus*, also larger and more finely striated than *C. cornuta*, but the number of striæ on the margin of *C. tenuistriata* is given as nearly 100, whereas the striæ are given as "more than 100 on the margin of *C. nova scoticus*.

The specimens in the Cornell University collection from the Clinton are much more finely striate than the figures given of the species *C. cornuta*.[3] The increase in number of radii is produced by dichotomising or interstitial additions in course of growth, and hence the larger the size of a given species (supposing the rate of increase were uniform) the greater would be the resulting number of radii at the margin. Fluctuation also takes place in the growth laterally in relation to the length.

The form I call *C. edmundsi* is a small species with the dichotomising process rare, as in typical *C. striatella*, and the lateral growth not reaching twice the length. The form I call *C. striatella* attains ordinarily more than twice the dimensions of *C. edmundsi*, the striæ occasionally but rarely bifurcate except at the cardinal angles, and

[1] 28th Ann. Rept. N. Y. State series, p. 155.
[2] Acadian Geol., 4th ed., p. 596.
[3] Pal. N. Y., vol. 2, pl. 21, fig. 10.

the lateral growth is double the length or even more and the number of radii at the edge is less than 100.

The form I name *C. cobscooki* is very close in outline to the Waldron form figured by Hall as *C. nova scoticus*, is somewhat larger, but shows evidence of at least 4 and sometimes 5 spines on each side. It is not "more ventricose than *C. cornuta*," but in some specimens is less so than seen in examples from the Clinton formation of New Hartford. The striæ are frequently bifurcated two or three times in course of their growth and reach a greater number than 100 at the front margin.

Genus BRACHYPRION Shaler.

BRACHYPRION SHALERI, new species.

Plate 29, figs. 10, 11, 12.

Shell of medium size, flat, semielliptical, wider than long, greatest width at cardinal edge. Pedicle valve slightly convex throughout its growth, brachial valve slightly concave. Surface ornamented by elevated thread-like radii of two sizes, the larger about 20 near beak and increasing to about 50 at the front, between which are finer lines becoming 5 to 8 in central shell, but one of them rising to strength of the primary radii divides them into 4 or 5 small between each large radii near the front border. The cardinal border is crenulated each side the middle for a third the distance to end of hinge line. The dental laminæ of the pedicle valve are strong and continued as slightly diverging ridges each side the muscular scar, about one-third the length of the shell. A linear median septum of about the same length divides the muscular scar into two lobes. The ridges from the outer face of the dental sockets of the brachial valve are strong; from the inner side of each proceeds forward a strong linear ridge, curving gently outward and extending halfway to the front, the two bounding the muscular scars.

The species closely resembles *Strophonella striata* (Hall), but differs from it in being convexo-concave throughout growth, showing no tendency to resupination. The shell is not perfectly symmetrical in its convexity, showing in some specimens of the pedicle valve slightly greater convexity on one side than the other, but in no specimen is reversal to concavity exhibited in course of growth, which feature excludes it from the genus *Strophonella*. The type-specimens are from the west shore of Cobscook River, south of Ball's Mountain, in Edmunds Township (localities 8.21.1A and 5.51.5B).

Specimen No. 1414.3 (pl. 29, fig. 12), an interior mold of a brachial valve, shows that valve to have been concave, and exhibits the characters of the central part of the shell in mold. Comparison with figures 4 and 8 of the same plate will show the differences between the brachial valve of this species and *Leptostrophia*.

Figure 7 shows a mold of the interior of a pedicle valve (magnified 2 diameters). It exhibits the characteristic ridges bounding the muscular scars which may be compared with the corresponding views of pedicle valves of *Leptostrophia filosa* illustrated by figures 1 and 2, which are natural size, and 9*a*, which is magnified 2 diameters.

Leptostrophia filosa which occurs in the same beds with this species is flatter, though *Brachyprion shaleri* is also nearly flat.

Formation and locality.—Edmunds formation from the outcrops on the east shore of Burnt Cove, south of Cunningham Mountain (loc. No. 5.51.5B), and west of Field Point, southeast of Ball's Mountain (loc. No. 8.1.8A), and west shore of Cobscook River, opposite Wilbur Point (loc. No. 8.21.1A), all in Edmunds Township, Washington County, Maine.

Cotypes.—Cat. Nos. 58950, 58951, 58952, U.S.N.M.

ON THE GROUP OF AVICULOID SHELLS CALLED AVICULA? DANBYI BY M'COY.

Frederick M'Coy published in the Annals and Magazine of Natural History in 1851 the description of some aviculoid shells found abundantly in the greenish quartzite (Upper Ludlow rock) of Benson Knob, Kendall, Westmoreland, under the name *Avicula? danbyi* (M'Coy).[1] With this original description no figures were published. Later in British Silurian Rocks and Fossils,[2] 1855, the species was redescribed and five figures were published. In both places doubt was expressed as to the reference of the species to the genus *Avicula*. The discovery in the Edmunds formation of the Eastport quadrangle, Maine, of specimens evidently belonging to this group of forms has led to a critical study of them and of M'Coy's descriptions and figures with the result of discriminating certain distinct generic characters for the group, resolving the forms described by M'Coy into two distinct species and the recognition of a new species among the Maine representatives of the genus.

M'Coy, in writing his description, evidently had before him specimens of each of the three specific forms, recognizing the wide range of variability and writing his description to cover the middle species. This is indicated by his giving "average" dimensions, by the statement that the species "varies much in the amount of its obliquity and transverse elongation and the number of radiations on the left valve," also "some of the varieties are so slightly oblique as to assume a rotundate-quadrate form."

In resolving the group into its constituent species I have taken the form represented by figure 13 of his plate 1*l*. as most closely conforming to his definition of the species *Avicula? danbyi*. The figures 11 and 15 represent a small and a large specimen of the same species.

[1] Silurian Mollusca, Ann. Nat. Hist., ser. 2, vol. 8, 1851, p. 59.
[2] Idem, p. 258, pl. 1*l*., figs. 11–15.

The second species is much more transversely elongate and has the anterior ear distinctly rounded without reentrant curve to the anterior border; for this form I propose the specific name *transversalis*.

Reference also is made, in the comments upon the species after its description, to a "rotundato-quadrate form." This is probably a representative of the form I am describing as a new species under the name *Palæopecten cobscooki*, making it the type of the new genus *Palæopecten*, which appears to include all the forms gathered under the name *Avicula? danbyi* by M'Coy.

PELECYPODA.

PALÆOPECTEN, new genus.

The genus combines certain characters which in later geologic times are found separated in different genera and distributed in the separate families Pectinidæ and Aviculidæ of modern writers. The shell is inequivalve and inequilateral. In the type species the shell is nearly symmetrical as in typical *Pectens;* in other species, intimately associated with it by intermediate forms, the shell is conspicuously inequilateral, the posterior body of the shell being much produced as in the genus *Follmamella.* Anterior ear and posterior wing both developed, the posterior wing larger than the anterior ear, both flattened, and no distinct evidence of byssal sinus. Cardinal border straight and shorter than transverse diameter of body of shell. Left valve gently convex, beak low, inconspicuous, within the middle third of the cardinal border. Right valve flattened, slightly convex transversely across the umbonal region but distinctly concave (dishing) from beak to front margin. Ligamental area of hinge distinctly marked by fine longitudinal lines; and under the beak of the left valve a distinct triangular cartilage pit. Two strong diverging ridges are seen, one each side the beak of the left valve, of about 5 to 8 mm. length in the type species (crural ridges). In the transverse species these crural ridges are less strong but longer than in the type species. The shell substance was apparently thin; the surface lines and foldings show with almost equal distinctness in interior molds and on exterior surfaces. These surface markings consist of fine linear concentric striæ and rather broad, irregular concentric foldings crossed on the left valve by obtuse ridges radiating from the beak and generally becoming obsolete toward the margin. Over the umbonal region the radiating ridges are separated by flattened furrows little wider than the ridges; but toward the front the furrows become several times the width of the ridges, and occasionally a secondary ridge develops between two adjacent primary radii. In size the specimens vary from 1 to 3½ inches in transverse diameter.

Type-species.—Palæopecten cobscooki, new species.

PALÆOPECTEN COBSCOOKI, new species.

Plate 29, fig. 13.

Cf. *Avicula danbyi* M'Coy (part), Brit. Pal. Fos., 1855, pl. 1*l*, fig. 12.

Shell suborbicular, erect, inequilateral but nearly symmetrical, posterior margin and wing extends backward about one-fifth more than the anterior ear and margin protrude forward of a line drawn vertical through the beak; left valve gently convex, beak elevated but not conspicuous; right valve unknown but presumably flattened or concave. The anterior ear small, flattened, angular and without evident byssal sinus; margin below it slightly incurved posterior; wing, triangular, flat, acutely pointed, a broad incurve connecting it with the protruding lower half of margin. Surface marked by fine, sharp, threadlike concentric lines and coarser ill-defined concentric wrinkles, crossed by 12 to 14 obtuse radiating ridges separated by flattened spaces which broaden toward the front and between them occasional secondary smaller ridges. These radii are distinct over the beak and central part of the shell and become faint on sides and front. The hinge margin is flattened and is marked by fine longitudinal ligamental striæ; under the beak is a distinct small cartilage pit. On the inside of the left valve each side the beak is a strong diverging crural ridge, extending 5 to 8 millimeters from the tip of beak and terminating abruptly; angle of divergence about 100°.

No evidence of either muscular scars or pallial line have been discovered. All the specimens seen of this species are left valves. The form of the right valve is inferred from a specimen of another species from the same locality, showing both valves attached. Dimensions of the type-specimen are as follows, namely: Length of cardinal area, 37 mm.; transverse diameter across widest part, 53½ mm.; height from base to end of beak, 52 mm.; from center of beak to tip of posterior wing, 22½ mm.; crural ridges, anterior, 5½ mm.; posterior, 9 mm.

This species resembles M'Coy's figure 12 of *Avicula danbyi*, but it is more erect, more nearly symmetrical, and less produced posteriorly, although a larger shell, and the ear and wing are larger proportionate to the size of the body part of the shell.

Formation and locality.—In tough gray sandy shales of the Edmunds formation on the east shore of Cobscook River, on outer side of the southern point forming the inclosure of Carrying Place Cove in the town of Trescott (locality 5.52.9A), Eastport quadrangle, Maine.

Holotype.—Cat. No. 58953, U.S.N.M.

PALÆOPECTEN DANBYI (M'Coy) (sensu stricto Williams).

Avicula? danbyi M'Coy, Ann. Nat. Hist., ser. 2, vol. 7, 1851, p. 59.
Avicula danbyi M'Coy, Brit. Pal. Foss., 1855, p. 258, pl. 1*l*, figs. 11 and 13.

In revising this species it has seemed to the writer that M'Coy had before him when writing his description three forms which may be specifically differentiated. M'Coy evidently wrote the description

so as to express the average or middle species and in preparing his plates represented this typical form by the figures numbered 11, 13, and 15. I assume that figure 13 best represents the average characters of his species *Avicula danbyi*. The specific characters which apply strictly to this figure are found in his definition in the terms, "oblique ovate, posterior end more or less narrowed, rounded," "hinge line rather less than half the width of the shell," "both wings nearly rectangular, with sharply concave margins. Average length, 1 inch 5 lines; width, 2 inches 3 lines; length of hinge, line 1 inch."

Assuming these to be characters of the species *Avicula danbyi* in strict sense, it is evident that figure 14 represents a more transversely elongate form of which the anterior ear is distinctly rounded and its margin undifferentiated from the general anterior convex margin of the shell. The other extreme is represented by *Palæopecten cobscooki*, already described, which is suborbicular with height and transverse diameter almost exactly equal.

I have represented on Plate IV (of the Eastport Folio) each of these three types, as they appear in the Edmunds formation in Maine. Figures 6 and 7 are molds of the exterior of a small and a large specimen of the left valve which I identify with M'Coy's species as restricted.

PALÆOPECTEN TRANSVERSALIS, new species.

Plate 29, figs. 17 and 18.

Cf. *Avicula danbyi* M'Coy (part), Brit. Pal. Foss., pl. 1*l*, fig. 14.

Shell obliquely ovate, transversely elongate, greatest width nearly twice the height; front margin broadly rounded, meeting the hinge line at an obtuse angle without incurve or byssal sinus. Posterior wing flattened, small, terminating in acute angle; lower half of body much produced backward beyond the end of wing. Left valve gently convex, right valve flat transversely gently concave from beak to lower margin. Left valve crossed by 12 to 14 obtuse radiating ridges, well defined over main body but becoming faint toward the margin. Surface of both valves marked by fine, thread-like concentric lines, and irregular concentric folds which are generally more marked toward the margin. Crural ridges present, one each side the beak, diverging at angle of about 150°.

Dimensions of type-specimen (No. M1407.2): Height, 33 mm.; transverse width, 67 mm.; hinge length, 40 mm.

Formation and locality.—Same as *Palæopecten cobscooki*.

Holotype.—Cat. No. 58954, U.S.N.M.

Observation.—This species is distinguished from *Palæopecten danbyi* (M'Coy) *sensu stricto*, by its more transverse form, the rounding of the anterior ear, and the absence of incurve of the anterior margin.

M'Coy's figure 14 of plate 1*l*, Brit. Pal. Foss., appears to belong to this species.

Genus PTERINEA Goldfuss.

PTERINEA (?TOLMAIA) TRESCOTTI Williams.

Plate 29, figs. 14, 15.

Shell of medium size, rhomboidal, body oblique, longitudinal axis at an angle with the hinge line of about 60°; length greater than height; valves unequal; left valve convex; right valve concave from beak to base, gently convex transversely across upper part but flat near basal margin. Hinge line straight, part behind beak nearly four times as great as that in front. Left-valve beak prominent, upright at origin, convex over umbonal region. Body convex, arcuate, anterior side more elevated than posterior, abruptly bounded both on anterior and posterior sides. Anterior ear strong, set off from body by deep rounded furrow; byssal sinus sharply defined, posterior wing triangular produced into short mucronate point at cardinal extremity, distinctly separated from body, posterior margin concave. Right valve broad, concave from hinge to base line, across center of shell from posterior side slightly convex, beak depressed, not protruding beyond cardinal margin. The surface markings on the left valve are composed of two sets of elevated radiating rays, the stronger set strong cord-like rays evident from front side of body to the extremity of wing, the finer set thread-like lines in bottom of furrows separating stronger rays; these are about a millimeter apart over center of body of shell. On the wing and posterior half of the body the secondary rays are absent from the upper half of the surface; on lower half the second series appear between the first set; on the anterior half of the body the secondary rays are evident well up upon the umbonal surface, and are sub-equal to the first set toward the base, where both sets appear to be lamellose. The rays are crossed by concentric lines which become lamellose over the anterior ear. Surface of right valve, as seen in a mold of the interior, is smooth with faint indication of radiating lines on basal half of body, crossed by a few broad concentric growth lines.

Teeth, anterior to beak are two to four strong, oblique, short teeth; posterior to beak two elongate lateral teeth on right valve curving a little inward toward posterior end, terminating about half way out on margin of wing. On left valve one strong lateral tooth.

Formation and locality.—Edmunds' formation, near the end or Crow Neck on the northeast side of North Trescott (loc. No. 5.33.8A).

Cotypes.—Cat. No. 58955, U.S.N.M.

Comments.—This species by its hinge and inequality of valves is distinctly within the genus *Pterinea*, not *Actinopteria*, although its external appearance recalls the Devonian Actinopterias. The outline is similar to that of *Pterinea dichotoma* Krantz,[1] but the beak is

[1] Frech, pl. 9, fig. 16.

more erect and wide, and the anterior ear is larger and not so deeply incut below. Externally the species resembles the Devonian Actinopterias of Hall, but its well-developed cardinal denticulation separates it from that genus.

It differs from *Pterinea* (*sensu stricto*) as restricted by me in its development of radial rays and fails to agree with Frech's group of *Pterinea lineata* Goldfuss (= *Tolmaia* Williams) by its well-developed anterior ear.

I call it *Pterinea* (*? Tolmaia*) *trescotti* (new species), using the generic name *Pterinea* in its broader sense as including rayed as well as smooth shells, since it is evidently a forerunner of the shells of the type of *Actinopteria boydii* and *A. perstrialis* of the Devonian of New York State, but is still in hinge structure one of the Pteriniidæ.

Genus TOLMAIA Williams.

TOLMAIA CAMPESTRIS, Williams.

Plate 29, fig. 16.

Cf. *Avicula reticulata?* HISINGER, Sowerby, Sil. Syst., 1839, p. 614, pl. 6, fig. 3.
Cf. *Pterinea sowerbii* M'COY, Brit. Pal. Rocks and Foss., 1855, p. 263.

This species bears considerable likeness to Sowerby's figure of *Avicula reticulata* Hisinger, redescribed under the name *Pterinea sowerbyii* by M'Coy. It is shorter in form and has a more strongly developed ear, set off from the body of the shell by a distinct byssal sinus.

The surface markings consist of sharp elevated radii crossed by thin lamellose concentric lines, covering the whole surface of the left valve, including ear and wing, and apparently also the right valve. The interior of both valves is smooth.

The body of the left valve is convex with moderate development of the umbones, and the deepest part of the shell is near the anterior edge. The posterior side of the body slopes off gradually to the large flat wing. The right valve is less convex than the left over the umbonal region, flattens toward the middle, and turns upward toward the front, making an outwardly concave shell.

Both cardinal and lateral teeth are present; the outer edge of the hinge is flattened and marked by ligamental striations parallel to the edge.

The dimensions of the type-specimen are 3 cm wide by 2½ cm high; the largest specimen from the same locality measures 4 by 3½ cm.

Avicula macerata Conrad, figured by Hall from the Niagara group of New York,[1] resembles this species, but the surface sculpture of that species on the right valve is limited to "concentric lines" only on the body and "a few obsolete radiating striæ" on the wing.

[1] Pal. N. Y., vol. 2, pl. 59, fig. 1c.

Actinopteria reticulata Weller from the Decker limestone of New Jersey is also a closely related form.[1]

Formation and locality.—Edmunds formation, Field Point, on west side Cobscook River, Edmunds Township, Washington County, Maine (loc. No. 8.1.8D).

Holotype.—Cat. No. 58956, U.S.N.M.

COMMENTS ON AVICULA ? RETICULATA SOWERBY.

J. de C. Sowerby described a shell from the Aymestry formation under the name *Avicula ? reticulata*, of which closely related, if not identical representatives, are found in the rocks of the Eastport quadrangle.

The original description is as follows:

Avicula ? reticulata Sowerby.

1839, Sil. syst., p. 614, pl. VI, fig. 3.

(Hisinger Petr. Suec. 57, t. XVII, f. 13?)

Ovate, broad, pointed toward the beaks, rather convex, ribbed; ribs numerous, decimated by the lines of growth; one valve nearly flat; ears unequal, one very large, right angled.

Length 2 inches, width 1 inch 8 lines.

Loc., Croft Valley, Aymestry.

Sowerby in the text records the species from the Aymestry limestone, but on page 618 it is also listed among the fossils of the lower Ludlow, loc. Myddleton Hall, Caermarthenshire, and on p. 628 from the Wenlock limestone, loc. Falfield-Tortworth.

1855, M'Coy, Brit. Pal. Foss., p. 263, redescribes the species and gives it the name *Pterinea sowerbii*. Ref. and syn.—*Avicula reticulata* (Sow.) Sil. syst., t. 6, fig. 3 (not of Hisinger nor Goldfuss). His description follows:

Sp. ch., obliquely ovate, depressed, slightly convex, greatest length along the posterior slope, which is straight and defined; posterior wing gently arched, scarcely extending beyond the shell; its posterior edge slightly and uniformly concave; surface radiated by slightly irregular obtuse ridges, about their thickness apart (five in two lines about the middle, at one inch from the beak), partially interrupted by thin concentric imbrications from one to two lines wide, having the radiating ridges obsolete, or nearly so, on their rostral half; radiating ridges of the wing rather larger, strongly marked only about the middle. Length from beak to respiratory angle two inches six lines; length of posterior wing 62/100, width of ditto 44/100; width from middle of hinge-line to ventral margin 97/100, depth of one valve 10/100.

This fine species differs from the *Pterinea reticulata* of the original Continental authors in its more elongate form, smaller posterior wing, with its gently concave posterior edge, and the comparatively few, broad, thin imbrications interrupting the radiating ridges.

Position and locality, Aymestry limestone, Leintwardine, Shropshire.

Frech[2] makes *Avicula reticulata* Goldfuss the type of his "*Gruppe der Avicula reticulata Goldfuss sp.,*" and distinguishes this species

[1] Pal. Fauna, Geol. Sur., New Jersey, vol. 3, 1903, p. 245, pl. 22, fig. 3.

[2] Frech Dev. Aviculiden Deutschl., 1891, p. 34.

from Hisinger's species, which he notes was originally described under the name *Pterinæa reticulata* by Hisinger from the Upper Silurian of Gotland. Frech cites Lindström as reporting that the Gotland form belongs to the genus *Aviculopecten*.

If this be the case, M'Coy's name for the *Pterinæa* from the British Silurian referred to by Sowerby under Hisinger's name stands, and the pterinoid form will be *Pterinæa sowerbii* M'Coy, while the toothless Aviculopecten species will be *Aviculopecten reticulata* Hisinger.

FOSSILS OF THE PEMBROKE FORMATION.

The name Pembroke formation was adopted for formation No. IV briefly defined in my paper on the "Correlation of the Paleozoic Faunas of the Eastport Quadrangle, Maine," to which reference has already been made on page 320. In addition to the new species here figured the following described species are inserted on the plates and will reappear in the Eastport folio as illustrations of the fauna of the Pembroke formation: viz. *Dalmanella lunata* (Sowerby), *Grammysia triangulata* (Salter), *Eurymyella shaleri* var. *minor* Williams, and *Platyschisma helicites* Sowerby.

BRACHIOPODA.

Genus DALMANELLA Hall and Clarke.

DALMANELLA LUNATA (Sowerby).

Plate 30, figs. 1, 2, 3, 4, 5, 8.

1839. *Orthis lunata* SOWERBY, Sil. Syst., p. 611, pl. 5, fig. 15.
1839. *Orthis orbicularis* SOWERBY, Sil. Syst., p. 611, pl. 5, fig. 16.
1869. *Orthis lunata* SOWERBY, Davidson, Brit. Sil. Brac., p. 215, pl. 28, figs. 1–5.

This is a common upper Ludlow species of Great Britain.

Formation and locality.—Pembroke formation, shales at head of Leighton Cove, at southern end of the Pembroke peninsula, Washington County, Maine, loc. No. 5.3.8 M^3, M^1, and F.

Plesiotypes.—Cat. Nos. 58957, 58958, 58959, U.S.N.M.

Genus CHONETES Fischer de Waldheim.

CHONETES BASTINI, new species.

Plate 30, figs. 6, 7, and 10.

On passing upward from the Edmunds to the Pembroke formation the *Chonetes* become very abundant, and in the latter formation show a wide range of fluctuation in all their diagnostic characters. The species to which I apply the specific name *bastini* is similar in form to *Chonetes striatella* Dalman, but differs in its finer and more numerous

surface striæ and in the number of its spines. Full-grown specimens are frequently 20 mm. wide and generally not quite 10 mm. long. The pedicle valve is gently convex; beak low; spines on the cardinal margin from 12 to 16 and the radiating striæ over 100 and occasionally as many as 200 at the margin. A short median septum is generally present under the beak of the pedicle valve. The brachial valve is slightly concave. There is no enlarged median rib on the pedicle valve, but occasionally a narrow median furrow crosses the shell at this point.

The shell differs from *Chonetes nova scoticus* Hall in its greater transverse extension; ordinarily it is twice as wide as long.

Locality.—Pembroke formation, Leighton Cove, Long Cove, and in many other localities in the town of Pembroke.

Cotypes.—Cat. Nos. 58960 and 58961, U.S.N.M.

Genus CAMAROTŒCHIA Hall and Clarke.

CAMAROTŒCHIA LEIGHTONI, new species.

Plate 30, figs. 9, 11, 12, 13.

Cf. 1839. *Terebratula lacunosa* SOWERBY, Sil. Syst., p. 611, pl. 5, fig. 19 (not *T. lacunosa* Schlotheim of p. 624, pl. 12, fig. 10).

Cf. 1848. *Terebratula lewisi* DAVIDSON, Bull. Soc. Géol. France, ser. 2, vol. 5, p. 330, pl. 3, fig. 30.

Subtrigonal, both valves convex and for the first ¾ cm. of growth nearly equally gibbous, the pedicle valve having a well-developed overarching beak. The pedicle valve for the first half of growth shows no distinguishable median sinus, but at the front and for a quarter way back in full-grown shells a slight sinus is formed by the depression of the central three plications and the prominence of the plications bounding the sulcus; the lateral slope, however, is gradual, the bounding plication not raised above the others. The plications are 8 on each side the sinus and a trace of a ninth can be seen at the extreme cardinal lateral angle of the shell. The plications and the grooves between them are evenly rounded—not angular. In mature shells of 1½ cm. length the plications for the first half are smooth on molds of the interior, and exterior molds show only very fine concentric lines. After mid-growth the plications are crossed by strong lamellar concentric lines, about 0.5 mm. apart, and on occasional specimens the change in mode of growth is marked by a strong line of thickened shell depressing the forward part from the early shell growth, as in specimens 10 and 1 on the slab with figured specimen (fig. 11). The brachial valve has 4 plications raised above the general surface from the middle to front, and 7 plications each side and in very good specimens a trace of the eighth at the cardino-lateral angle. A thin median septum cuts the beak of the brachial valve and reaches to near the middle of the shell in molds of the interior. These charac-

ters are typically represented by the specimens on slab containing figured-specimen M1204.

Small shells from the same beds are like the corresponding part of the larger shells showing only smooth plications, thus representing the characters to which the names *Terebratula nucula* and *T. pulchra* were given by Sowerby.

In form the species presents the characters of *Rhynchonella lewisi* Davidson [1] except that the fold of the brachial valve is less elevated and "pinched," and the sinus shallower and broader than in the extreme form expressed by Davidson's fig. 25, in this particular assuming the form presented by his figure 26. In surface markings it differs from Davidson's species in that the "scalelike concentric ridges" do not cover the whole surface but begin rather abruptly about halfway from the beak to the front margin.

The number of plications is generally 20 and may be 22, but none have been seen with 26 plications. There are three depressed in the sinus and four elevated on the fold in all specimens counted. In dimensions our species is generally smaller than *R. lewisi* and more nearly equal in the two diameters. A typical pedicle valve (in mold) measures length 15 by 15 mm. A brachial valve (mold of interior) from the same beds (M1331.9) measures length 11 width 15 mm. Another pedicle (mold of exterior) measures 12 by 16 (M1206).

Davidson's figures of *R. lewisi* measure: Figure 25, 17 by 20 mm.; figure 26, 30 by 38 mm. (magnified); figure 28, 12 by 12¾ mm. Our specimens are all in condition of molds of either exterior or interior and are more or less distorted by pressure in several cases.

The two short dental lamellæ of the pedicle valve and the median septum divided posteriorly to form an elongate cavity, are as in *Camarotœchia* and are very similar to that expressed in *Camarotœchia eximia* Hall of the Devonian. These characters were evidently referred to in his description of *Rhynchonella lewisi* and quoted by Davidson.[2]

Formation and locality.—Pembroke formation, gray shales outcropping on northern shore of Leighton Cove at end of the promontory of Pembroke Township, Washington County, Maine (loc. 5.3.8).

Cotypes.—Cat. Nos. 58962, 58963, U.S.N.M.

Genus LINGULA Bruguiere.

LINGULA SCOBINA, new species.

Plate 30, fig. 18 (enlarged 3 diameters).

Cf. 1839. *Lingula lewisii* SOWERBY, Sil. Syst., p. 615, pl. 6, fig. 9.

Cf. 1866. *Lingula lewisii* SOWERBY, Davidson, Brit. Sil. Brac., p. 35, pl. 3, figs.1–6.

This species in size and form agrees very closely with Davidson's interpretation of Sowerby's species *L. lewisii* [3] but the surface of one

[1] Brit. Sil. Brach., p. 180, pl. 23, figs. 25–28. [2] Idem, p. 180. [3] Idem, p. 35, pl. 3, figs. 1–6.

of our specimens shows a very fine sculpturing which is reproduced (magnified about 3 diameters) in our figure 18 on plate 30. The definition of *L. lewisii* given by Davidson is in part, namely, "Subquadrate, oblong, longer than wide; sides almost parallel; front very slightly rounded; beaks obtusely angular; valves almost equally deep, the convexity very small." This applies to our shell. The size, "14 by 10 by 2½ lines," refers to the larger, not the smaller figures given by Davidson. His figure No. 2 measures 23 by 17 mm.

Our figured specimen measures 19 by 14, and a larger specimen from same locality measures 21 by 17 mm. Our shell differs, however, in surface sculpture. The concentric growth-ridges are much as in *L. lewisii*, but in addition to them our species is marked also by very sharply cut striæ crossing the shell, across the middle nearly parallel to the front border, but dropping downward on the sides where they appear as radiating from a point somewhat anterior to the beak. The striæ are undulating and on sides appear like cancellations from the crossing of the concentric striæ which there come close together. There are 24 of them to the centimeter in center of the magnified figure giving about 72 to the centimeter in the natural size shell. An inner layer of shell shows fine elevated radiating lines near the front, but these are not in evidence on the inner surface which appears smooth.

The surface sculpture is similar to that seen on the New York Devonian species *Lingula punctata* Hall; and a similar sculpturing is described for *L. granulata* and *L. tenuigranulata* of the Ordovician.[1] The shell is larger, more quadrate, and in form differs from the species *L. cornea* Sowerby which occurs higher up both in British rocks and in the formations about Eastport, Maine. It resembles the Clinton form *L. oblata* Hall, but is a much larger shell.

Formation and locality.—Pembroke formation, in the shales outcropping at head of Leighton (Schooner) Cove on south end of the Pembroke peninsula, Washington County, Maine (loc. No. 5.3.8M[3]).

Holotype.—Cat. No. 58967, U.S.N.M.

LINGULA MINIMA var. AMERICANA, new variety.

Plate 31, fig. 6.

Cf. 1839. *Lingula minima* SOWERBY, Sil. Syst., p. 612, pl. 5, p. 23.
1866. *Lingula minima* SOWERBY, Davidson, Brit. Sil. Brac., p. 48, pl. 2, figs. 36–44.

Sowerby neither by his definition nor his figures made it clear wherein *L. minima* differs from *L. cornea*, and M'Coy regarded them as identical, saying at close of definition of the species *L. cornea*, "The *L. minima* does not show the slightest difference that I can perceive."[2]

[1] Davidson, Brit. Sil. Brach., pp. 36 and 37.

[2] Brit. Pal. Foss., p. 251.

Davidson, however, recognized the distinctness of the two species and redefined *L. minima* as follows:

> Shell small, oblong, elongated; sides curved, gradually merging into the slopes forming the acuminate pointed beaks; front rounded; valves slightly convex and marked with fine concentric striæ. Two specimens measured 4 by 2½ and 5 by 2½ lines (the latter a Lesmahago specimen).

And on his plate 2 the difference between the two species becomes clearly manifest.[1]

Adopting Davidson's interpretation of the species *L. minima*, I can find little other than varietal modification to separate our Pembroke Lingulas from *L. minima*. Our shell is a little more slender than the Davidson figures average.

The specimens figured by Davidson from Lesmahago called *L. unguiculus* Salter MS. approach more nearly the general characters of the American variety than do those from the Downton sandstone, old Leominster Road near Ludlow, which is probably closer to the type as defined by Sowerby. In case our variety were to be regarded as of specific rank separate from *L. minima*, the name *L. unguiculus* Salter may be substituted.

The specimen I have figured is a fair average specimen; other specimens from the same purple shales differ in size, some larger and some smaller. They are all characterized by the elements of form described in the definition, and the larger number of specimens observed in the formation are smaller than the specimen figured. They differ from *L. cornea*, as figured and described (and as represented in the Eastport Lingulas) in the more curved side and front, the more acute beak, and the slightly greater length in proportion to width. The size, is, however, a diagnostic character. In the Pembroke formation Lingulas of the *cornea* type appear, but they are rarely seen in the Hersey red shale member, where the characteristic Lingula is the small one.

Formation and locality.—Pembroke formation, the upper red shales (Hersey member) on the shore of west side Sipp's Bay south of highway bridge, Pembroke (loc. No. 2.32.9A).

Holotype.—Cat. No. 58973, U.S.N.M.

Comments.—The figure given of this variety (pl. 31, fig. 6) represents a selected specimen of the average form and size (the figure is drawn twice the size of the original) of the Lingulas met with frequently in both the gray and the purple shales of the Pembroke formation. It is easily distinguished from the wider and larger species from the higher (Eastport) formation, which I have identified with *Lingula cornea* Sowerby. Specimens of a more slender and also of a wider form are represented in the collection. The variable form is

[1] Brit. Sil. Brach., p. 48, pl. 2, figs. 36–44.

indicated by the figures given by Davidson.[1] Our specimens from the Pembroke formation present similar variation in form, but throughout the formation are distinguished by their small size. They undoubtedly represent the *Lingula minima* Sowerby, and the application of a variety name to them (*L. minima* var. *americana*) is suggested by the difficulty experienced in determining which of the various forms expressed by Davidson's figures may be regarded as the type of the species.

PELECYPODA.

Genus ACTINOPTERIA Hall.

ACTINOPTERIA BELLA, new species.

Plate 30, figs. 17, 19.

Shell oblique, ovate; both valves convex; left valve the larger; posterior wing accuminate; anterior ear small, triangular; both wing and ear strongly defined from the central body part of the shell; beak of the left valve strong, rather broad, overarching the cardinal border, body of the shell convex, flattened over the center. Beak of right valve smaller than the left and scarcely reaching beyond the cardinal border; right valve gently convex, sloping gradually into the posterior wing; body portion separated from the anterior ear by a shallow furrow. Surface of the left valve over the body part crossed by rounded distinct radiating lines, which are absent from the ear and wing; crossed by finer concentric lines over the whole surface. The whole surface of the right valve crossed by fine concentric lines, without distinct radiating lines; upon some specimens very faint radii are visible over the body portion. In some large specimens referred to the species the radiating lines become obsolete upon the extreme border of the left valve, forming a rim of 2 or 3 mm. wide crossed only by concentric lines.

Dimensions of type-specimen (No. M1216.1, pl. 30, fig. 17, a left valve) from tip of anterior ear to posterior-ventral angle, 22 mm.; hinge, 18 mm.; hinge to vent margin, 14 mm. Corresponding measurements of cotype of right valve (specimen No. M1217, pl. 30, fig. 19), 19, 20, and 13 mm. Smaller specimens than the types show the beak of the left valve narrower and more gibbous, but in full-sized specimens the central body portion becomes broadly convex.

Formation and locality.—Shales of Pembroke formation at the head of Leighton Cove, at the southern end of Pembroke Township, Washington County, Maine (loc. No. 5.3.8M[1]).

Cotypes.—Cat. No. 58964, U.S.N.M.

[1] Brit. Sil. Brach., pl. 2, figs. 36–44.

ACTINOPTERIA FORNICATA, new species.

Plate 30, figs. 14, 15, 16.

This species resembles *A. bella* in its general form, but differs from it by its greater convexity, more prominent and narrower beak and elevated narrow body of the left valve. The type-specimen is smaller than the majority of specimens referred to the same species from the same locality and is chosen as type on account of showing both valves. Left valve: The beak of the left valve is pointed, arching over the hinge and rapidly rises to the high arched narrow body which broadens gradually as it proceeds to the front; at the middle of the shell the anterior and posterior slopes are nearly symmetrical. The wing is flattened and produced at the cardinal margin into a short accuminate point which extends slightly beyond the postero-ventral angle. The anterior ear is prominent, arched at its center, and acutely pointed and separated from the body by a shallow sulcus. Radiating lines sharp and fine over the umbones become broader toward the front and are restricted to the body portion of the shell; they are crossed by finer concentric lines which cover the whole surface, including the ear and wing, where they are more or less laminose. The right valve is low-convex; its beak is small but rather sharply defined and rises scarcely beyond the hinge line; the body is gently convex and is separated from the nearly flat ear by a shallow sulcus. The surface of the right valve is without radiating lines and shows some faint concentric lines. Dimensions: Hinge line, 25 mm.; from hinge to ventral margin perpendicular to the hinge, 15 mm.; from beak to postero-ventral corner, 20 mm. Thickness of the two approximated valves, 10 mm., of which about 7 belongs to the left valve. Two large specimens referred to the same species are 25 and nearly 30 mm. along the hinge line.

Formation and locality.—Shales of Pembroke formation on the northwestern shore of Young's Cove, Pembroke Township, Washington County, Maine (loc. No. 5.1.4B). Cat. No. M1385.

Holotype.—Cat. No. 58965, U.S.N.M.

ACTINOPTERIA DISPAR, new species.

Plate 30, figs. 20, 21.

This species, of which left valves only are in evidence, is of the general type of *A. bella* but differs from it in its more erect form.

Shell elongate-ovate, erect, moderately convex; beak strong, rather wide and overarching. Body of shell low-convex, elongate, spatulate, its axis nearly erect, inclined slightly backward. Posterior and anterior margins nearly straight and subparallel, greatest width at hinge margin. Posterior wing triangular, flattened, and terminating

in an acute point. Ear smaller than the wing. Surface of body of shell covered by fine rounded radii, which in larger shells cease before reaching the ventral margin and are wanting on the ear and wing, crossed by fine concentric lines and coarse wrinkles, which become lamellose upon the wing and ears, and in full-grown specimens along the ventral margin form there a band of sometimes 3 or 4 mm. width, upon which the radii cease.

A small specimen (pl. 30, fig. 21, magnified) is referred to this species. It appears to possess all the characters of the larger specimens shown on the early stage of their growth, except that on the anterior slope of the body the radii extend faintly across the sulcus of the ear, but are not present upon the main area of the ear or upon the wing.

Dimensions of the type specimens (pl. 30, fig. 20): Length of hinge, 19 mm.; length of body from hinge to ventral border, 20 mm.; from tip of beak, 22 mm.; from end of anterior ear to postero-ventral angle, 23 mm.; width across center of shell, 18 mm. Young specimen: Greatest width at hinge, 9; at middle of shell, 8½; from hinge to front, 9; from tip of beak, 11; tip of ear to post. vent. angle 11½ mm.

Formation and locality.—Pembroke formation at head of Leighton Cove, Pembroke, Maine (loc. No. 5.3.8M²).

Cotypes.—Cat. No. 58966, U.S.N.M.

Genus GRAMMYSIA Verneuil.

GRAMMYSIA PEMBROKENSIS, new species.

Plate 31, fig. 2.

This species from the purple sandstones of the upper part of the Pembroke formation is similar to *G. cingulata* Hisinger of the Upper Silurian of Great Britain. It differs from the figures of that species given by Salter [1] in its narrower more transverse form and the more angular anterior termination of the cardinal angle. In size it is smaller, and our specimens show only a single furrow on the left valve. The dimensions of our figured specimen (Cat. No. M1238) (which is a mold, the figure having been drawn from a wax impression of the specimen) are greatest transverse length 32 mm., across the shell perpendicular to hinge line from termination of sulcus to the cardinal margin 12½ mm. The figure is slightly enlarged. A second specimen of the same form (Cat. No. M1303) is 36½ mm. long; it is extended farther forward of the sulcus than the first specimen. A third specimen (M1303.2) a left valve is 31½ mm. long transversely,

[1] Mem. Geol. Surv. Great Britian, vol. 2, pt. 1, 1848, pl. 17, figs. 1, 2.

and, approximately, 13 mm. across at end of sulcus (the edge is broken in that specimen). Only a single sulcus is seen on the left valve. Specimens figured as fig. 1 and 3 are probably distorted examples of this species.

Formation and locality.—Upper part of the Pembroke formation (Hersey red shale member) in Pembroke village at the three localities numbered 2.32.9A, 2.42.8A, and 2.52.3A.

Holotype.—Cat. No. 58968, U.S.N.M. (also M1303 and M1303.2).

GRAMMYSIA TRIANGULATA (Salter).

Plate 31, fig. 17.

1848. *Orthonota triangulata* SALTER, Mem. Geol. Surv. Great Britain, vol. 2, pt. 1, Pal. append., p. 361, pl. 18, fig. 7.

1855. *Grammysia cingulata* var. *triangulata* SALTER, M'Coy, Brit. Pal. Foss., p. 280, pl. 1*k*, fig. 28.

The figure we have given of a specimen from the Pembroke formation is very near both in form and size Salter's figure 7.

Formation and locality.—Tough gray sandstone of the Pembroke formation at the head of Long Cove, Pembroke Township (loc. No. 5.2.9A).

Plesiotype.—Cat. No. 58970 U.S.N.M.

Genus LEIOPTERIA Hall.

LEIOPTERIA RUBRA, new species.

Plate 31, fig. 4.

This shell belongs to the same group of forms defined by Hall from the Niagara under the names *Avicula undata, A. subplana* and *Posidonomya ? rhomboidea.*[1] Its characters are not sharply defined, but in general form our species resembles *A. undata* Hall and differs from that species in a more gibbous umbonal region the beak protruding higher above the cardinal border, and the body more swollen, and the shell is somewhat more extended along the umbonal ridge making its form more elongate.

The surface markings are a few concentric lines of growth otherwise smooth. The posterior wing is well developed and submucronate. The anterior ear is not in evidence.

I figure the specimen and give it a name as it is the only specimen of the aviculoid type discovered in the Hersey red shale member of the Pembroke formation.

Formation and locality.—Hersey red shale member of the Pembroke formation, at head of Giffs Bay (loc. No. 2.32.6A).

Holotype.—Cat. No. 58971, U.S.N.M.

[1] Pal. New York, vol. 2, pl. 59.

Genus EURYMYELLA Williams.

EURYMYELLA SHALERI var. MINOR Williams.

Plate 31, fig. 5.

1912. *Eurymyella shaleri* var. *minor* WILLIAMS, Proc. U. S. Nat. Mus., vol. 42, p. 387, pl. 49, fig. 9.

This variety is occasionally seen in the Hersey red shale member of the Pembroke formation, and does not seem to differ appreciably from the common form of the Eastport formation. Specimens of the typical species *E. shaleri* have not been seen in these lower beds.

Formation and locality.—Hersey red shale member of the Pembroke formation, on the west shore of Sipps Bay, south of the highway bridge (loc. No. 2.32.9A).

Plesiotype.—Cat. No. 58972, U.S.N.M.

Genus MODIOLOPSIS Hall.

MODIOLOPSIS LEIGHTONI, new species.

Plate 31, figs. 7, 8, 9, 10.

This species is very common in some layers of the Pembroke formation, and shows considerable variation in form and size. The specimens selected for illustration (figs. 7, 8, 9, 10) together express fairly the general appearance of the shell. As the illustrations show no two specimens are exactly alike. In the following definition are noted the characters expressed by average specimens.

Shell transversely subovate; length a little more than twice the height; hinge line nearly straight; posterior height slightly greater than anterior. Beak within the anterior third of hinge length, low, flattened, ovate, arching; the umbonal ridge strong, gradually flattening out toward postero-ventral angle. Middle of shell flattened, slightly depressed from over the beak to the front. Surface covered by irregular lines of growth.

Two specimens taken as expressing average size and dimensions measure: Cat. No. M1351.35, length, 21; height at middle, 9½; at beak, 9 mm. Cat. No. M1351.4, length, 22½; height at middle, 10; at beak, 9 mm.

The corresponding dimensions of Billings's figure of *M. exilis* from the Arisaig (pl. 8, fig. 6) are 40 by 16 by 14, showing the difference in size in comparison with a species perhaps more nearly related to this one than any other American described species.

Formation and locality.—Pembroke formation, in Leighton gray shale member, at head of Leighton Cove, Pembroke Township (loc. No. 5.3.8F and M).

Cotypes.—Cat. No. 58974, U.S.N.M.

MODIOLOPSIS LEIGHTONI var. QUADRATA, Williams.

Plate 31, figs. 12, 13.

This variety has the surface markings very similar to and varying as in *M. leightoni* but it differs from the typical form in its greater height. The antero-posterior diameter exceeds the height by about a third, whereas in the typical form the length is about twice the height. The specimens figured do not express the average size. Figure 13 represents the largest specimen in the series and fairly expresses the general form, except that the surface is distorted by some hard fragment underlying it. Figure 12 has the front side a little shorter than usual, giving the vertical margin greater obliquity than the species generally exhibits. It is also somewhat crushed irregularly.

The two specimens (Cat. No. M1349.7 and M1351.32) give the characters of the variety in its medium expression. Intermediate forms between this and the typical species are also seen in the series from the same locality.

Formation and locality.—Pembroke formation, in Leighton gray shale member at head of Leighton Cove, Pembroke Township (loc. No. 5.3.8F and M).

Cotypes.—Cat. No. 58975, U.S.N.M.

Genus NUCULITES Conrad.

NUCULITES CORRUGATA, new species.

Plate 31, figs. 11, 14.

Shell elongate ovate, thin, about twice as long as high; hinge line nearly straight; front evenly rounded. Posterior end extending backward and subangulate. Beak, within the anterior third of length of shell, but varying in the several specimens. Surface smooth except for faint concentric lines of growth and crossed by several faint radial grooves on the posterior half of the right valve. On the left valve these consist of two umbonal ridges separated by a broad furrow; in one specimen there appears a secondary ridge in middle of the furrow. These radiating ridges and furrows are faintly expressed and are nearly obsolete in some specimens. The clavicular ridge is slender and long, in some specimens reaching beyond the middle. Its inclination varies considerably in the specimens and the proportions of the shell also vary. The differences, however, appear to be due partly at least to distortion during and since fossilization.

The species resembles *Nuculites oblongatus* Conrad, also Beushausen's figure 11 on his plate 5 of *Cucullela elliptica* Mauer. It differs from both in the radiating ridges and furrows and in the subangulate posterior margin.

Formation and locality.—Pembroke formation, in the Leighton gray shale member at the head of Leighton Cove, Pembroke Township (loc. No. 5.3.8.F).

Cotypes.—Cat. No. 58976, U.S.N.M.

GASTROPODA.

Genus PLATYSCHISMA McCoy.

PLATYSCHISMA HELICITES (Sowerby).

Plate 31, figs. 15, 16, and 18.

1839. *Trochus helicites* SOWERBY, Sil. Syst., p. 603, pl. 3, figs. 1e and 5.
1888. *Platyschisma helicites* (Sowerby) ETHERIDGE, Foss. Brit. Isl., vol. 1, Paleozoic, p. 114.

This common Ludlow species is represented by numerous specimens in several horizons of the upper part of the Pembroke formation. It has not been detected either in the Edmunds below or the Eastport above, and is therefore, for the Eastport area, a characteristic Pembroke species.

Locality.—Hersey red shale member of the Pembroke formation, eastern shore of Hersey Cove, Pembroke Township (loc. No. 2.42.8A and 2.52.3A).

Plesiotypes.—Cat. No. 58977, U.S.N.M.

EXPLANATION OF PLATES.

PLATE 29.

New species from the Edmunds formation of Washington County, Me.

Figs. 5, 6, 7, 13, 14, 15, 16, 17, 18, natural size.
Figs. 1, 2, and 4, slightly enlarged.
Fig. 3, enlarged 2½ diameters.
Figs. 8, 9, 10, 11, 12, enlarged 2 diameters.

Whitfieldella edmundsi Williams.

Figs. 1, 2, 4.—Brachial, front and pedicle view of a specimen of ordinary size.
Fig. 3.—A small specimen, showing the interior spiral arms.
Locality: East shore of Burnt Cove, south of Cunningham Mountain, Edmunds Township, Washington County, Me. (loc. No. 5.51.5B).
Cat. No. 58944.

Chonetes cobscooki Williams.

Fig. 5.—Mold of the interior of a pedicle valve, showing a form less transverse than some of the specimens of the species and the finer and more numerous lineations than on *Chonetes striatella* Dalman.
Locality: Calcareous shales south of Field Point, Edmunds Township (loc. No. 8.21.1A).
Cat. No. 58949.

Chonetes edmundsi Williams.

Figs. 6, 7.—Pedicle and brachial valves normal size.
Fig. 8.—An enlarged view of a pedicle valve showing spines.
Fig. 9.—Mold of interior of pedicle valve, enlarged.
Locality (specimens 6, 7, and 8 from): One half mile south of Field Point, west shore of Cobscook River, Edmunds Township (loc. No. 8.21.1A); Spec. No. 9, west side Burnt Cove, Edmunds Township (loc. No. 5.51.5A).
Cat. Nos. 58945, 58946.

Brachyprion shaleri Williams.

Fig. 10.—Mold of the interior of a pedicle valve, showing the short crenulated area and smooth terminal portion of the hinge and the subquadrate form of the muscular area bounded by strong subparallel ridges.

Locality: West shore Cobscook River, opposite Wilbur Point, Edmunds Township (loc. No. 8.21.1A).

Cat. No. 58952.

Fig. 11.—Exterior of a small pedicle valve showing the surface sculpture.

Locality: Shore of the small bay west of Field Point, southeast of Balls Mountain, Edmunds Township (loc. No. 8.1.8A).

Cat. No. 58951.

Fig. 12.—Mold of the interior of a brachial valve, showing the hinge crenulations, the cardinal process, the dental sockets, and the strong ridges bounding the muscular impression.

Locality: East shore of Burnt Cove, south of Cunningham Mountain, Edmunds Township (loc. No. 5.51.5B).

Cat. No. 58950.

Palæopecten cobscooki Williams.

Fig. 13.—A nearly complete mold of the interior of a left valve, showing the erect form, the characteristic radii, the pectenoid form, and the crural ridges. This specimen is the type of the new genus *Palæopecten* as well as of the new species *P. cobscooki*.

Locality: East shore of Cobscook River, outside Carrying Place Cove on western side of township of Trescott (loc. No. 5.52.9A).

Cat. No. 58953.

Pterinea (?*Tolmaia*) *trescotti* Williams.

Fig. 14.—A specimen showing the interior of a right valve, its low umbonal region, and concave toward the front.

Locality: Near the end of Crow Neck on the east side of North Trescott (loc. No. 5.33.8A).

Fig. 15.—A left valve, showing natural mold of the exterior with the strong radii, trace of the cardinal teeth and lateral tooth, and well defined and developed anterior ear.

Locality: Same as figure 14.

Cat. No. 58955.

Tolmaia campestris Williams.

Fig. 16.—A left valve, figured from a wax mold of the original specimen, showing the reticulated surface sculpture covering the body and both ear and wing.

Locality: Field Point on west shore of Cobscook River, Edmunds Township (loc. No. 8.1.8D).

Cat. No. 58956.

Palæopecten transversalis Williams.

Fig. 17.—Mold of the interior of a left valve, showing the transversely elongate form, the rays, and absence of a differentiated anterior ear.

Locality: East shore of Cobscook River, same locality as figure 13.

Fig. 18.—Mold of exterior of same specimen.

Cat. No. 58954.

PLATE 30.

New species from the Pembroke formation of Washington County, Maine.

Figs. 1, 2, 3, 4, 5, 6, 7, 8, 9, 11, 12, 13, enlarged 1½ diameters.

Figs. 17, 19, slightly enlarged.

Fig. 21, enlarged 2 diameters.

Fig. 18, enlarged 3 diameters.

Figs. 10, 14, 15, 16, 20, natural size.

Dalmanella lunata (Sowerby).

Fig. 1.—A pedicle valve drawn from rubber mold of the exterior.

Locality: Head of Leighton Cove, Pembroke Peninsula, Washington County, Maine (loc. No. 5.3.8M[3]).

Cat. No. 58957.

Fig. 2.—A small specimen of pedicle valve (?young), a natural mold of the interior.

Locality: Leighton Cove, higher up in section than figure 1 (loc. No. 5.3.8F).

Cat. No. 58958.

Fig. 3.—A pedicle valve of the wider form, taken from a wax mold of the exterior.

Locality: Same as figure 1.

Cat. No. 58957.

Fig. 4.—A small brachial valve (?young), showing the narrow form of *Orthis elegantula* Dalman.

Locality: Same as figure 2.

Cat. No. 58958.

Fig. 5.—A brachial valve, drawn from a wax mold of the exterior, showing the characteristic surface sculpture.

Locality: Same as figure 1.

Cat. No. 58957.

Fig. 8.—A pedicle valve of the wide variety.

Locality: Leighton Cove, a few feet higher in the section than figure 1 (loc. No. 5.3.8.M[1]).

Cat. No. 58959.

Chonetes bastini Williams.

Fig. 6.—Exterior of a pedicle valve.

Locality: Leighton Cove, Pembroke Township (loc. No. 5.3.8F).

Cat. No. 58960.

Fig. 7.—Exterior of a pedicle valve showing a median furrow.

Locality: Leighton Cove (loc. No. 5.3.8.M[3]).

Cat. No. 58961.

Fig. 10.—A slab showing several specimens natural size, showing both the variation in form and the very fine radial lines. The specimen in the left upper corner resembles *C. striatella* and the specimen on the right lower corner *C. nova scoticus.*

Locality: Same as figure 7.

Cat. No. 58961.

Camarotoechia leightoni Williams.

Fig. 9.—A brachial valve showing the median septum, and the concentric imbrications not showing till near the front.

Locality: Leighton Cove (loc. No. 5.3.8M[1]).

Cat. No. 58962.

Fig. 11.—A pedicle valve, showing the concentric imbrications beginning suddenly at about mid growth, the sinus with three well defined plications.

Locality: Same as figure 9.

Cat. No. 58962.

Fig. 12.—A pedicle valve showing widening of the sinus toward front and beginning of division of the plications bounding the sinus.

Locality: Same as figure 9.

Cat. No. 58962.

Fig. 13.—Front view of specimen showing both valves. The specimen is compressed from front to back, making it to appear more gibbous than natural.

Locality: Leighton Cove, a few feet below locality of figure 9 (loc. No. 5.3.8M[3]).

Cat. No. 58963.

Actinopteria fornicata Williams.

Figs. 14, 15, 16.—Three views of the same specimen.
Locality: Shales of the Pembroke formation on northwestern shore of Young's Cove, Pembroke township (loc. No. 5.1.4 B).
Cat. No. 58965.

Actinopteria bella Williams.

Fig. 17.—A natural mold of the exterior of a left valve showing the concentric lines over whole surface, and the radiating lines confined to the body of the shell.
Locality: Leighton Cove (loc. No. 5.3.8M[1]).
Cat. No. 58964.
Fig. 19.—Mold of the interior of a right valve, showing concentric lines over whole surface but no radii.
Locality: Same as figure 17.
Cat. No. 58964.

Lingula scobina Williams.

Fig. 18.—A specimen, enlarged 3 diameters, to show the peculiar surface sculpture and the radiating lines near the front on inner layer of the shell.
Locality: Leighton Cove, Pembroke (loc. No. 5.3.8M[3]).
Cat. No. 58967.

Actinopteria dispar Williams.

Fig. 20.—Mold of the interior of a left valve, ordinary size.
Locality: Leighton Cove, Pembroke (loc. No. 5.3.8 M[2]).
Cat. No. 58966.
Fig. 21.—A small left valve, enlarged 2 diameters.
Locality: Same as figure 20.
Cat. No. 58966.

PLATE 31.

New species from the Pembroke formation of Washington County, Maine.

Specimen 5, enlarged 3 diameters.
Specimens 6, 15, 16, 18, enlarged 2 diameters.
Specimens 1, 2, 3, 4, enlarged 1½ diameters.
Specimens 7, 8, 9, 10, 11, 12, 13, 14, slightly enlarged.
Specimen 17, natural size.

Grammysia pembrokensis Williams.

Fig. 2.—A right valve, slightly more elongate transversely, and the front of the shell more sharply angular than ordinary.
Formation and locality: Hersey red shale member of the Pembroke formation on west shore northernmost cove of Sipps Bay (loc. No. 2.32.9 A).
Cat. No. 58968.

Grammysia cf. *pembrokensis* Williams.

Figs. 1 and 3.—Specimens showing considerable difference in form from the type which is believed to be due to distortion after fossilization.
Locality: Same as figure 2.
Cat. No. 58969.

Grammysia triangulata (Salter).

Fig. 17.—Specimen of a left valve presenting very closely the form of one of Salter's type figures.
Formation and locality: Tough gray sandstone of the Pembroke formation near base at head of Long Cove, Pembroke Township (loc. No. 5.2.9A).
Cat. No. 58970.

Leiopteria rubra Williams.

Fig. 4.—A small left valve.

Formation and locality: Hersey red shale member of Pembroke formation, at head of Sipps Bay, 100 yards south of highway bridge (loc. No. 2.32.6A).

Cat. No. 58971.

Eurymyella shaleri var. *minor* Williams.

Fig. 5.—A small specimen, magnified 3 diameters, showing the form of the type species, but of the small size, as it occurs in the Eastport formation.

Formation and locality: Hersey red shale member of the Pembroke formation on west shore of Sipps Bay, south of the highway bridge, Pembroke Township (loc. No. 2.32.9A).

Cat. No. 58972.

Lingula minima var. *americana* Williams.

Fig. 6.—A specimen slightly larger than ordinary (magnified 2 diameters), showing the general form and size of the species.

Locality: Same as Figure 5 (loc. No. 2.32.9A).

Cat. No. 58973.

Modiolopsis leightoni Williams.

Figs. 7, 8, 9, and 10.—A set of two right and two left valves showing the ordinary expression of the species where it is found in abundance, fluctuating both in form and surface characters.

Formation and locality: Argillaceous shales in the lower portion of the Pembroke formation. Leighton Cove, Pembroke Township (loc. No. 5.3.8F and M).

Cat. No. 58974, U.S.N.M.

Modiolopsis leightoni var. *quadrata* Williams.

Figs. 12, 13.—Two left valves showing the ordinary expression of the quadrate form.

Locality: Same as figures 7–10.

Cat. No. 58975.

Nuculites corrugata Williams.

Fig. 11.—A left valve, slightly shorter and ventral margin slightly more arched than ordinary.

Formation and locality: Gray argillaceous shale of lower part of Pembroke formation at head of Leighton Cove (loc. No. 5.3.8F).

Cat. No. 58976.

Fig. 14.—A right valve of nearly normal form, except that the ventral border is rolled under, making the edge nearly straight.

Locality: Same as figure 11.

Cat. No. 58976.

Platyschisma helicites Sowerby.

Figs. 15, 16.—Two views of a specimen somewhat crushed, making it to appear with lower spire than ordinary.

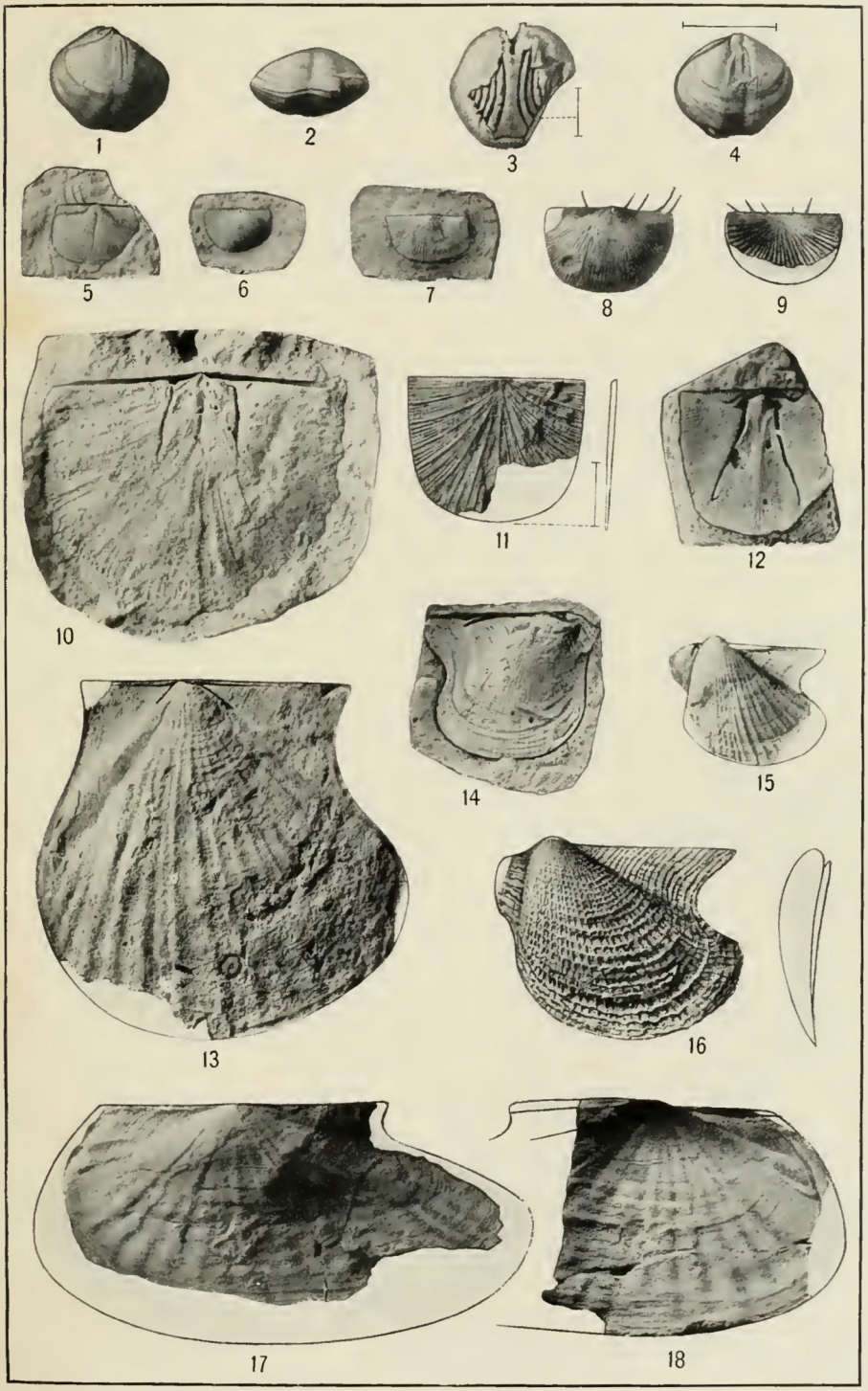
Formation and locality: Hersey red shale member of the Pembroke formation on eastern shore of Hersey Cove, Pembroke Township (loc. No. 2.42.8A).

Cat. No. M1243.

Fig. 18.—A slab showing molds of several small specimens which were probably immature.

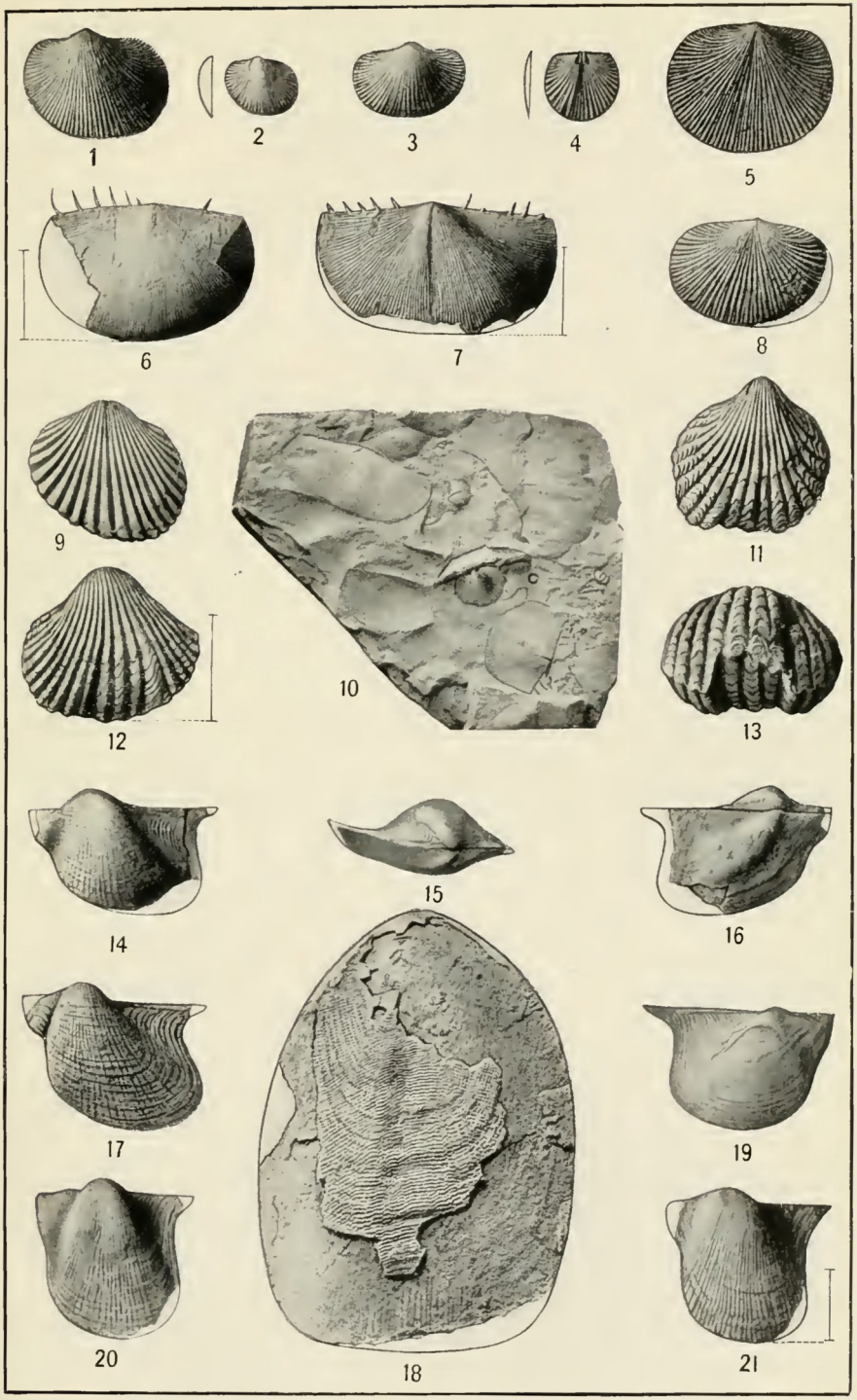
Formation and locality: Hersey red shale member of Pembroke formation on eastern shore Hersey Cove (loc. No. 2.52.3A).

Cat. No. 58977.



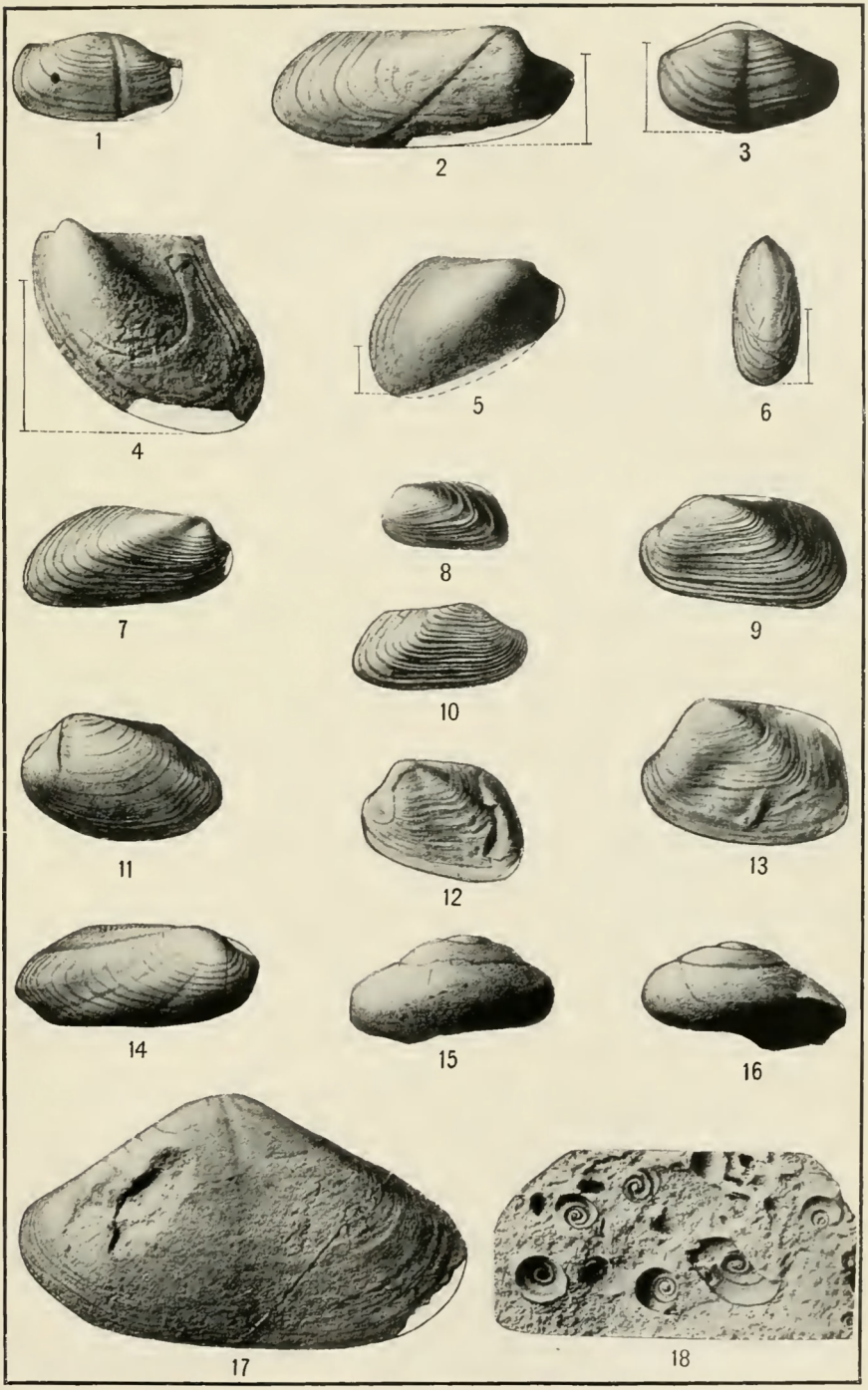
NEW SPECIES OF SILURIAN FOSSILS.

FOR EXPLANATION OF PLATE SEE PAGES 348 AND 349.



NEW SPECIES OF SILURIAN FOSSILS.

FOR EXPLANATION OF PLATE SEE PAGES 349-351.



NEW SPECIES OF SILURIAN FOSSILS.

FOR EXPLANATION OF PLATE SEE PAGES 351 AND 352.

NEW PARASITIC HYMENOPTERA BELONGING TO THE TRIBE XORIDINI.

By S. A. Rohwer,

Of the Bureau of Entomology, United States Department of Agriculture.

This paper, which is a contribution from the Branch of Forest Insects of the Bureau of Entomology, United States Department of Agriculture, contains descriptions of all the new species of parasitic Hymenoptera belonging to the tribe Xoridini which have been accumulated by the above-mentioned branch of the bureau, and also those which have been found in the collections of the National Museum. The types of all the species here described are in the collections of the United States National Museum. The paper is presented at the present time so the names of some of the species here described may be available for economic purposes.

Genus XYLONOMUS Gravenhorst.

According to the material at hand *Xylonomus* may be separated into three groups by the following table. These groups, as well as some others, are considered by Schmiedeknecht as subgenera. The recognition of subgenera on the position of the transverse median of the fore wings would necessitate the making of additional subgenera to include species in which the transverse median is squarely interstitial with the basal.

Table to subgenera of Xylonomus.

Antennæ of both sexes hairy, the female only toward the apex (female antennæ ringed with white, male antennæ not banded; first dorsal abdominal segment with two complete carinæ; second dorsal abdominal segment wider than long; abdomen coarsely sculptured).....*Sterotrichus* Foester.

Antennæ not hairy although female may have short bristles apically..... 1.

1. Second dorsal abdominal segment not as long as or subequal with its apical width. *Xylonomus* Gravenhorst.

Second dorsal abdominal segment much longer than its apical width. *Mærophora* Foester.

XYLONOMUS (XYLONOMUS) PLESIUS, new species.

This species is related to *frigidus* Cresson, but it may be readily separated from that species by the longitudinal carinæ of the first abdominal segment being complete.

Female.—Length to the apex of the abdomen 12 mm., length of the ovipositor 12 mm. Face in the middle granular, laterally irregularly, transversely striate; the area between the ocelli and the antennæ with well-defined separate punctures; vertex and posterior orbits shining, practically impunctate; postocellar line distinctly longer than the ocellocular line; antennæ much longer than the head and thorax, the third and fourth antennal joints subequal; the anterior, lateral angles of the pronotum subtuberculate; prescutum long, well defined; notauli transversely foveolate; scutum and prescutum opaque with fine irregular punctures; mesepisternum shining, impunctate; propodeum opaque, obliquely striato-granular; basal area and areola confluent, areola heptagonal, about one-third longer than its apical width; the posterior legs of the sides one-third longer than the anterior legs and parallel; posterior lateral angles subdentate; first abdominal segment coarsely reticulato-granular, constricted at spiracles, with two longitudinal carinæ which originate slightly anterior to the constriction and extend to the posterior margin; these carinæ broaden anteriorly to the constriction, narrow at the constriction and slightly broaden posteriorly; second abdominal segment coarsely reticulato-granular with oblique furrows on the lateral anterior angles; the third and following abdominal segments aciculato-granular. Black; tarsi piceous; wings hyaline, venation dark brown.

Described from one female in the United States National Museum collection, labelled "Collection of C. V. Riley."

Type.—Cat. No. 15365, U.S.N.M.

XYLONOMUS (XYLONOMUS) RUFICOXIS, new species.

Superficially this species resembles in size and general appearance *humeralis* Say, but *humeralis* belongs to a different subgenus.

Female.—Length to the apex of the abdomen 16 mm., length of the ovipositor 14 mm. Face coarsely striato-punctate; head opaque with a number of widely scattered punctures; the lateral ocelli much below the supraorbital line, separated from each other by the distance almost twice as great as the ocellocular line; antennæ much longer than the head and thorax, the third joint slightly shorter than the fourth; anterior face of the pronotum shining, with a number of widely scattered, distinct punctures; dorsal lateral angles of the pronotum strongly, sharply tuberculate; prescutum long, posteriorly strongly, transversely striate, anteriorly shining, along the sides striato-punctate, in the middle with large distinct separate punctures;

scutum medianly transversely striate, laterally with a few large punctures; mesepisternum shining, practically impunctate; propodeum coarsely punctured; basal area separated from the areola by a short longitudinal furrow; basal area triangular in outline, sides but little shorter than its basal width; areola heptagonal, the posterior part of the lateral defining carina slightly longer than the anterior part, areola coarsely reticulate; lateral areas of dorsal aspect of the propodeum transversely wrinkled; propodeum not dentate laterally but sharply angulate; first abdominal segment punctato-striate, basally with poorly defined longitudinal carinæ; the second abdominal segment transversely striato-punctate; third abdominal segment transversely striato-punctate but more finely so than the second; the third and following segments finely, transversely aciculate; transverse median of the fore wings almost squarely interstitial with the basal but really slightly beyond. Black; a white annulus on the antennæ beyond the middle; posterior coxæ rufous; wings hyaline; venation dark brown.

Apalachicola, Florida. Described from two females collected by W. F. Fiske and recorded under the Bureau of Entomology No. Hopk. U. S. 3381a.

Type.—Cat. No. 15366, U.S.N.M.

XYLONOMUS (MAEROPHORA) YUKONENSIS, new species.

This species is related to the foregoing one, but may be separated by the areola being but little longer than its greatest width and the posterior portion converging posteriorly.

Female.—Length to the apex of the abdomen 10 mm., length of the ovipositor 8 mm. Face transversely, irregularly striate; a faint tubercule between the bases of the antennæ; area between the antennæ and the ocelli shining, practically impunctate; posterior orbits shining, practically impunctate; anterior face of the pronotum finely striate on a granular surface, ventrally and posteriorly foveolate; dorsal lateral angles of the pronotum subdentate; scutum and prescutum shining, impunctate; notauli transversely striate; posteriorly the apex of the scutum is rather coarsely reticulate; mesepisternum shining, practically impunctate; propodeum opaque, obliquely irregularly striate; areola and basal area separated by a transverse carina; basal area trapezoidal in outline, about twice as wide anteriorly as posteriorly; areola about one and one-third times longer than broad, hexagonal in outline, greatest width occurring at the anterior third, posteriorly converging; dorsal lateral angles of the propodeum subdentate; first abdominal segment finely granular basally, posteriorly reticulato-granular with two faint but complete longitudinal carinæ; second and following abdominal segments opaque, finely reticulate; transverse median of the fore wings a little

beyond the basal vein. Black; four anterior legs and the posterior coxæ rufous; wings hyaline; venation dark brown.

Fort Yukon, Alaska. Described from one female collected by L. M. Turner.

Type.—Cat. No. 15367, U.S.N.M.

XYLONOMUS (MAEROPHORA) EASTONI, new species.

Female.—Length to the apex of the abdomen 10 mm., length of the ovipositor 10 mm. Face transversely striato-punctate; area between the antennæ and the ocelli punctate, more sparsely so above; posterior orbits longitudinally striate; postocellar line almost twice as long as the ocellocular line; anterior face of the pronotum with distinct separated punctures, lateral margin of the pronotum with an elongate, small tubercule; prescutum poorly defined, anteriorly finely granular, laterally rather coarsely reticulate, posteriorly transversely, irregularly striate; scutum transversely, irregularly striate; scutellum with distinct separate punctures; mesepisternum shining, irregularly striato-punctate; sides of the propodeum reticulate, dorsally the propodeum is punctato-reticulate; basal area and the areola separated by a transverse carina; basal area trapezoidal in outline, about four times as wide basally as apically; areola hexagonal in outline, more than twice as long as its greatest width, narrowing at the anterior third, subparallel posteriorly; propodeum not dentate laterally; abdomen finely granular; first abdominal segment without carinæ or depressions, subdentate at the spiracles; transverse median of the fore wings distinctly beyond the basal vein; third antennal joint slightly shorter than the fourth. Black; four anterior legs and the posterior coxæ rufous; wings hyaline; venation dark brown.

Fall River, Massachusetts. Described from one female collected May 31, 1910, by N. S. Easton, for whom the species is named.

Type.—Cat. No. 15368, U.S.N.M.

XYLONOMUS (MAEROPHORA) DUPLICATUS, new species.

Superficially this species is like *albopictus* Cresson, but may be readily separated from that species by the areola and the basal area of the propodeum being separated by a transverse carina (in *albopictus* the areola and the basal area are separated by a longitudinal carina).

Male.—Length 10 mm. Slender. Entire head shining, practically impunctate; anterior face of the pronotum finely punctured, ventrally and posteriorly foveolate; dorsal lateral angles subdentate; prescutum long; the notauli foveolate posteriorly; scutum and prescutum with distinct, well separated punctures; mesepisterum shining with a few widely separated punctures; propodeum shining; areola and basal area separated by a transverse carina; areola hexagonal

in outline, two and one-half times as long as its greatest width which occurs basad of the middle, posteriorly the areola slightly converges; basal area trapezoidal in outline, about twice as wide basally as apically; posterior lateral angles of the propodeum strongly dentate; first abdominal segment transversely striate, with two complete longitudinal nearly parallel carinæ; second, third, fourth, and fifth abdominal segments coarsely, irregularly reticulato-granular, the apical segments shining, finely aciculate; transverse median of the fore wings beyond the basal vein. Black, variegated with white; the following parts white: clypeus, face except a small median spot, inner orbits above the antennæ, scape beneath, posterior orbits, spot on dorsal and ventral margins of the pronotum, prepectus above, tegulæ, metapleuræ, scutellum, metanotum, apex of the propodeum, sides of the dorsal lateral apical margin of the abdominal segments; the four anterior legs rufous, coxæ beneath white; posterior legs, except the trochanters and base of the tibiæ which are white, black to piceous on the tarsi; wings hyaline; venation dark brown.

Clark Station, Missouri (near St. Louis). Described from one male collected by A. D. Hopkins and recorded under the Bureau of Entomology No. Hopk. U. S. 2848e.

Type.—Cat. No. 15369, U.S.N.M.

XYLONOMUS (MAEROPHORA) PICEATUS, new species.

Xylonomus stigmapterus SAY, Howard, Insect Book, 1904, pl. 9, fig. 2.

This species is related to *humeralis* Say, but may be separated from it by the dark ferruginous color, and the different proportions of the sides of the areolation of the propodeum.

Female.—Length to the apex of the abdomen 17 mm., length of the ovipositor 15 mm. Face irregularly reticulate; a strong carina projecting between the bases of the antennæ; the area between the ocelli and the antennæ closely, distinctly punctured; dorsad and ventrad of the anterior ocellus is a deep furrow; postocellar line about two and one-half times as long as the ocellocular line; posterior orbits strongly striate; pronotum densely punctured, with the dorsal lateral angles strongly, sharply tuberculate; prescutum long, well defined, with a shallow median depression, anteriorly densely (some places confluently) punctured, posteriorly transversely striate; scutum strongly punctured, anteriorly the punctures are confluent so there is a transverse striation; mesepisternum with close punctures; propodeum closely punctato-reticulate; basal area triangular in outline, separated from the areola by a longitudinal carina; areola heptagonal in outline, with sides of the areola one-fourth shorter than the anterior carina; propodeum not dentate laterally; first three abdominal segments coarsely reticulate, the following finely reticulate; first abdominal segment longitudinally depressed basally, slightly dentate

at the spiracles; transverse median slightly beyond the basal vein. Dark rufo-ferruginous; antennæ beyond the middle with a broad white annulus; legs ferruginous, paler at the knees; tarsi and wings strongly dusky; venation dark brown.

Dade County, Florida. Described from one female collected by E. A. Schwarz.

Type.—Cat. No. 15370, U.S.N.M.

XYLONOMUS (MAEROPHORA) MODESTUS, new species.

Male.—Length 14 mm. Antennæ 11 mm. Face transversely striato-punctate; no tubercule between the bases of the antennæ; area between the antennæ and the ocelli punctate, which laterally becomes striato-punctate; posterior orbits finely longitudinally striate; vertex punctate in the middle, laterally striato-punctate; postocellar line slightly longer than the ocellocular line; anterior face of the pronotum finely punctured; scutum and prescutum shining, punctured, the punctures become confluent so in some places striato-punctate; mesepisternum shining, with distinct, regular, well separated punctures; propodeum shining, laterally reticulate, dorsally practically impunctate; basal area and areola separated by a transverse carina; basal area trapezoidal in outline, the basal width two and one-half times as great as the apical width; areola hexagonal in outline, but laterally the angulation is very poor, about two and one-half times as long as its greatest width; first abdominal segment transversely irregularly striato-granular, distinctly angulate at the spiracles, with two complete longitudinal carinæ which terminate as a rounded tubercule at the middle of the first apical abdominal segment; second, third, and fourth abdominal segments opaque, transversely irregularly striate; transverse median of the fore wings slightly beyond the basal vein. Black; anterior legs ferruginous, the femora basally piceous; intermediate legs piceous; posterior legs, except the second to fourth joints of the tarsi, black; venation black; wings hyaline.

Skykomish, Washington. Described from one male collected June 23, 1892.

Type.—Cat. No. 15371, U.S.N.M.

Genus ODONTOMERUS Gravenhorst.

ODONTOMERUS ATRIPES, new species.

This species may, in the female, be readily distinguished by the red abdomen and black legs.

Female.—Length to the apex of the abdomen 11 mm., length of the ovipositor 11 mm. Face shining with irregular, well defined, rather

close punctures; head above the antennæ shining with a few scattered, irregular punctures; cheeks more densely punctured; a deep furrow between the lateral ocelli; postocellar line about one-sixth shorter than the ocellocular line; antennæ much longer than the head and thorax, the third antennal joint one-fifth longer than the fourth; anterior face of the pronotum practically impunctate, ventrally foveolate as it is also posteriorly; thorax shining with a few well scattered punctures; prescutum long, well defined; notauli not foveolate; basal area and areola confluent; areola about twice as long as its greatest width, hexagonal in outline, rather sharply angulate in the middle; the posterior face, as seen from above, deeply emarginate anteriorly; tubercules on the propodeum rounded, placed on the lateral dorsal angle; first abdominal segment transversely striate in the middle, apically shining; faintly tuberculate at the spiracles; anteriorly impressed by a longitudinal furrow; most of the second abdominal segment and all of the following shining, impunctate; propodeum and femora with sparse white hair. Black; abdomen beyond the second segment red; wings rather strongly dusky; venation black.

Male.—According to the description of the male of this species it is related to *æthiops* Cresson but differs from the original description in having the second and following abdominal segments nearly impunctate (not rather densely punctured).

Length 9 mm. Length of the antennæ 10 mm. Face shining with regular, well defined, separate punctures; head above the antennæ shining, practically impunctate; cheeks with a number of fine punctures; area between the lateral ocelli not separated by a furrow; postocellar line a trifle shorter than the ocellocular line; anterior face of the propodeum shining, almost impunctate, ventrally and posteriorly foveolate; prescutum long, well defined; notauli not foveolate; thorax shining, practically impunctate; basal area and areola confluent; the areola transversely, irregularly rugose, hexagonal in outline, about two and one-fourth times as long as its greatest width which occurs at the anterior third; the posterior face, as seen from above, deeply emarginate anteriorly, tubercules on the lateral dorsal margin; dorsal aspect of the first abdominal segment in the middle longitudinally reticulate, slightly tuberculate at the spiracles, anteriorly with a longitudinal furrow; base of the second abdominal segment irregularly reticulate, the apex of the second and all of the following segments shining, impunctate; head and thorax with rather dense gray hair; wings dusky hyaline; venation black.

Described from one female collected at Franconia, New Hampshire, and one male, the male collected at Princeton, Maine, July 12, 1904, by C. W. Johnson.

Type.—Cat. No. 15372, U.S.N.M.

ODONTOMERUS ALASKENSIS, new species.

Colored like *mellipes*, but may be separated from it as well as from all other species in North America by the obsolete carinæ of the propodeum and by the short prescutum.

Female.—Length to the apex of the abdomen 8 mm., length of the ovipositor 8 mm. Face shining with a few distinct scattered punctures; cheeks and head above the antennæ practically impunctate; postocellar line one-third shorter than the ocellocular line; area between lateral ocelli separated by a furrow; antennæ much longer than the head and thorax, third and fourth joints subequal; anterior face of the pronotum coarsely punctured, in the middle the punctures become confluent so as to give a striate appearance; mesepisternum shining, practically impunctate; prescutum short, as wide as long, not sharply defined posteriorly, it and the scutum shining, very sparsely punctured; propodeum opaque, finely punctured or punctato-reticulate; carina practically obsolete but indicated under high power when the areolation is as in *mellipes;* first abdominal segment longitudinally striato-granular, faintly dentate at the spiracles with a broad longitudinal depression; the apex of the second and the entire following segments shining, practically impunctate; propodeum with sparse gray hairs. Black; palpi piceous; legs entirely rufous; wings dusky hyaline, iridescent; venation dark brown.

Sitka, Alaska. Described from two females collected by T. Kincaid. The paratype is 6½ mm. long, and slightly piceous; otherwise it seems to be the same. This species was determined as *mellipes* by Ashmead.

Type.—Cat. No. 15373, U.S.N.M.

ODONTOMERUS ERRANS, new species.

Related to *mellipes* (Say), but may be readily separated from that species by having the basal area of the areola separated by a transverse carina (in *mellipes* the basal area and the areola are confluent).

Female.—Length to the apex of the abdomen 12 mm.; length of the ovipositor 12 mm. Face closely, finely punctured; head above the antennæ shining with a few irregular punctures; lower part of cheeks with large, widely scattered punctures; the postocellar line much shorter than the ocellocular line; no furrow between the lateral ocelli; antennæ a little longer than the head and thorax, the third antennal joint one-third longer than the fourth; thorax densely pubescent, subopaque with a few widely scattered punctures; notauli complete, not foveolate; anterior face of the pronotum transversely irregularly striate; sides of the propodeum shining, dentation of the propodeum occurring below the dorsal lateral angle; basal area trapezoidal in outline, about four times as wide basally as apically;

areola separated from the basal area by a transverse carina, about two and one-fourth times as long as its greatest width, apically rounded, roundedly dentate by the arched carina separating the two faces; first abdominal segment shining, apically with a few irregular, fine striations, faintly dentate at the spiracles; the base of the second abdominal segment irregularly, transversely striate; apex of the second and the following segments with faint granulations. Black; palpi and legs rufous; wings hyaline, faintly dusky; venation dark brown.

South Dakota. Described from one female without further data.

Type.—Cat. No. 15374, U.S.N.M.

ODONTOMERUS DICHROUS, new species.

This species is related to *bicolor* Cresson, but may be separated by having the sides of the propodeum finely punctured, the notauli finely, irregularly foveolate, the propodeal tooth on the dorsal lateral angle, the areola of the propodeum not three times as long as the basal width and sharply angulate, as well as other minor characters.

Female.—Length to the apex of the abdomen 13 mm.; length of the ovipositor 17 mm. Face with distinct, well-defined punctures which are closer in the middle; head above the antennæ polished, with a few irregular scattered punctures; the lower portion of the cheeks finely, irregularly punctured; ocelli in a low triangle; the postocellar line much shorter than the ocellocular line; a deep furrow between the lateral ocelli; antennæ much longer than the head and thorax, the third joint about one-third longer than the fourth; thorax shining, polished; scutum with a few irregular punctures; notauli finely, irregularly foveolate posteriorly; scutellum rather more densely punctured than the scutum; the anterior face of the pronotum punctate; the mesepisternum nearly impunctate; sides of the propodeum finely punctured, below the longitudinal carina striato-punctate; basal area and the areola confluent, the areola about two and one-half times as long as its greatest width, broadened near the middle where it is sharply angulate; posterior face of the propodeum transversely and obliquely rugose; dentation of the propodeum on the dorsal lateral angle; first abdominal segment longitudinally striato-granular, tuberculate at the spiracles; base of the second abdominal segment transversely striato-reticulate, apex of the second and the following abdominal segments impunctate; legs and venation of the normal type. Black; legs and abdomen entirely rufous; wings dusky hyaline, vitreous; venation black.

Longmires, Washington. Described from one female collected by H. E. Burke, August 2, 1905.

Type.—Cat. No. 15375, U.S.N.M.

THREE INTERESTING BUTTERFLIES FROM EASTERN MASSACHUSETTS.

AUSTIN HOBART CLARK,
Assistant Curator, Division of Marine Invertebrates, United States National Museum.

The three following records relating to the diurnal lepidoptera of eastern Massachusetts seem worthy of publication. The specimens upon which they are based have been deposited in the United States National Museum.

Junonia cœnia, which is abundant in the Southern States, reaches the northern limit of its range in southern New England; *Euphydryas phaëton* occurs from West Virginia and Missouri northward to northern Canada, reaching as far as Lake of the Woods; it is very local in its distribution, but is usually very common wherever found; *Feniseca tarquinius* ranges from the Mississippi Valley and the Carolinas to Nova Scotia, but is rare and local in eastern Massachusetts.

JUNONIA CŒNIA Hübner.

In my private collection I had two specimens of this species, taken in the summer months of 1895 or 1896, one in Mount Vernon Terrace, Newtonville, the other just north of Mount Vernon Street, near the Newtonville-West Newton border. The former has been lost, but the latter is in the national collection.

I have found this insect commonly at Coffin's Beach, opposite Annisquam, in July, but otherwise it is of very uncertain occurrence in the middle and northern portions of the State.

EUPHYDRYAS PHAËTON (Drury).

Plate 32.

In the latter part of June, 1897, while crossing a boggy meadow in Newtonville, Massachusetts, bounded on the north by Otis Street and on the east by Lowell Avenue, I found this species, previously unknown in that locality, very abundant. Returning immediately with my net, I captured about thirty specimens, among them the one described below. So far as I know no butterflies of this species have ever been taken in this locality since.

I found upon consulting the literature that my aberrant specimen was essentially similar to one described by Strecker [1] as *Melitæa* (i. e.,

[1] Butterflies and Moths of North America, 1878, p. 125.

Euphydras) *phæton*, ab *a*, *superba*, and also by Hulst,[1] which was taken on Long Island, New York, in 1875. On June 21 I wrote to Mr. Samuel Scudder in regard to my capture, and, under date of June 24, he replied: "The suffused specimen of *phaëton* which you describe is different from those heretofore known, and it would be worth your while to describe it. These aberrations are always interesting, and when they are accumulated in sufficient numbers will serve as a basis for some general statement which can hardly be made now. Your specimen ought finally to rest in some public museum."

Mr. W. F. Fiske[2] has also described a very similar specimen which he captured in Webster, New Hampshire, on June 12, 1895, in a bog where the species had never previously been observed and where diligent search failed to discover more.

The specimen is a female, and much larger than the average for the species, measuring 64 mm. in expanse. The wings are more rounded than in typical examples, the outer margins of the primaries being convex and not straight or slightly concave in the posterior two-thirds as in the typical form.

The upper surface is not greatly different from that of the typical form, though the yellow spots are much enlarged and more or less confluent.

On the lower surface the yellow spots are enormously enlarged and confluent, forming a broad yellow (of a lighter tint than usual) band of uniform width, extending inward from the red border, from which it is separated by the usual black lunules, to the middle of the wings. This yellow band is crossed by black veins, which are narrowly bordered by black and grayish scales. In the middle and parallel to the borders there is a faint indicated grayish narrow stripe. The usual yellow spots on the inner half of the secondaries are absent, and the red spots are much enlarged; they are separated from the broad yellow band by a narrow but distinct black line.

FENISECA TARQUINIUS (Fabricius).

This insect is rare in eastern Massachusetts and, though I collected constantly in that region for a number of years, I was never able to capture a specimen. Long after my attention had been diverted from entomology into other fields of zoological activity, I noticed, on July 25, 1910, a single specimen flying low over the lawn of the house at the southwest corner of the intersection of Lowell and Highland Avenues, Newtonville. Seizing the hat from the head of a child which was playing near by, I succeeded, with this substitute for a net, in capturing it.

[1] Bulletin Brooklyn Entomological Society, vol. 3, p. 77, pl. I.
[2] Entomological News, vol. 7, March 1896, p. 87.



EUPHYDRYAS PHAETON (DRURY); UNDERSIDE OF A SUFFUSED FEMALE REPRESENTING THE VARIETY SUPERBA STRECKER. NATURAL SIZE. DRAWN BY MISS V. DANDRIDGE.

MISCELLANEOUS CONTRIBUTIONS TO THE KNOWLEDGE OF THE WEEVILS OF THE FAMILIES ATTELABIDÆ AND BRACHYRHINIDÆ.

By W. Dwight Pierce,

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The present paper contains a large number of miscellaneous studies which have been made in the taxonomy of the weevils of the tribe Rhynchitini, family Attelabidæ, and of the family Brachyrhinidæ. The paper includes fixations of the types of all of the North American genera in these two groups and also descriptions of 4 new genera, 2 new subgenera, 24 new species, and 9 new varieties.

A complete paper on the types of the genera of the Rhynchophora for the world is in the process of preparation.

The classification used below is to a large measure based upon that proposed by Lacordaire, although many alterations have been made, and group names have been given in accordance with our established rules of nomenclature.

Family ATTELABIDÆ Kirby (1837).

Subfamily RHYNCHITINÆ Pascoe (1870).

The following tables, while not entirely satisfactory, are the best that can be offered without considerable additional study:

Key of tribes of Rhynchitinæ.

1. Elytra striately punctate; third joint of tarsi more or less dilated.
   Rhynchitini, new tribe.
2. Elytra not striately punctate; third joint of tarsi not dilated.
   Auletini, new tribe.

RHYNCHITINI, new tribe.

Key to genera of Rhynchitini.

Posterior coxæ transverse, reaching metepisterna, which are very narr

1. Head arcuately emarginate at base; antennæ with first joint, only, of funicle, sensibly longer than wide; centro-sternal piece separating the apices of the proepimera ..... *Deporaus* Leach.
2. Head not emarginate or truncate at base; antennæ with funicular joints 2 to 4, at least, longer than wide.
   a^1. Pygidium covered by elytra ..... *Eugnamptus* Schönherr.
   a^2. Pygidium exposed.
      b^1. Apices of proepimera separated by centro-sternal piece.. *Merhynchites* Sharp.
      b^2. Apices of proepimera joined ..... *Rhynchites* Schneider.

The centro-sternal piece of the prosternum is a tiny piece behind or separating the epimera. The term was first used by Sharp.[1] Everts in the following year published "Quelques remarques à sujet d'une Etude de Mr. David Sharp sur la structure du prosternum dans les Rhynchorides."[2] This is a character which merits considerable study.

This table in a measure follows Desbrochers. If the definition of *Deporaus* is correct, our *glastinus* LeConte must be assigned to *Rhynchites* or a new genus.

Genus DEPORAUS Leach (1819).

Platyrhynchus THUNBERG, Nov. Act. Upsal., vol. 7, 1815.
Deporaus LEACH, Samouelle's Compendium, 1819, p. 201.

The genus *Deporaus* is monotypic, based on *betulæ* Linnæus. Crotch (1870) designated the same species as type of *Platyrhynchus*. The latter name is preoccupied by Desmines (1805) in Aves.

Genus EUGNAMPTUS Schönherr (1839).

Eugnamptus SCHÖNHERR, Gen. Curc., vol. 5, 1839, p. 339.

The type was originally designated as *collaris* Fabricius.

The sexes of this genus are readily distinguished by the male beak being shorter, eyes larger and closer together, and by the male mandibles being externally one-toothed, while the female mandibles are externally two-toothed.

Table of species and varieties of Eugnamptus.

I. Elytral interspaces narrower than the striæ; eyes in male not greatly larger than in female.

1. Interspaces very convex; strial punctures large, quadrate, crowded; head strongly punctured in male, more moderately in female; front foveate in female and medially sulcate in male; black or piceous black, head and thorax reddish. Florida. Length 4.5–5 mm ..... *striatus* LeConte.

2. Interspaces almost flat; strial punctures round, less crowded; head strongly punctured; front more or less sulcate; testaceous, elytra sometimes piceous black or clouded. Maryland to Florida and Kansas. Length 2.7–4 mm. *puncticeps* LeConte.

II. Elytral interspaces as wide as or wider than the striæ; eyes in male considerably larger than in the female and much more approximate.

3. Elytra bluish.

a^1. Head finely punctured.

b^1. Elytra bluish green; elytral interspaces flat; front sulcate; prothorax strongly punctured, medially depressed or sulcate; head, thorax, antennæ and legs reddish, venter black. Arizona. Length 5–6 mm. *nigriventris* Schaeffer.

b^2. Elytra bluish black.

[1] Trans. Ent. Soc. Lond., 1889, pt. 1.
[2] Tijdschrift voor Entomologie, vol. 32, for 1889–1890 (1890), pp. 349–353, pl. 15.

c^1. Abdomen black; front smooth in female, carinate at base in male; elytral interspaces with a faint external rim bordering the striæ; prothorax moderately to strongly punctured, medially depressed or sulcate. *collaris* Fabricius.

d^1. Entirely black, except elytra, head sometimes with red frontal spot. Massachusetts to Kansas and Virginia. Length 4.2–4.7 mm. var. *nigripes* Melsheimer, female.

d^2. Body black, elytra bluish black, legs reddish, head sometimes with red frontal spot. Massachusetts to Kansas and Virginia. Length 3.5–3.7 mm.....var. *fuscipes*, new variety, male, female.

d^3. Body black, thorax red, elytra bluish black. Massachusetts to Iowa, Florida and Louisiana. Length 3.5–4.5 mm. var. *collaris* Fabricius, male, female.

d^4. Body black; head, thorax, and appendages reddish, elytra bluish black. Texas. Length 4 mm.....var. *ruficeps*, new variety, male, female.

c^2. Abdomen entirely or in most part reddish testaceous; front sulcate; elytral interspaces slightly convex; prothorax strongly punctured, medially depressed or sulcate; body reddish throughout, eyes black, elytra nigrocoeruleus. Alabama to Texas. Length 3.2–4.7 mm. *sulcifrons* Gyllenhal.

a^2. Head strongly punctured; elytral interspaces convex, not wider than the striæ; prothorax strongly punctured, medially depressed or sulcate. Arizona. *punctatus*, new species.

e^1. Entirely black, elytra nigrocoeruleous. Length 4.5 mm. var. *niger*, new variety, female.

e^2. Black, thorax red, elytra nigrocoeruleous. Length 4 mm. var. *punctatus*, typical variety, female.

4. Elytra testaceous or piceous black.

f^1. Head moderately to strongly punctate; thorax medially depressed; front sulcate.....*angustatus* Gyllenhal.

g^1. Head and thorax strongly punctate; color uniformly rufotestaceous. Texas. Length 4.2 mm.....var. *testaceus*, new variety, male.

g^2. Head and thorax moderately punctate; thorax medially depressed; front sulcate; color rufotestaceous, elytra more or less piceous black. Virginia to Texas. Length 3.7–4.2 mm..var. *angustatus* Gyllenhal, male, female.

f^2. Head and thorax finely punctured, front sulcate; color pale testaceous. Texas and Arizona. Length 3.2–4 mm.....*pallidus* Schaeffer.

This is one of the most difficult genera in the Rhynchophora to separate into species. The writer has had at hand about 150 individuals representing what appear to be eight distinct species and five additional color variations. The characters available are not as easy to use as the characters in other genera.

EUGNAMPTUS STRIATUS LeConte.

This species is characteristic of Florida in this country, being represented from Crescent City and Haulover. It has only been taken in March on a single species of *Quercus*.

EUGNAMPTUS PUNCTICEPS LeConte.

This species is the smallest before the writer. Specimens have been taken at Rosslyn, Virginia; Plummers Island, Maryland; Jacksonville, Florida; Oak Grove, Alabama; Meridian, Mississippi; Cov-

ington, Louisiana; Onaga, Kansas; Kenosha, Nebraska. The collecting dates range from June 19 to August 25. At Plummer's Island Mr. Schwarz reports having taken it only on *Rhus copalina*.

EUGNAMPTUS NIGRIVENTRIS Schæffer.

This species seems to be peculiar to Arizona. Material is at hand from the Santa Rita Mountains, Chiricahua Mountains, and Huachuca Mountains, dated May 29 to June 19. It occurs in the canyons on *Quercus*.

EUGNAMPTUS COLLARIS Fabricius.

Schönherr designates three varieties of this species:

var. α—black, thorax red.

var. β—head above red, elytra nigrocoeruleous.

var. γ—nigrocoeruleous, head only red.

It has been found necessary to designate four varieties and names have been given them because they have long been a source of puzzlement to American students. There does not seem to be any name directly applicable to the second or fourth varieties, and therefore new names are proposed. The names *ruficollis* Germar and *rubricollis* Say are both applicable to var. *collaris* Fabricius.

EUGNAMPTUS COLLARIS NIGRIPES Melsheimer.

Entirely black, except elytra, head sometimes with red frontal spot. Length 4.2–4.7 mm.

Only females have been found to represent this variety. It is at hand from Marion, Massachusetts; Lime Rock, Pennsylvania; Washington, District of Columbia; Plummers Island, Maryland; Afton and Rosslyn, Virginia; Retreat, North Carolina; Nashville, Tennessee; Mobile, Alabama; Detroit, Michigan; Iowa; Missouri; Kansas; and Dallas, Texas. The collecting season is according to these records from May 15 to August.

EUGNAMPTUS COLLARIS FUSCIPES, new variety.

Body black, elytra bluish black, legs reddish, head sometimes with red frontal spot. Length 3.5–3.7 mm.

Two females are at hand from Kansas and Kimmswick, Missouri. Males have been found at Marion, Massachusetts; Washington, District of Columbia; Plummers Island, Maryland; Rosslyn, Virginia; Harper's Ferry, West Virginia; Nashville, Tennessee; Langdale, Alabama; Detroit and Port Huron, Michigan; and Kimmswick, Missouri. The dates of collection range from May 19 to August.

Type.—Cat. No. 14623, U.S.Nat.Mus. (Detroit, Michigan).

EUGNAMPTUS COLLARIS COLLARIS Fabricius.

Body black, thorax red, elytra bluish black. Length 3.5–4.5 mm.

The typical form of this species is found in both sexes. The records of occurrence are from Chicopee and Montgomery, Massachu-

setts; Lime Rock, Pennsylvania; Plummers Island and Bladensburg, Maryland; Afton, Virginia; Retreat, North Carolina; St. Catherine Island, Georgia; Jacksonville, Florida; Oak Grove, Mobile, Jackson, Langdale, and Thomasville, Alabama; Natchitoches, Louisiana; Cincinnati, Ohio; Evansville, Indiana; Detroit, Michigan; Iowa City, Iowa; St. Louis and Kimmswick, Missouri; West Point, Nebraska; Dallas and Calvert, Texas.

The collecting dates are from March 27 to July 24. Specimens from Natchitoches, Louisiana, were taken on *Quercus phellos*, March 27, 1907.

EUGNAMPTUS COLLARIS RUFICEPS, new variety.

Body black; head, thorax, and appendages reddish; elytra bluish black. Length 4 mm.

This appears to be distinctly a southwestern form, but no structural characters of value can be found to separate it. It occurs in both sexes in the Belfrage collection from Texas.

Type.—Cat. No. 14624, U.S.Nat.Mus.

EUGNAMPTUS SULCIFRONS Gyllenhal.

This species was described from Carolina and seems to be distinctly southern, and differs structurally only by the frontal sulcus. Specimens are at hand from Mobile, Alabama; Dallas and Kerrville, Texas. The dates of collection range from April 3 to June 20.

EUGNAMPTUS PUNCTATUS, new species.

Length 4–4.5 mm. Head strongly punctate. Eyes considerably larger in male than in female. Thorax strongly punctate, medially depressed or sulcate. Elytral interspaces convex, not wider than the striæ. Elytra almost bluish black.

EUGNAMPTUS PUNCTATUS PUNCTATUS, typical variety.

Black, thorax red, elytra nigrocoeruleous.

Two female specimens are at hand, the type from Santa Rita Mountains, Arizona, May 25 (Hubbard and Schwarz), and the other from the Pinal Mountains, Arizona (Wickham). The type was taken on *Quercus hypoleuca*.

Type.—Cat. No. 14625, U.S.Nat.Mus.

EUGNAMPTUS PUNCTATUS NIGER, new variety.

Black throughout, except elytra, which are nigrocoeruleous. One specimen is at hand from Arizona (Morrison).

Type.—Cat. No. 14626, U.S.Nat.Mus.

EUGNAMPTUS ANGUSTATUS ANGUSTATUS Gyllenhal.

Specimens are at hand from Washington, District of Columbia; Nashville, Tennessee; St. Louis, Missouri; Texas.

EUGNAMPTUS ANGUSTATUS TESTACEUS, new variety.

Head and thorax strongly punctate; color uniformly rufotestaceous. Length 4.2 mm.

Described from a single male from Kerrville, Texas, April 22, 1908 (F. C. Pratt).

Type.—Cat. No. 24627, U.S.Nat.Mus.

EUGNAMPTUS PALLIDUS Schæffer.

A specimen from Texas (Belfrage) seems to fit the description of this species.

Genus RHYNCHITES Schneider (1791).

Rhynchites SCHNEIDER, Neuestes Mag. für Liebhaber der Ent., vol. 1, 1791.
Rynchites HERBST, Die Käfer, vol. 7, 1797, p. 134.
Rhyncites LATREILLE, Cons. gen., 1810.

The type of this genus is *bacchus* Linnæus, as designated by Latreille (1810).

Genus MERHYNCHITES Sharp (1889).

Merhynchites SHARP, Trans. Ent. Soc. Lond., 1889, p. 57.

Sharp separated the two nonmetallic species, *hungaricus* Herbst and *bicolor* Fabricius from *Rhynchites* because of differences in the centro-sternal piece. Whether this character is of valid generic rank has not been carefully studied out, although it is undoubtedly of considerable value and merits further research. In the absence of type designation we may consider *bicolor* as type.

MERHYNCHITES BICOLOR Fabricius.

The large series of this species is readily separable into varieties or races.

Table of varieties of Merhynchites bicolor Fabricius.

1. Elytra red, body with greenish luster.
   - a^1. Red throughout, except on the venter of the mesothorax, metathorax, and abdomen, which are black; California to North Dakota..var. *cockerelli*, new variety
   - a^2. Elytra, prothorax and head red; ventral parts reddish piceous; beak, antennæ and legs piceous black; South Dakota.....var. *ventralis*, new variety.
   - a^3. Elytra, prothorax and base of head to eyes red; remainder of body black; New Hampshire to Iowa; Utah and New Mexico.....var. *bicolor* Fabricius.
   - a^4. Elytra and prothorax only, red; remainder of body black; British Columbia to New Mexico and North Dakota.....var. *wickhami* Cockerell.
2. Elytra piceous or black; body with greenish luster.
   - b^1. Elytra piceous black; remainder of body black; strial punctures indistinct; Oregon.....var. *piceus*, new variety.
   - b^2. Body unicolorous, black with a bluish-green luster; elytra with a slight piceous undertone; strial punctures very distinct; Arizona.
     var. *viridilustrans*, new variety.

MERHYNCHITES BICOLOR BICOLOR Fabricius.

The typical specimens have elytra, prothorax, and base of head to the eyes red, the remainder of the body black. These specimens usually have the elytral strial punctures quite plainly larger than the interstitial punctures. The front between the eyes is moderately punctate, and rugose near base of beak. Material of this form is at hand from Washington, District of Columbia; Durham, New Hampshire; Ogonquit, Maine; Milton and Melrose Highlands, Massachusetts; Winnipeg and Aweme, Manitoba; New Jersey; Wisconsin; Iowa City, Sioux City, and Spirit Lake, Iowa; Utah; New Mexico. With two exceptions, then, this form is eastern.

MERHYNCHITES BICOLOR WICKHAMI Cockerell.

The commoner form in the collection has the elytra and prothorax only red, and the remainder of the body black. The elytral strial punctures are less easily separable from the interstitial punctures. The front in both sexes is strongly rugosely punctate to the vertex. The material comes from Kaslo, and North Bend, British Columbia; Victoria, Vancouver; Seattle, Yakima, Tacoma, Easton, and Everett, Washington; Fuller, Oregon; Humboldt County, Eureka, Los Angeles, San Diego, San Mateo County, Los Gatos, Dunsmuir, and Kaweah, California; Pocatello, and Fort Sherman, Idaho; American Fork Cañon, City Cañon, Fort Douglas, and Salt Lake City, Utah; Cheyenne, Wyoming; Havre and Kalispell, Montana; Ouray, Berkeley, Colorado Springs, Breckenridge, and Leadville, Colorado; Williams, Arizona; Santa Fe, New Mexico; University, North Dakota; North Carolina. All the specimens are western except four labeled only "N. C." These may be in error.

MERHYNCHITES BICOLOR COCKERELLI, new variety.

This form is red throughout except on the venter of the mesothorax, metathorax, and abdomen, which are black. The sculpture is as in variety *wickhami*. San Francisco County, California, is chosen as the typical locality. Specimens are at hand also from Los Angeles County, California; Pocatello, Idaho; American Fork Cañon, Utah; and Williston, North Dakota. The latter specimens have the basal half of the beak black.

Type.—Cat. No. 14628, U.S.Nat.Mus.

MERHYNCHITES BICOLOR VENTRALIS, new variety.

Two specimens from Volga, South Dakota (Wickham collection), have the beak, antennæ, and legs piceous black, ventral parts reddish piceous, head, thorax, and elytra red.

Type.—Cat. No. 14629, U.S.Nat.Mus.

MERHYNCHITES BICOLOR PICEUS, new variety.

Two specimens from Oregon (Hubbard and Schwarz collection) are too closely allied to be separated as a distinct species. The head, thorax, and under parts are black, and the elytra are piceous black. The front is strongly rugosely punctured. The elytral striation is even more indistinct than in *wickhami*.

Type.—Cat. No. 14630, U.S.Nat.Mus

MERHYNCHITES BICOLOR VIRIDILUSTRANS, new variety.

A single specimen from near the Bright Angel Trail in the Colorado Cañon, Arizona (Pipe Creek, 3,700 feet altitude), collected May 10, 1903, by H. S. Barber, represents the opposite extreme of coloration from *cockerelli*. The entire body is unicolorous black, but shining with luster which from some angles is brilliant green, from others a rich blue, and yet again may show a piceous undertone. The elytral strial punctures are quite plainly larger than the interstitial punctures. The front is strongly rugosely punctate. This form is readily separable from *piceus* by the strial punctation.

Type.—Cat. No. 15263, U.S.Nat.Mus.

The six varieties described above are readily separable in the material at hand, but there are undoubtedly intermediate forms.

Family BRACHYRHINIDÆ Bedel (1885), *emended*.

Otiorhynchidæ LeConte, 1874.
Brachyrrhinidæ Bedel, 1885.

Table of subfamilies of Brachyrhinidæ.

I. Ocular lobes more or less developed; eyes variable, but generally elongate, transverse, acuminate beneath, and in part at least covered.
  1. Mentum large, covering the maxillæ.
    a 1. Scobes not directed beneath.....EREMNINÆ Pascoe (1870).
    a 2. Scrobes directed beneath .....ENTIMINÆ, new subfamily.
  2. Mentum smaller.
    b 1. Mentum not retracted; maxillæ entirely free; scrobes feebly angled, rapidly evanescent.....DIROTOGNATHINÆ, new subfamily.
    b 2. Mentum retracted; scrobes deep, arcuate, sometimes confluent beneath. PROMECOPINÆ Pierce (1911)

II. Ocular lobes absent, and the eyes rounded or shortly oval and always free.
  3. Scrobes linear, directed beneath.
    *c*1. Prothorax with ocular vibrissæ, or if without them, with anterior coxæ narrowly separated.....TANYMECINÆ Pierce (1911).
    *c*2. Prothorax without ocular vibrissæ.
      *d*1. Anterior coxæ contiguous; middle coxæ feebly separated. PSALLIDIINÆ, new subfamily.
      *d*2. Anterior coxæ not contiguous; middle coxæ more or less widely separated. PACHYRHYNCHINÆ, new subfamily.
  4. Scrobes variable, never at the same time linear and directed beneath. BRACHYRHININÆ, new subfamily.

The subfamily Pachyrhynchinæ does not occur in our fauna.

Subfamily EREMNINÆ Pascoe (1870).

Table of tribes of Eremninæ.

1. Beak as large as head at base and continuous with it.....CYPHICERINI, new tribe.
2. Beak narrower than head.
   a^1. Pterygia of beak not or hardly divaricate.....EREMNINI, new tribe.
   a^2. Pterygia of beak more or less divaricate.....PHYTOSCAPHINI, new tribe.

Only the tribe Eremnini is represented in the United States.

EREMNINI, new tribe.

Genus PHYXELIS Schönherr (1843).

Phyxelis SCHÖNHERR, Gen. et Sp. Curc., vol. 7, 1843, pt. 1, p. 122.

The type was originally designated as *rigidus* Say.

ENTIMINÆ, new subfamily.

Table of tribes of Entiminæ.

1. Metasternum very short.
   a^1. Beak robust, quadrangular, more or less distinctly trisulcate above; scrobes rapidly inferior, well defined. Eyes always narrow and acute below, partially concealed by the ocular lobes.....OPHRYASTINI Horn (1876).
   a^2. Beak rounded at angles, subcylindrical, seldom sulcate above, at most moderately robust; scrobes feebly inferior, usually directed toward the eyes or visible from above and badly defined. Eyes oval, not acute below and usually free. TROPIPHORINI, new tribe.
2. Metasternum more or less elongate.
   b^1. Anterior coxæ not contiguous.....LEPTOSTETHINI, new tribe.
   b^2. Anterior coxæ contiguous.
      c^1. Beak scarcely or feebly enlarged at apex; antennal club oval, rarely oblong-oval.....MENŒTIINI, new tribe.
      c^2. Beak robust strongly enlarged at apex in almost all; antennal club at least oblong-oval, often very elongate.....ENTIMINI, new tribe.

The last three tribes are not represented in the United States.

Tribe OPHRYASTINI Horn (1876).

Table of genera of Ophryastini.

1. Abdomen with second segment rarely as long as the two following together, first suture straight. Intercoxal process moderately wide.
   a^1. Third tarsal joint broadly bilobed, and much wider than second, pubescent beneath.
      b^1. Rostral striæ deep, the lateral ones strongly angulate at base of beak, meeting the scrobes beneath the eyes; second ventral segment nearly as long as third and fourth combined.....*Sapotes* Casey.
      b^2. Rostral striæ not so sharply outlined.
         c^1. Rostral striæ evident, straight; second ventral segment much shorter than third and fourth combined.
            d^1. Mentum concealing palpi entirely.....*Eupagoderes* Horn.
            d^2. Palpi projecting beyond apex of mentum (a Mexican genus). *Caccophryastes* Sharp.
         c^2. Rostral striæ obsolete, indicated only by faint depressions; second ventral segment subequal to the third and fourth combined. *Amydrogmus*, new genus.

a^2. Third tarsal joint not broadly bilobed, hardly wider than second, emarginate at apex, not pubescent beneath; rostral striæ straight.

e^1. Prothorax more or less tuberculate at sides and very little narrower than elytra, if at all; corbels of posterior tibiæ more or less imperfectly cavernous. *Ophryastes* Schönherr.

e^2. Prothorax not tuberculate at sides, very much narrower than elytra; corbels of posterior tibiæ with laminate tip..... *Tosastes* Sharp.

2. Abdomen with second segment longer than the two following together, first suture strongly arcuate. Intercoxal process very broad. Third tarsal joint emarginate, but not broader than the second, spinulose beneath..... *Rhigopsis* LeConte.

Genus SAPOTES Casey (1888).

Sapotes CASEY, Ann. New York Acad. Sci., vol. 4, 1888, p. 241.

The genus is monotypic, based on *puncticollis* Casey.

Genus EUPAGODERES Horn (1876).

Eupagoderes HORN, Proc. Amer. Philos. Soc., vol. 15, 1876, p. 32.

In the absence of previous type designations, *speciosus* LeConte is hereby designated as type.

This genus is systematically even more difficult than *Ophryastes*. For the present we must consider Mr. Fall's table as the clearest possible delineation of the specific characters. To this must be added *E. cretaceus* Sharp recorded by Champion from Arizona. The writer is by no means satisfied that the genus has yet been properly treated and considers that a vast amount of material must be added to our collections first.

Genus AMYDROGMUS, new genus.

Rostrum with scrobes deep and definite, passing rapidly inferior; rostral striæ almost obsolete, indicated by faint depressions; third tarsal joint broadly bilobed, and pubescent beneath; second abdominal segment subequal to the two following; prothorax not tuberculate at sides.

Name derived from ἀμυδρός (faint) + ὄγμος (furrow) = faint furrow, referring to the rostral striæ.

Type of genus.—A. variabilis, new species.

AMYDROGMUS VARIABILIS, new species.

Small, resembling *Sapotes puncticollis* in form, with elytra more or less robust, closely covered with pavement scales, which are generally white, but sometimes heavily mottled with brown, and with two brown fasciæ on prothorax. Length, 4–6 mm.; width, 1.75–2.75 mm. Beak strongly constricted at base above and beneath, a little longer than head above, densely covered with white polygonally crowded pavement scales, with short erect setæ interspersed, apically emarginate and medially shallowly sulcate, also with feeble longitudinal impressions in front of eyes. Antennæ densely clothed

with scales, with exception of club, which is finely pubescent. Prothorax a little shorter than head; truncate at base and apex; ocular lobes small, finely fimbriate; sides broadly arcuate, base not as wide as apex, slightly constricted in front of base; surface very unevenly punctate with deep punctures of variable sizes; in specimens showing color, two fasciæ of brown scales; vestiture as described for beak. Elytra of females inflated as in *Tosastes ovalis* and *globularis*, while in males very little wider than the thorax; elytral striæ very fine, punctures fine, interstitial punctures irregular but as large as strial punctures; surface sometimes mottled with brown. Undersides densely squamose and clothed as above. Last ventral segment in female elongate triangular, apically rounded, and longer than the two preceding segments. Legs densely squamose; corbels of posterior tibiæ with a double row of spines, inclosing an elliptical squamose area.

Described from 60 individuals collected by J. D. Mitchell and R. A. Cushman on *Prosopis glandulosa*, June 13–17, 1908, on the Rio Grande, in Brewster County, Texas. Part of the original set is retained in the Dallas, Texas, collection.

Type.—Cat. No. 14631, U.S.Nat.Mus.

Genus OPHRYASTES Schönherr (1833).

Ophryastes SCHÖNHERR, Gen. et. Sp. Curc., vol. 1, 1833, p. 508.

The originally designated type was *sulcirostris* Say.

This genus presents many difficulties to the systematist because of the great variation in a series of one species from a single locality. Up to the present the writer has been unable to obtain any satisfaction from a study of it and believes that only large series from many localities will assist in finally separating the species correctly.

OPHRYASTES OVIPENNIS Sharp.

Ophryastes bituberosus PIERCE (not Sharp).

According to Champion [1] the specimen from San Diego, Texas, recorded by the writer [2] as *bituberosus* is *ovipennis*. This undoubtedly applies to the other material also.

OPHRYASTES COLLARIS Champion.

This species is described by Champion from Texas and Nuevo Laredo, Tamaulipas, Mexico.

Genus TOSASTES Sharp (1891).

Tosastes SHARP, Biol. Centr.-Amer., Coleop., vol. 4, 1891, pt. 3, p. 91.

In the absence of previous type designations we may consider *globipennis* Sharp as type of the genus.

[1] Biol. Centr.-Amer. Coleop., vol. 4, Dec., 1911, pt. 3, p. 318.
[2] Proc. U. S. Nat. Mus., vol. 37, 1909, p. 344.

Table of species of Tosastes.

1. Elytra with acute humeral angle.....*humeralis* Sharp.
[Chihuahua City, Mexico.]

2. Elytra with rounded humeri.

a^1. Corbels of posterior tibiæ tipped with a single row of spines.

b^1. Beak sulcate and laterally impressed.....*coarctatus* Champion (1911).
[Monclova, Mexico.]

b^2. Beak smooth; elytra globular; thorax feebly sculptured.

c^1. Elytra with very obsolete sculpture, consisting of vague large pits, arranged serially.....*globipennis* Sharp.
[Guajuco, Nuevo Leon, Mexico.]

c^2. Elytra with striæ very fine, consisting of long, fine punctures; median line of thorax distinct.....*globularis* Pierce.
[Albuquerque, New Mexico.]

a^2. Corbels of posterior tibiæ tipped with a double row of spines.

d^1. Thorax very short, more than twice wider than long, distinctly and coarsely but rather sparsely punctate; elytra globular with striæ consisting of large ill-defined punctures.....*ovalis* Pierce.
[Del Rio and Marathon, Texas.]

d^2. Thorax longer, less than twice as wide as long, indistinctly, finely and rather closely punctate; elytra longer, with striæ indistinctly depressed and punctate.....*cinerascens*, new species.
[Wenatchee, Washington.]

TOSASTES CINERASCENS, new species.

Described from two female and three male specimens collected at Wenatchee, Washington, April 17, 1911, and sent the writer from the Washington Experiment Station (Wash. Exp. Sta. No. 4) by Mr. M. A. Yothers. A sixth specimen (female) is retained in the writer's collection, and it is understood that still more material is in the Washington Station collection.

The female of this species is the largest of our Tosastes and is very similar in form to Champion's new *coarctatus* of which the cotypic series is before the writer. The smooth beak and double row of spines at the tip of the posterior tibiæ readily separates it.

Female, length 6–8 mm., width 3–4 mm.; male, length 5 mm., width 2.5 mm. Elytra very convex, inflated, humeri rounded; densely clothed with mottled grayish and darker scales, and with rows of setæ on elytral interspaces. Rostrum short, broad, lightly transversely impressed at base, with very faint impressions at sides, but with no median groove; scrobes deep, strongly arcuate, rapidly inferior; scape and first six funicular joints clad with white scales, seventh dark like club and without scales. Thorax transverse, about one-third wider than long; ocular lobes distinctly fimbriate; convex on sides without lateral emarginations; very shallowly and indistinctly but closely punctate; median impression apparent. Striæ impressed, as broad as interspaces; punctures indistinct because of close scaly vestiture. Elytra in small males almost twice

as wide as thorax, but not in large females, and longer proportionately than in *ovalis*. Abdominal suture straight, second not as long as the third and fourth combined, fifth segment in female long and narrowly rounded at apex, in male shorter and broader at apex. Hind tibiæ with a double row of spinules at apex. First three tarsal joints with apices of lobes mucronate.

Type.—Cat. No. 14632, U.S.N.Mus.

Genus RHIGOPSIS LeConte (1874).

Rhigopsis LECONTE, Amer. Nat., 1874, p. 459.

The genus is monotypic based on *effracta* LeConte.

TROPIPHORINI, new tribe.

We have undoubtedly had a wrong conception of what is a genus in this tribe, but it has become very difficult to reconstruct the classification. The accompanying table is presented in the hopes that it will make some difficult places in the tribe more clear. For the purpose of simplicity the number of genera is considerably reduced, it being considered more advisable to use subgenera where the species groups are so closely allied. In the following studies considerable mention is made of the form of the nasal plate. This plate is a more or less defined area at the tip of the beak, its base is the apex of the beak.

Table of genera of Tropiphorini.

Rostrum with scrobes feebly inferior, usually directed toward eyes, or visible from above and badly defined.

I. Seventh joint of funicle contiguous to club or differently clothed from the other joints. Vestiture squamose and pilose pubescent.

1. Third joint of tarsi feebly emarginate, scarcely broader than the preceding; tarsi sparsely setose beneath; beak distinctly separated from the head by a transverse depression. Nasal plate more or less obsolete ..... *Cimbocera* Horn.

2. Third joint of tarsi bilobed, distinctly wider than second; tarsi spinose beneath beak not separated from head by deep depression; nasal plate obsolete. *Miloderes* Casey.

II. Seventh joint of funicle distant from club; third joint of tarsi broader than second, tarsi densely pubescent beneath.

1. Scrobes deep, well defined, at least moderately arcuate, passing inferiorly.

a^1. Scrobes strongly arcuate, passing beneath at a distance from the eyes.

b^1. First suture of abdomen straight; second segment never longer than the two following united; hind tibiæ mutic; vestiture squamose with intermixed squamiform bristles; nasal plate sharply defined by distinct rim. *Dichoxenus* Horn.

b^2. First suture of abdomen arcuate; second segment usually as long as or longer than the two following united; hind tibiæ mutic.

c^1. Vestiture squamose not intermixed with setæ or pubescence; anterior tibiæ denticulate within; nasal plate depressed but not sharply defined. *Orimodema* Horn.

c^2. Vestiture squamose and intermixed with hairs or bristles; anterior tibiæ not denticulate within.

d^1. Vestiture squamose intermixed with decumbent bristles; support of deciduous piece of mandible not prominent; alternate elytral intervals slightly more convex; ventral scales squamose; nasal plate ill-defined.....*Amotus* Casey.

d^2. Vestiture squamose intermixed with fine erect hairs; support of deciduous piece of mandible prominent; nasal plate sharply defined by a distinct rim.

e^1. Apex of hind tibiæ with a double row of setæ forming an apical disk; humeri entirely obliterated.....*Diamimus* Horn.

e^2. Apex of hind tibiæ with a single row of setæ at apex; humeri rectangular.....*Peritaxia* Horn.

a^2. Scrobes not passing beneath at a distance from the eyes; vestiture squamose and intermixed with bristles.

f^1. Scrobes moderately arcuate, passing immediately beneath the eyes; nasal plate sharply defined by a distinct rim.....*Anametis* Horn.

f^2. Scrobes narrow, deep and well defined throughout, obliquely descending to lower angle of eye, beak not depressed at base; nasal plate short, broadly angulate, distinctly rimmed.....*Melbonus* Casey.

2. Scrobes evanescent posteriorly, badly defined, nearly straight or flexed gradually downward, directed toward lower angle of eye.

a^1. Metasternal side pieces rather wide, suture distinct.

b^1. First ventral suture generally straight or only slightly arcuate in the middle; second ventral segment not longer than the next two combined.

c^1. Scaly vestiture mixed with fine, long pubescence. Nasal plate poorly defined.....*Melamomphus* Horn.

c^2. Scaly vestiture mixed with stout setæ or bristles; nasal plate triangular or crescentiform, generally poorly defined, slightly emarginate *Dyslobus* LeConte.

b^2. First ventral suture broadly arcuate; second ventral segment usually much longer than the next two combined; nasal plate very deeply emarginate, strongly defined.....*Adaleres* Casey.

a^2. Metasternal side pieces indistinct, suture obliterated; strial punctures squamigerous; beak stout, broad, separated from head by a distinct impression, eyes strictly lateral.....*Panscopus* Schönherr.

Several distinct facies occur in this tribe, but it is impossible to find characters to draw those together of like facies. There is a striking similarity of appearance between *Orimodema protracta*, *Melbonus denticulatus*, and *Dyslobus segnis*, *lecontei*, and *verrucifer*. *Diamimus*, *Peritaxia*, *Melamomphus* and *Thricomigus* form another group of similar facies. A third distinct group is formed of those species with the alternate intervals elevated in *Dyslobus* (*Amnesia*), *Adaleres*, and *Panscopus*.

Genus CIMBOCERA Horn (1876).

Cimbocera HORN, Proc. Amer. Philos. Soc., vol. 15, 1876, p. 55.

The genus is monotypic, based on *pauper* Horn.

It appears to have as its principal character the narrow third tarsal joint. The seventh funicular joint in some cases may not be contiguous to the club but is usually much broader than the preceding joints and differently clad.

CIMBOCERA PAUPER Horn.

Table of varieties.

1. Abdomen with first suture slightly angulate, but the second segment not greatly longer at the middle than on the sides, second segment laterally subequal to the third and fourth segments together.
   a^1. Nasal plate glabrous broadly rounded behind, slightly emarginate at apex. Beak sulcate. Pubescence long.....var. *pauper* Horn.
   a^2. Nasal plate obsolete; beak smooth, not sulcate. Pubescence long. var. *sericea*, new variety.
2. Abdomen with first suture more strongly angulate, second segment longer than the two following together. Nasal plate obsolete; beak smooth or sulcate. Pubescence long.....var. *conspersa* Fall.

The characters which separate these geographical varieties or races are entirely too fine for specific characters, and as variations are to be found in the obsoleteness of the nasal plate, the appearance of the seventh funicular joint, the smoothness of the beak, the relative length of the abdominal segments, and the degree of arcuation of the first suture, it is with hesitancy that the writer even ascribes the value of local varieties to them.

CIMBOCERA PAUPER PAUPER Horn.

The species was described from "Dacota." A series of seven specimens from Cheyenne, Wyoming, answer the description perfectly. This locality belongs to the old Territory of "Dacota."

CIMBOCERA PAUPER SERICEA, new variety.

In the material at hand this northern mountain form is much more mottled than the typical variety and has a white median vitta on the prothorax. The typical locality must be considered as American Fork Cañon, Utah, from which 13 specimens are at hand. The material also includes 1 specimen from Helena, Montana, 10 from Canon City, 2 from Garland, and 1 from Grand Valley, Colorado. The latter was taken by H. F. Collier, April 5, 1911, injuring apple twigs.

Type.—Cat. No. 14633, U.S.Nat.Mus.

CIMBOCERA PAUPER CONSPERSA Fall.

Cimbocera conspersa FALL.

This form was described from Santa Fe, and San Ildefonso, New Mexico. Material is at hand from Santa Fe, Gallup, Las Vegas, and Albuquerque, New Mexico, and from Winslow, Bright Angel Hotel (rim of Colorado Cañon), and Holbrook, Arizona.

At Bright Angel this form was taken on piñon trees (*Pinus edulus*).

Genus MILODERES Casey (1888).

Milodores CASEY, Ann. New York Acad. Sci., vol. 4, 1888, p. 252.

The genus was monotypic, based on *setosus* Casey.

Table of species of Miloderes.

1. Elytra with evident, though fine, serial punctures (California).....*setosus* Casey.
2. Elytra without trace of serial punctuation (Arizona).....*viridis* Pierce.

Examination of *setosus* and *viridis* shows that the nasal plate in both species is obsolete.

Genus DICHOXENUS Horn (1876).

Dichoxenus, HORN, Proc. Amer. Philos. Soc., vol. 15, 1876, p. 39.

The genus is monotypic, based on *setiger* Horn.

DICHOXENUS SETIGER Horn.

This species has a sharply defined concave, glabrous nasal plate with lateral rims and strong basal emargination.

Genus ORIMODEMA Horn (1876).

Orimodema HORN, Proc. Amer. Philos. Soc., vol. 15, 1876, p. 43.

The genus is monotypic, based on *protracta* Horn.

ORIMODEMA PROTRACTA Horn.

The nasal plate in this species is glabrous, depressed and crescent shape or at least emarginate at base.

Genus AMOTUS Casey (1888).

Mimetes HORN, Proc. Amer. Philos. Soc., vol. 15, 1876, p. 44 [not Lacordaire].
Amotus CASEY, Ann. New York Acad. Sci., vol. 4, 1888, p. 243.

The type of the genus *Mimetes* (Schönherr) Lacordaire is evidently *setulosus* (Schönherr) Lacordaire by original designation, and we hereby designate the type of *Amotus* as *longisternus* Casey. There has been considerable misunderstanding of these genera. Lacordaire and Schönherr associated *Mimetes* with the *Brachyderides*, which are without postocular lobes. The material previously[1] placed by the writer under *Mimetes seniculus* Horn is apparently *Mimetes setulosus* Lacordaire and belongs as Lacordaire placed it, in the Psallidiinae, Epicaerini. The species *Mimetes setulosus* Horn [not Lacordaire] is therefore *Amotus gracilior* Casey. *Mimetes seniculus* Horn must be placed, until recognized, under Amotus.

Table of species of Amotus.

1. Elytral interspaces flat; median groove of beak feeble in front but with an angulate impression at base between the eyes.....*seniculus* Horn.
2. Alternate elytral interspaces more convex.
   - a^1. Ocular vibrissæ extremely short and inconspicuous; median impressed groove of beak very feeble and only present near base.....*longisternus* Casey.
   - a^2. Ocular vibrissæ longer and more conspicuous; beak strongly impressed along the middle.
     - b^1. Prothorax longer than wide; species 8 mm. long....*longipennis* Pierce.
     - b^2. Prothorax wider than long; species 5.5 mm. long.....*gracilior* Casey.

[1] Proc. U. S. Nat. Mus., vol. 37, p. 348.

AMOTUS LONGISTERNUS Casey.

The nasal plate is triangular with truncate lateral angles and basal emargination. The area is bounded by a poorly defined rim, is glabrous and strongly punctate.

AMOTUS GRACILIOR Casey.

Mimetes setulosus HORN, 1876 [not Lacordaire].

The nasal plate is represented by a broadly triangular, punctate, glabrous ill-defined, basally emarginate area.

AMOTUS LONGIPENNIS Pierce.

The nasal plate is represented by an apically convex, basally emarginate, punctate, glabrous depressed area.

Genus DIAMIMUS Horn (1876).

Diamimus HORN, Proc. Amer. Philos. Soc., vol. 15, 1876, p. 46.

The genus is monotypic, based on *subsericeus* Horn.

DIAMIMUS SUBSERICEUS Horn.

The nasal plate is a well-defined concave, rimmed, glabrous, minutely punctate, basally emarginate, ogival area. The posterior tibiæ have at the apex a double row of bristles forming an inclosed area.

Genus PERITAXIA Horn (1876).

Peritaxia HORN, Proc. Amer. Philos. Soc., vol. 15, 1876, p. 46.

In the absence of previous type designation we may consider *rugicollis* Horn as type.

The species of this genus have a habitus very easy to recognize. The vestiture is varnished and interspersed with much pubescence. The nasal plate is concave, triangular, rimmed, glabrous and basally emarginate. The tip of the posterior tibiæ has only a single row of bristles.

Table of species of Peritaxia.

1. Elytral interspaces much wider than striae. Species moderately robust.
   - a^1. Pubescence short, cinereous, vestiture consisting of very dark piceous scales; ocular lobes distinct but feeble ..... *rugicollis* Horn.
   - a^2. Pubescence long, grayish.
     - b^1. Prothorax as broad as long, very irregularly, but deeply punctate; size 9 mm ..... *hispida* Horn.
     - b^2. Prothorax transverse, indistinctly punctate; size 5–7.5 .. *perforata* Casey.
2. Elytral interspaces not wider than strial punctures. Prothorax as long as broad, deeply and regularly punctate. Species very slender. Pubescence long grayish; size 8 mm ..... *elongata*, new species.

PERITAXIA ELONGATA, new species.

Described from a single specimen collected in the Chisos Mountains, Brewster County, Tex., June 10, 12, 1908 (Mitchell and Cushman.)

A very slender, elongate species, bristling with long pubescence and clad with a thick varnished covering of scales. Body black,

appendages piceous. Beak slightly larger than head, longer than broad, slightly dilated at tip; nasal plate broadly triangular, basally emarginate, rimmed. Prothorax about as long as broad, as wide as elytra at their widest point, basally and apically truncate, laterally strongly arcuate; ocular lobes absent, but replaced by a fringe of vibrissae; disk closely and deeply punctate. Elytra not wider than prothorax, about two and a half times as long as wide; striæ consisting of large deep punctures, as wide as intervals. The first ventral suture is angulate, but the second segment is not as long as the two following segments at the sides.

Type.—Cat. No. 14634, U.S.Nat.Mus.

Genus ANAMETIS Horn (1876).

Anametis HORN, Proc. Amer. Philos. Soc., vol. 15, 1876, p. 43.

The genus is monotypic, based upon (*grisea* Horn) = *granulata* Say.

ANAMETIS GRANULATA Say.

Barynotus granulatus SAY.
Anametis grisea HORN.
Anametis subfusca FALL.

This species is at hand from Ontario, Michigan, Wisconsin, South Dakota, Nebraska, Iowa, Indiana, Wyoming, Texas and New Mexico. The writer can not find sufficient characters to even separate the southern forms as a race. The color of the scales, length of pubescence and arrangement are of no value whatever as characters. The breadth of the elytra is very variable. The granulation of the prothorax is variable in degree and as strong in some Canadian and Iowa specimens as in the New Mexico material at hand. The nasal plate is triangular, strongly rimmed, concave, glabrous, and strongly emarginate at base.

Genus MELBONUS Casey (1895).

Melbonus CASEY, Coleop. Not., pt. VI, 1895, p. 820.

The monotype of the genus is *scapalis* Casey.

Table of species of Melbonus.

Ocular lobes and vibrissae lacking.
1. Elytra three-fourths longer than wide.....*scapalis* Casey.
2. Elytra two and one-fourth times longer than wide.....*denticulatus* Pierce.

MELBONUS DENTICULATUS Pierce.

The nasal plate is deeply depressed, rimmed, concave, very short but broad and angulate crescentiform.

Genus MELAMOMPHUS Horn (1876).

Melamomphus HORN, Proc. Amer. Philos. Soc., vol. 15, 1876, p. 40.
Thricomigus HORN, Proc. Amer. Philos. Soc., vol. 15, 1876, p. 48.

The type of *Melamomphus* is *niger* Horn, and of *Thricomigus*, *luteus* Horn, both being monotypic.

Between the types of these two genera there is considerable difference in facies, but the writer has been unable to find a single generic character to separate them. The descriptions are almost identical except as to the direction of the first abdominal suture, and the mucronation of the hind tibiæ. Neither of these characters can be used as they vary in specimens of the same series of the same species. The genus as here presented is therefore a reconstruction based upon the characters which are presented in the table of genera of this tribe. The nasal plate in this genus is depressed, but poorly defined.

Table of species of Melamomphus.

I. Apex of posterior tibiæ with a double row of spines forming an inclosed disk.
  1. Anterior tibiæ, only, denticulate.
    a^1. Species elongate. Prothorax strongly granulato-tuberculate, the tubercles punctured; beak very roughly sculptured.
      b^1. Species black; vestiture black; pubescence dense and black; nasal plate triangular, not strongly defined, basally emarginate; humeral angles rectangular, broader than base of prothorax (Nevada)..... *niger* Horn.
      b^2. Species black; vestiture brown; pubescence dense and brown; nasal plate crescent form, not strongly defined; humeral angles entirely obliterated, not broader than base of prothorax (California)..... *elongatus* Horn.
    a^2. Species less elongate, more robust.
      c^1. Prothorax strongly granulato-tuberculate, the tubercles punctured; beak very roughly sculptured.
        d^1. Humeral angles entirely obliterated; species brownish red; nasal plate triangular, emarginate (California)..... *sordidus* Horn.
        d^2. Humeral angles small, wider than prothorax at base; species black, with brownish vestiture; nasal plate crescent shaped (California), *deciduus* Horn.
      c^2. Prothorax not strongly granulato-tuberculate.
        e^1. Species black, humeral angles small, but wider than prothorax at base; vestiture silvery, pubescence moderately long; nasal plate semielliptical, basally emarginate; posterior tibiæ mucronate at tip (Washington), *nigrescens*, new species.
        e^2. Species reddish-piceous, humeral angles minute; vestiture brownish, cinereous, pubescence moderately long; nasal plate hemispherical, ill-defined, basally emarginate; alternate intervals sometimes clothed with lighter vestiture; hind tibiæ mucronate in males, mutic in females, first ventral suture straight in males, arcuate in females (Montana, Washington), *luteus* Horn.

    [*tessellatus* Casey probably belongs here.]
  2. All tibiæ denticulate; prothorax with punctured tubercles.
    a^1. Humeral angles rectangular; nasal plate subtriangular, poorly defined, strongly emarginate (California, Vancouver)..... *raucus* Horn.
    a^2. Humeral angles obliterated; nasal plate subtriangular, poorly defined, strongly emarginate; alternate intervals sometimes clothed with lighter vestiture (Montana, California)..... *alternatus* Horn.

    [*granulatus* Casey probably belongs here.]

II. Apex of posterior tibiæ with a single row of spines; anterior and median tibiæ denticulate; prothorax covered with punctured tubercles; humeri angulate; nasal plate crescent shape..... *ciliatus*, new species.

MELAMOMPHUS NIGER Horn.

A single specimen is at hand answering perfectly to the description. It was collected at Carson City, Nevada, July 30, by Professor Wickham.

MELAMOMPHUS ELONGATUS Horn.

Amnesia elongata HORN.

This species is absolutely congeneric with *niger* and is of exactly the same facies. The single specimen at hand is labeled from California.

MELAMOMPHUS SORDIDUS Horn.

Amnesia sordida HORN.

This species has a slightly different facies, but has no characters of generic value separating it from the preceding group.

MELAMOMPHUS DECIDUUS Horn.

Amnesia decidua HORN.

One specimen labeled California and one from Alameda County, California, have been assigned here. The nasal plate is concave, crescent shaped, and poorly defined.

MELAMOMPHUS NIGRESCENS, new species.

Described from three specimens from Riparia, Washington, March 22, 1911 (Wash. Exp. Sta. No. 3), transmitted by Mr. M. A. Yothers.

Length 6.5 mm.; width 2 mm.

Body black, covered with silvery striate scales, and with long, fine black and white pilosity; appendages reddish.

Head and beak roughly punctate and tuberculate; beak longer than head and separated from it by a broad transverse depression; beak dilated at alæ; scaly vestiture quite close, pubescence sparse. Nasal plate semielliptical, but basally emarginate, depressed, glabrous, more than usually well defined. Genæ truncate. Supports of deciduous pieces of mandibles very prominent. Scrobes subterminal, deep and well defined at apex, but broadening and becoming obsolete at a short distance from the eyes. Scape reaching a little beyond the middle of the eyes; funicle with first joint longer than second, remaining joints becoming shorter than broad; club oval. Prothorax about as long as wide, basally and apically truncate, laterally convex, ocular lobes small, fimbriate; disk granulato-tuberculate; vestiture dense. Elytra narrow; humeral angles small but wider than prothorax at base; intervals broad, flat, densely squamose, sparsely pilose; strial punctures long, shining, approximate, shallow, setigerous. Undersides shallowly, confusedly punctate, sparsely squamose and pilose; first ventral suture straight, second segment not longer than the two following segments; tibiæ mucronate, the anterior denticulate, the posterior with an apical disk inclosed by spines.

Type.—Cat. No. 14635, U.S.Nat.Mus.

MELAMOMPHUS LUTEUS Horn.

Thricomigus luteus HORN.

The material before the writer which most nearly answers the description of this species is the female series from Prosser, Washington. The males and females of this series collected April 1, 1910, and transmitted by Mr. M. A. Yothers, belong in different genera according to Horn's table. The writer has selected this series to stand for Horn's species because the females lack a posterior tibial mucro and have the first abdominal suture somewhat arcuate. Specimens are also at hand from Mission, Washington, May 5, 1911.

MELAMOMPHUS TESSELATUS Casey.

Amnesia tessellata CASEY.

No specimens are at hand.

MELAMOMPHUS RAUCUS Horn.

Amnesia rauca HORN.

Material of this species is at hand from San Francisco County and Alameda County, California, and Victoria, Vancouver Island.

MELAMOMPHUS ALTERNATUS Horn.

Amnesia alternata HORN.

This species is to all appearances the same as *luteus*, but differs only by the denticulation of the tibiæ. The material at hand is from Helena, Montana, and Siskiyou County, California.

MELAMOMPHUS GRANULATUS Casey.

Amnesia granulata CASEY.

The specimen from Siskiyou County, California, just mentioned, may possibly be this.

MELAMOMPHUS CILIATUS, new species.

Described from a single specimen taken among cones of *Cupressus macrocarpa* in Monterey County, California, February 8, 1904, by Coleman.

Length 8 mm.; width 3 mm.

Body piceous black, covered with coppery scales, and with long, fine pubescence; appendages lighter in color.

Head and beak roughly rugulosely punctate; beak longer than head and separated from it by a broad transverse depression, dilated at alæ; scaly vestiture sparse, especially on beak; pilosity sparse but long. Nasal plate depressed, glabrous, crescent-shape. Genæ truncate. Scrobes subterminal, deep, and well defined, but rapidly evanescent posteriorly. Scape reaching beyond middle of eyes; first two funicular joints elongate subequal, remaining joints diminishing in

length and increasing in breadth. Prothorax broader than long, basally and apically truncate, laterally very convex; ocular lobes moderate with very short fimbriæ; disk densely punctate-tuberculate, vestiture sparse. Elytra elongate, sides almost parallel; humeri small but strongly angulate, wider than prothorax at base; intervals broad, slightly convex, densely squamose and pilose; strial punctures large, round, separated, setigerous; striæ not impressed. Undersides densely, confusedly, and shallowly punctate; sparsely squamose, the scales narrower than above, sparsely pilose, the hairs finer than above. First ventral suture angulate at middle; second segment not longer than third and fourth together. Tibiæ mucronate and denticulate, the posterior apically with a single row of spines.

Type.—Cat. No. 14636, U.S.Nat.Mus.

Genus DYSLOBUS LeConte (1869).

Dyslobus LECONTE, Ann. Mag. Nat. Hist., 1869, p. 380.
Amnesia HORN, Proc. Amer. Philos. Soc., vol. 15, 1876, p. 48 (typical part).

The type of *Dyslobus* was designated by Horn (1876) as *segnis* LeConte. The type of *Amnesia* as originally designated was *granicollis* LeConte.

It is no longer possible to separate these genera as distinct.

Table of species of Dyslobus.

I. Funicular joints elongate; large species usually over 8 mm. long.
1. Elytral intervals alternating in convexity.
a^1. Serial punctures setigerous (*Amnesia* proper).
b^1. Elytra sparsely but strongly tuberculose throughout, the sutural prominence at the summit of the apical declivity very pronounced; anterior tibiæ denticulate..... *tumidus* Casey.
b^2. Elytra not tuberculose.
c^1. Sutural prominence of elytra moderate or feeble.
d^1. Terminal spur of posterior tibiæ long, stout, and prominent; body oval, rather robust at least in the female; all tibiæ denticulate. *granicollis* LeConte.
d^2. Terminal spur of posterior tibiæ very small, nearly obsolete; body narrow and elongate at least in male; antennal scape very long and slender, slightly passing the posterior margin of the eye; anterior tibiæ strongly denticulate.
e^1. Legs black, anterior femora distinctly elongated in the male. *discors* Casey.
e^2. Legs red, the anterior femora not elongated in the male. *sculptilis* Casey.
c^2. Sutural prominence strong, doubly tuberculate; anterior tibiæ denticulate..... *bituberculatus*, new species.
a^2. Serial punctures squamigerous; all tibiæ denticulate; sutural prominence of elytra keeled..... *denticulatus*, new species.
2. Elytral intervals not alternating in convexity throughout their length; anterior and median tibiæ denticulate (*Dyslobus* proper).
a^1. Serial punctures squamigerous; elytral suture prominent and keeled near the the summit of the posterior declivity.

b^1. Serial punctures small; hind tibiæ very strongly bent near the apex in the male.....*segnis* LeConte.

b^2. Serial punctures much coarser; scales brilliantly metallic in color; hind tibiæ of the male only very feebly arcuate toward apex...*lecontei* Casey.

a^2. Serial punctures setigerous; elytral suture not keeled near the apex, but with a small and abruptly-elevated double tubercle; scales in great part opalescent.....*verrucifer* Casey.

II. Only the first two or three funicular joints elongate, the remainder moniliform.

3. Elytral intervals alternating in convexity.

a^1. Serial punctures setigerous; elytra not tuberculose; sutural prominence moderate or feeble; all tibiæ minutely denticulate.....*debilis* Casey.

a^2. Serial punctures squamigerous.

c^1. Anterior tibiæ denticulate.....*squamipunctatus* Pierce.

c^2. All tibiæ denticulate.....*decoratus* LeConte.

4. Elytral intervals not alternating in convexity throughout their length; elytral suture not prominent or keeled near the summit of the posterior declivity; serial punctures setigerous; prothorax densely tuberculate.....*ursinus* Horn.

The species of this complex genus might be divided into two groups on the basis of the antennal funicle, or the alternation of elytral intervals, or the vestiture of the serial punctures, but obviously none of these characters is of generic value. The antennal character most nearly associates those of like appearance. The combinations of the three characters above mentioned divide the genus into seven closely associated groups of species. The writer feels that at present this is the most satisfactory arrangement which can be given the genus.

DYSLOBUS TUMIDUS Casey.

Amnesia tumida Casey.

The nasal plate is a poorly defined triangular depressed area.

DYSLOBUS GRANICOLLIS LeConte.

Amnesia granicollis Horn.

To conform with Col. T. L. Casey's restrictions, only the Oregon, Washington, and Vancouver material is to be placed here. The two following species are so close that the writer does not believe they should be kept separate.

The nasal plate is a hemispherical, concave, depressed punctate, poorly defined area with emarginate base.

DYSLOBUS DISCORS Casey.

Amnesia discors Casey.

A single specimen from Los Gatos, California, may be assigned to this species. The nasal plate is as in the preceding species.

DYSLOBUS SCULPTILIS Casey.

Amnesia sculptilis Casey.

Material from Eureka and Fieldbrook, California, may be assigned to this species. The nasal plate is as in the preceding two species.

DYSLOBUS BITUBERCULATUS, new species.

Described from two specimens collected June 6 and 7 at North Bend, British Columbia (Hubbard and Schwarz collection).

Length, 10 mm.; width, 4 mm.

Black, densely clad with silvery and light pinkish rounded scales and with interspersed short subrecumbent setæ. Legs and antennæ reddish piceous to black.

Beak but little longer than head from which it is separated by a shallow transverse depression; vestiture densest on vertex, becoming sparsest at apex of beak; setæ fine and recumbent; surface very coarsely rugosely punctate; nasal plate poorly defined, crescentiform. Scrobes subterminal, deep, and sharply defined at apex, but evanescent behind; scape almost reaching posterior edge of eyes; funicular joints all elongate; the first and second longest, seventh longer than sixth; club narrow, pointed, as long as the first two funicular joints, distinctly annulate. Eyes oval, narrowest below. Prothorax a little wider than long, truncate at base and apex, laterally convex, transversely constricted before apex; ocular lobes broad but not strong, vibrissæ short, golden. Elytra widest behind middle, humeri small but distinct; interspaces convex, alternately more so; striæ not impressed; strial punctures setigerous, large, round, deep, and widely separated; scaly vestiture dense, setæ small and sparse; sutural interspaces separately tuberculate at summit of apical declivity. Undersides shallowly punctate, densely squamose with longer scales; the third and fourth abdominal segments sparsely clad, the fifth very strongly setigerous. Anterior and median tibiæ denticulate, anterior and posterior tibiæ strongly bent near apex, all tibiæ mucronate, apical area of posterior tibiæ very narrow.

Type.—Cat. Nat. 14637, U.S.Nat.Mus.

DYSLOBUS DENTICULATUS, new species.

Described from two specimens collected June 19, 1903, on Bair's ranch, Redwood Creek, Humboldt County, Cal., by H. S. Barber.

Length, 10–11 mm.; width, 4 mm.

Black, variegated with black and aeneus round scales, with interspersed short, recumbent setæ. Legs piceous.

Beak but little longer than head from which it is separated by a shallow transverse depression; vestiture densest on vertex, sparsest at apex of beak; setæ sparse, fine, recumbent. Surface rugosely punctate; nasal plate hemispherical, concave, poorly defined, basally notched at middle. Scrobes subterminal, deep, and sharply defined at apex, but evanescent behind; scape reaching posterior edge of eyes; funicular joints elongate, the first and second longest, seventh longer than sixth; club narrow, pointed, longer than the last two funicular joints. Eyes oval, narrowest below. Prothorax wider than

large, truncate at base, sides almost parallel, narrowed obliquely to base and apex; transversely impressed before apex; ocular lobes broad but not strong, vibrissæ short, black. Elytra with sides parallel in median half, narrowed at base and to apex; humeri small but distinct; interspaces convex, alternately more so; striæ shallowly impressed; strial puncture squamigerous, large, round, widely separated; scaly vestiture dense, tessellate; setæ black, curved, recumbent; sutural interspaces keeled on summit of apical declivity. Undersides densely squamose with lighter scales, moderately pilose with recumbent hairs; anterior tibiæ bent near apex; all tibiæ denticulate and mucronate; apical area of posterior tibiæ elliptical.

Type.—Cat. No. 14638, U.S.Nat.Mus.

DYSLOBUS SEGNIS LeConte.

The nasal plate is a large, triangular, longitudinally depressed, rimmed, impressed, glabrous, basally emarginate area.

DYSLOBUS LECONTEI Casey.

The nasal plate is somewhat raised, poorly defined, with both edges arcuate, and lateral ends rounded, surface minutely punctate.

DYSLOBUS VERRUCIFER Casey.

The nasal plate is poorly defined, the boundary being broadly elevated but not ridged or rimmed, the area depressed, minutely punctate and subcrescentiform.

DYSLOBUS DEBILIS Casey.

Amnesia debilis CASEY.

Material from Vancouver, Orégon, and Washington is at hand. The latter was formerly ascribed by the writer to *sculptilis*. The nasal plate is small, depressed, shining, crescentiform, and fairly sharply defined.

DYSLOBUS SQUAMIPUNCTATUS Pierce.

Amnesia squamipunctata PIERCE.

The nasal plate is broadly angulate crescentiform, depressed, and poorly defined.

DYSLOBUS DECORATUS LeConte.

Amnesia decorata HORN.

The nasal plate is small, depressed, crescentiform, and poorly defined.

DYSLOBUS URSINUS Horn.

Amnesia ursina HORN.

The nasal plate is moderately large, triangular, with curved sides; glabrous, punctate, emarginate, and well defined.

Genus ADALERES Casey (1895).

Adaleres CASEY, Coleop. Not., pt. VI, 1895, p. 816.

In the absence of previous type designation the type of this genus is hereby designated as *ovipennis* Casey.

Table of species of Adaleres.

The following table is taken entire from Colonel Casey's treatment of the genus, and is included merely to make the present series of tables to this tribe complete.

1. Humeri broadly rounded; elytral intervals not alternating in convexity or only slightly so near the apex; pronotum nearly smooth and densely and evenly squamose.....*ovipennis* Casey.
2. Humeri oblique, obtusely prominent at a slight distance behind the base; elytra more oblong and less oval, the intervals alternately more convex, the suture prominently keeled at the posterior declivity; pronotum coarsely granulose and irregularly squamose.....*humeralis Casey.*

ADALERES OVIPENNIS Casey.

Material presumably of this species is at hand from Los Angeles, San Diego, and Rainbow, California. Positive identification of the females can not be made. The male nasal plate is very deeply roundingly emarginate, the rim being very close to the anterior edge at sides, but more broadly and roundingly arcuate than the emargination; the area is concave and lightly punctate.

ADALERES HUMERALIS Casey.

Material is at hand only from Los Angeles, California. Some of the specimens formerly classed here belong to the preceding species. The male nasal plate is deeply triangularly emarginate, and the rim is also angulate, but much more sharply so; the area is depressed and lightly punctate.

Genus PANSCOPUS Schönherr (1842).

Panscopus SCHÖNHERR, Gen. et Sp. Curc., vol. 6, 1842, pt. 2, p. 266.
Phymatinus LECONTE, Ann. Mag. Nat. Hist., 1869, p. 382.
Nocheles LECONTE, Amer. Nat., July, 1874, pp. 453, 456.
Nomidus CASEY, Coleop. Not., pt. VI, 1895, pp. 818–819.

The type of *Panscopus* is *erinaceus* Say by virtue of original designation, of *Phymatinus* is *gemmatus* LeConte because it is monotypic, of *Nocheles* is *torpidus* LeConte by present designation, and of *Nomidus* is *abruptus* Casey because it is monotypic. It appears advisable to unite these genera into a single genus, and give each subgeneric rank.

Table of species of Panscopus.

I. Articular surfaces of the hind tibiæ oblique (corbels open).
1. Alternate elytral intervals elevated except in *sulcirostus*, which has all elevated.
*a*¹. Abdomen with four segments in the female; humeri obliquely truncate. subgenus *Nocheles.*
*b*¹. Funicle sparsely setose not squamose, first two joints very elongate. Third to seventh joints moniliform; scape sparsely clad with narrow scales; nasal plate ogival, rimmed, concave, basally emarginate. *torpidus* LeConte.

a^2. Abdomen with five segments in both sexes.

c^1. Thorax and elytra covered with punctured tubercles; beak elongate; humeri rounded.....subgenus *Phymatinus*.

d^1. Beak finely sulcate; funicular joints elongate, setose; nasal plate ogival, strongly medially depressed, apically angulately emarginate; elytral intervals, only alternately tuberculate.....*gemmatus* LeConte.

d^2. Beak broadly and very deeply sulcate; funicular joints 3–7 moniliform; nasal plate elongate triangular, concave, slightly emarginate; all elytral intervals tuberculate.....*sulcirostris*, new species.

c^2. Elytra not tuberculate; beak shorter and stouter; humeri small, angulate. subgenus *Panscopus*.

d^1. Even elytral intervals with a few setae near apical declivity; funicle setose, first two joints elongate, others moniliform; nasal plate broadly ogival, rimmed, concave, apically slightly emarginate....*erinaceus* Say

d^2. Even elytral intervals without setae; funicle setose, all joints longer than broad, nasal plate ogival, rimmed, strongly medially depressed, apically angulately emarginate.....*alternatus* Schaeffer.

2. Alternate elytral intervals hardly elevated, humeri rounded. subgenus *Panscopidius*.

a^1. Thorax only, tuberculate; beak moderately elongate; all elytral intervals setose; funicle closely setose, first two joints elongate, others moniliform; nasal plate ogival, strongly medially depressed, apically angulately emarginate.

b^1. Elytral vestiture very dense; only posterior tibiæ plainly denticulate. *squamosus*, new species.

b^2. Vestiture sparser; all tibiæ strongly denticulate.....*dentipes*, new species.

II. Articular surfaces of the hind tibiæ terminal, almost inclosed (corbels cavernous).

3. Alternate elytral intervals elevated and setigerous; even intervals without setæ.....subgenus *Nomidus*.

a^1. Beak not carinate; humeri rounded. First two funicular joints elongate, others moniliform; prothorax finely impressed on median line; nasal plate ogival, rimmed, concave, deeply roundingly emarginate...*abruptus* Casey.

a^2. Beak carinate; prothorax widely impressed on median line.

b^1. Humeri minutely angulate. All funicular joints longer than wide; species 9 mm. long; nasal plate ogival, rimmed, concave deeply emarginate. *impressus*, new species.

b^2 Humeri rounded; only first two funicular joints longer than wide; species 6.5 mm. long; nasal plate short, ogival, concave, rimmed, angulately emarginate.....*ovalis*, new species.

4. Alternate elytral intervals not conspicuously elevated; all intervals setigerous. subgenus *Neopanscopus*.

a^1. Beak elongate, considerably longer than head, smooth, not carinate; humeri rounded.....*æqualis* Horn.

b^1. Prothorax deeply sulcate; nasal plate broadly rounded, punctate, rather poorly defined.....var. *vestitus* Casey.

b^2. Prothorax less deeply sulcate; nasal plate ogival, more acute at apex. var. *æqualis* Horn.

a^2. Beak not much longer than head, broad.

c^1. Beak smooth, not carinate; humeri rounded; nasal plate very poorly defined by an arcuate raised area, punctate, emarginate. *squamifrons*, new species.

c^2. Beak carinate; humeri minutely angulate; nasal plate defined by an oval rim, basally truncate and notched, concave.....*carinatus*, new species.

By interpreting *Panscopus* in the broader sense as above we obtain a generic aggregation of nearly related species, which may however

be conveniently arranged in six subgenera. By the formerly accepted method of arrangement we would be compelled to have seven genera for eleven species. Such a system would soon lead to nothing but chaos.

Subgenus NOCHELES Horn.

Nocheles Horn.

This subgenus is adequately defined in the table preceding. The type is *torpidus* LeConte.

PANSCOPUS (NOCHELES) TORPIDUS LeConte.

Nocheles torpidus (LeConte) Horn.

This species is especially remarkable for the loss of the third or fourth ventral segment in the female, which is also much more robust than the male. Six specimens of each sex are at hand from Olympia, Washington, and Portland, Oregon. The material from Alta, Utah, formerly referred here is probably *abruptus* Casey.

Subgenus PHYMATINUS LeConte.

Phymatinus LeConte.

This subgenus is adequately defined in the table preceding. The type is *gemmatus* LeConte.

PANSCOPUS (PHYMATINUS) GEMMATUS LeConte.

Phymatinus gemmatus LeConte.

This is the most beautiful species in the genus and by its assemblage of characters might be thought to merit generic rank. On close inspection it is found to possess only one character, its tuberculation, which radically separates it from all the other species, except the following.

PANSCOPUS (PHYMATINUS) SULCIROSTRIS, new species.

This very extraordinary species is described from a single specimen collected at Oak Point, Washington, April 30, 1910, by M. A. Yothers (Wash. Exp. Sta. No. 5). In coloration it resembles certain species of European Otiorhynchus but in structure it is a near relative of *P. gemmatus* LeConte.

Length 9.5 mm.; width 4 mm. Color deep black, tarsi piceous; vestiture of very sparse golden scales, arranged in patterns; surface extremely tuberculate.

Head smooth to a transverse depression between the posterior portions of the eyes, with a few scales set in shallow punctures. From this transverse depression the front and beak are very roughly rugose and punctate. The deep narrow frontal sulcus on the beak becomes broader and deeper but again narrows toward the tip and becomes a finely sulcate carina which divides to form the nasal plate; the sulcus is finely and sparsely squamose. The borders of the sulcus are sparsely punctured carinae. The sides of the beak are deeply and densely rugosely punctate. The space in front of the insertion of the

antennæ is depressed. The nasal plate is elongate triangular, distinctly rimmed, concave, emarginate. The scrobes are deep at base but rapidly evanescent at a considerable distance from the eyes; the alæ are prominent, causing a considerable widening of the beak at apex. Scape strongly clavate not reaching the middle of the eyes; funicle with the first two joints elongate, the remainder moniliform, widening toward club; club short, oval, but little longer than the two preceding joints. Eyes rounded, strongly prominent, convex. Two little areas of scaly vestiture bordering the inner edges of the eyes are the only striking areas of vestiture on the head or beak. Prothorax as long as wide, convex at base, truncate at apex, slightly convex at sides; ocular lobes broad and very slightly convex, not prominent, vibrissæ lacking; surface above very strongly tuberculate with punctured tubercles which bear tiny hairs in the punctures; median lines slightly indicated; scaly vestiture sparse, arranged principally in broad lateral fasciæ and two transverse fasciæ from these at the middle turning forward near the median line of the thorax and extending to the apex. Elytra oval, with rounded humeri; interspaces all tuberculate with flattened shining tubercles each punctured behind, with a tiny seta in each puncture; strial punctures very shallow; scales arranged principally in humeral fasciæ extending obliquely back to the middle of the elytral suture, and in an apical fascia extending transversely from near the suture to the sides at the vertex of the apical declivity and then passing along the sides to the apex. Undersides closely, shallowly punctate, without vestiture except small patches on the sides of the metasternum and the second abdominal segment. Metasternal side pieces covered by the elytra (in the type the pin has pushed the abdomen down and exposed the side pieces). First abdominal suture straight; the second segment transversely impressed at its middle, about as long as the two following. Femora clavate, the middle and hind pairs externally clothed with a patch of golden scales near apex; femora punctate, each puncture setigerous; tibiæ mucronate, minutely denticulate, spinose; posterior corbels oblique.

Type.—Cat. No. 14639, U.S.Nat.Mus.

Subgenus PANSCOPUS Schönherr.

This subgenus is adequately defined in the table preceding. The type is *erinaceus* Say.

PANSCOPUS (PANSCOPUS) ERINACEUS Say.

This species as formerly interpreted by the writer contained also *alternatus* and *carinatus*. The only specimens which fit the original description are from Buffalo, New York; New Hampshire; Washington, District of Columbia; Plummers Island, Maryland; and Berkeley, West Virginia.

PANSCOPUS (PANSCOPUS) ALTERNATUS Schaeffer.

Five specimens from Round Knob, North Carolina, June 24, 26 (Hubbard and Schwarz), are undoubtedly this species.

PANSCOPIDIUS, new subgenus.

This new subgenus is erected to contain two species of which *squamosus* is the type. It most nearly approaches *Neopanscopus* in facies. The definition in the table is sufficient.

PANSCOPUS (PANSCOPIDIUS) SQUAMOSUS, new species.

Described from a single specimen from Hilgard, Oregon (Wickham' collection).

Length 7 mm.; width 2.7 mm. Piceous black, densely clad with golden or brownish scales and setæ; appendages reddish piceous.

Beak longer than head, with sides parallel from eyes to alæ, alæ prominent; nasal plate ogival, strongly medially depressed, apically angulately emarginate. Head and beak very coarsely rugulosely punctate, coarsely clad with elongate squamiform setæ. Scrobes deep, strongly visible from above at alæ, laterally becoming rapidly evanescent; scape elongate, reaching posterior margin of eyes, densely setose with decumbent golden setæ; funicle closely setose, the first two joints elongate, the others moniliform; club oval, about equal in length to the three preceding joints. Eyes lateral, pointed below, and very little convex.

Prothorax about as long as wide, apically and basally truncate, laterally strongly convex, widest in front of middle, transversely finely impressed just behind apex; median line impressed; ocular lobes small; surface very rough with punctured tubercles, most of which bear a squamiform seta in the puncture. Scutellum minute. Elytra with rounded humeri, sides parallel to the posterior declivity and hardly wider than thorax at its widest point; alternate intervals faintly more prominent, intervals wider than striæ; striæ not impressed, punctures large, rounded, separated by own diameter, each filled with a large oval, striate scale; intervals densely clothed with smaller oval, striate scales, and with more sparsely placed striate, squamiform setæ. Under sides more finely and more sparsely clothed, coarsely punctate. Metasternal side pieces not visible. First abdominal suture straight; second segment hardly longer than either the third or fourth. Femora clavate, lightly punctate, lightly squamose; tibiæ mucronate, the posterior denticulate; posterior corbels oblique. The anterior tibiæ are very obscurely denticulate.

Type.—Cat. No. 14640, U.S.Nat.Mus.

PANSCOPUS (PANSCOPIDIUS) DENTIPES, new species.

Described from a single specimen collected by J. W. Hungate at Pullman, Washington, April 12, 1894.

It resembles *squamosus* in many respects and is of the same size and form. It differs in the following respects: Body black, sparsely clad with scales and setæ; appendages reddish. Alternate elytral intervals not more prominent; intervals about the same width as the striæ; strial punctures large, separated by much less than their own width; intervals very sparsely squamose and setose. Undersides closely punctate, very finely setose. First abdominal suture arcuate; second segment longer than either third or fourth. All tibiæ denticulate.

Type.—Cat. No. 14641, U.S.Nat.Mus.

Subgenus NOMIDUS Casey.

Nomidus CASEY.

The type of this subgenus is *abruptus* Casey.

PANSCOPUS (NOMIDUS) ABRUPTUS Casey.

Nomidus abruptus CASEY.

Seven specimens from Alta, Utah, June 28, 29 (Hubbard and Schwarz), appear to be this species.

PANSCOPUS (NOMIDUS) IMPRESSUS, new species.

Described from three specimens from Stone Creek, Lee County, Virginia (Hubbard and Schwarz).

Length 8.5–9.5 mm.; width 4–4.5 mm. Black, very densely clad with aeneus to yellowish brown scales, with intermixed setæ; appendages reddish-piceous. Beak longer than head, sides gradually widening to alæ, which are quite prominent; nasal plate ogival, rimmed, concave, deeply angulately emarginate. Head and beak moderately roughly punctate, dimly tricarinate, densely clothed with overlapping æneous, striate scales, and sparsely with squamiform setæ. Scrobes deep, visible from above in entire length, evanescent behind; scape densely squamose, not reaching posterior margin of eye; funicular joints elongate, shining, sparsely setose, the first two longest; club but little longer than the two preceding joints. Eyes oval, pointed below, lateral, very slightly convex. Prothorax wider than long, apically sinuate, basally truncate, laterally strongly convex, widest slightly before middle, transversely finely impressed before apex; ocular lobes wide but short; median line widely impressed; surface very rough with punctured setigerous tubercles, which are completely hidden by the dense, overlapping vestiture of æneous, striate scales. Scutellum minute, triangular. Elytra with

humeri minutely angulate, sides convex, wider than prothorax; alternate intervals strongly convex, even intervals flat; all intervals wider than striæ; striæ not impressed, punctures shallow, rounded, widely separated, each filled with an oval striate scale; intervals and strial area between punctures densely closely clothed with overlapping striate scales, tessellate in shades of brown; alternate intervals with numerous elongate, truncate squamiform setæ. Undersides very densely squamose and sparsely setose. Metasternal side pieces not visible. First abdominal suture angulate at middle; second segment almost as long as the next two. Legs densely squamose, sparsely setose; femora clavate; tibiæ strongly mucronate and finely denticulate; posterior corbels oblique, but inclosed and tarsi attached at apex.

A single specimen labeled Indiana (H. Soltau) is also at hand.

Type—Cat. No. 14642, U.S.Nat.Mus.

PANSCOPUS (NOMIDUS) OVALIS, new species.

Described from a single specimen from Banff Hot Springs, Alberta, June 10 (Hubbard and Schwarz).

Length 6 mm.; width 3 mm. Piceous, densely clad with reddish piceous, black or straw colored, striate scales and sparsely with straw-colored setæ; appendages piceous. Beak considerably longer than head, sides parallel from eyes to alæ, which are quite prominent; nasal plate short, ogival, concave, rimmed, angulately emarginate, shining, punctate. Head and beak rugulosely punctate, beak with a very shining glabrous median carina which is grooved and forked at apex and foveate between the eyes; lateral carinæ are also apparent but densely squamose; occiput clothed with flat brownish scales, but from the upper edge of the eyes to the triangular area inclosed by the forks of the median carina the vestiture is dense consisting of straw-colored, striate rounded scales and sparser setæ; the apical triangular area is glabrous and includes the nasal plate. Scrobes deep, visible from above at alæ, becoming very shallow near eyes; scape short, densely squamose, barely passing anterior margin of eyes; funicle short, setose and pubescent, only the first two joints longer than broad, others moniliform, becoming broader toward apex; club as long as three preceding joints. Eyes oval, pointed below. Prothorax wider than long, apically broadly emarginate, basally truncate, laterally convex, with a fine impression behind apex; ocular lobes small but prominent; median line widely impressed; surface very rough with punctured setigerous tubercles, which are almost completely hidden by the vestiture of aeneous brown striate scales. Scutellum not visible. Elytra with humeri rounded; sides but slightly convex to posterior declivity; but little over one-half longer than wider; alternate intervals convex, even intervals flat, all

wider than the striæ; striæ not impressed, punctures rounded, distant at least their own diameter; each filled with a round, striate scale; surface densely covered with overlapping reddish brown or black scales; alternate intervals with numerous golden striate squamiform setæ. Under sides densely clothed with dark reddish brown scales and with numerous squamiform setæ. Metasternal side pieces not visible. First ventral suture slightly arcuate; second segment almost as long as the two following. Legs squamose sparsely setose with lighter colored scales; femora clavate; tibiæ mucronate, the anterior minutely denticulate; corbels closed.

Type.—Cat. No. 14643, U.S.Nat.Mus.

NEOPANSCOPUS, new subgenus.

This subgenus is defined in the preceding table. The type is *æqualis* Horn.

PANSCOPUS (NEOPANSCOPUS) ÆQUALIS Horn.

Nocheles æqualis HORN, Proc. Amer. Philos. Soc., vol. 15, 1876, p. 55
Nocheles cinereus HORN, Proc. Amer. Philos. Soc., vol. 15, 1876, p. 55.

Horn's tabular name does not agree with the name used in the description, the latter being evidently the name intended. Material is at hand from National Park, and Green River, Wyoming; Montana; Utah; Tonasket, Washington, and California.

PANSCOPUS (NEOPANSCOPUS) ÆQUALIS VESTITUS Casey.

Nocheles vestitus CASEY.

Two Nevada specimens are at hand labeled as Colonel Casey's species, and answering the description, but it does not seem that they merit more than varietal rank, if that. These specimens were formerly arranged by the writer under *æqualis* proper.

PANSCOPUS (NEOPANSCOPUS) SQUAMIFRONS, new species.

Described from a single specimen from Placer County, California, June (Koebele).

Length 7 mm.; width 2.5 mm. Piceous, densely covered with reddish piceous, and straw-colored striate scales, and sparsely with reddish piceous and straw-colored setæ. Beak longer than head, sides parallel from eyes to alæ, which are prominent; nasal plate very poorly defined by an arcuate raised area, punctate, emarginate. Head and beak strongly punctate, not carinate, densely squamose and sparsely setose with mixed scales, but with a light patch behind the eyes. Scrobes deep, visible from above, short and evanescent at a distance from eyes; scape short, densely squamose, not reaching middle of eye; funicle short, setose and pubescent, the first two joints only, elongate, others moniliform; club oval, about equal to the three

preceding joints. Eyes oval, pointed below, very slightly convex, lateral. Prothorax wider than long, truncate basally and apically, laterally convex, with a fine constriction behind apex; ocular lobes strong, broad, vibrissæ minute; median line shallowly impressed; surface smoother, densely squamose, sparsely setose, scales brown, setæ straw-colored. Scutellum minute, triangular. Elytra with humeri rounded; sides parallel in half their length; about three-quarters longer than wide; intervals convex, but not alternating in convexity, wider than striæ; striæ fine, impressed, punctures small, distant about their diameter, each filled with a scale; surface densely clothed with brown scales, mottled with straw-colored scales, especially on the sides and declivity; setæ elongate, brown. Undersides and legs densely squamose, sparsely setose with light-colored scales. Metasternal side-pieces not visible. First ventral suture arcuate at middle; second segment as long as two following. Femora clavate; tibiæ internally sparsely spinose; corbels closed.

Type.—Cat. No. 14644, U.S.Nat.Mus.

PANSCOPUS (NEOPANSCOPUS) CARINATUS, new species.

Described from two specimens from Detroit, Michigan, June (Hubbard and Schwarz).

Length 7 mm.; width 3 mm. Piceous, densely clothed with yellowish and brownish æneous, striate scales and sparsely setose with brown bristles; antennæ red. Beak longer than head, gradually increasing in width to alæ; nasal plate defined by an oval rim, basally truncate and notched, concave. Head and beak strongly rugulosely punctate, separated by a deep, broad, arcuate impression; beak strongly carinate, with a large apical triangular, glabrous, punctate area containing the nasal plate; surface densely squamose with æneous scales, darker on vertex, and sparsely setose with curved bristles. Scrobes deep, visible from above in entire length, evanescent near eyes; scape reaching middle of eye, squamose and setose; funicle elongate, shining, sparsely setose, all joints longer than wide; club oval, little longer than the two preceding joints. Eyes lateral, slightly convex, oval, pointed below. Prothorax wider than long, apically emarginate, basally truncate, laterally broadly convex, constricted behind apex; ocular lobes short and broad, without fimbriæ; surface covered with punctured setigerous tubercles and densely squamose; median line broadly impressed; scales mottled but lighter on sides. Scutellum minute, triangular. Elytra with humeri minutely angulate; sides slightly convex; over one-half longer than wide; intervals convex, the alternate ones visibly a little more so; all wider than striæ; striæ not impressed, punctures round, closer than their own diameters, each filled with a round striate scale; surface

densely squamose with mottled scales, all intervals setigerous, undersides densely clothed with lighter scales, sparsely setose, metasternal side-pieces not visible. First ventral suture slightly arcuate; second ventral segment not as long as the two following. Legs squamose; femora short and strongly inflated; tibiæ mucronate, denticulose and spinose; corbels cavernous.

Type.—Cat. No. 14645, U.S.Nat.Mus.

DIROTOGNATHINÆ, new subfamily.

Genus DIROTOGNATHUS Horn (1876).

Dirotognathus Horn, Proc. Amer. Philos. Soc., vol. 15, 1876, p. 79.

The genus is monotypic, based on *sordidus* Horn.

Subfamily PROMECOPINÆ Pierce (1911).

Table of genera of Promecopinæ.

1. Beak strongly dilated at tip; scrobes meeting beneath the eyes; mesosternum protuberant.....*Colecerus* Schönherr.
2. Beak very feebly dilated, cylindrical, flattened; scrobes not meeting beneath the eyes, but turning forward; mesosternum not protuberant.

a^1. Elytra broadly oval, scutellum small; metasternum short.
Aracanthus Schönherr.

a^2. Elytra oblong, broader at base than the thorax, scutellum transverse; metasternum moderately long .....*Eudiagogus* Schönherr.

Genus COLECERUS Schönherr (1840).

Colecerus Schönherr, Gen. et Sp. Curc., vol. 5, 1840, pt. 2, p. 928.
Coleocerus Gemminger and Harold, Cat. Coleopt., vol. 8, 1871, p. 2374.

The originally designated type is *setosus* Schönherr, of Mexico.

Genus ARACANTHUS Schönherr (1840).

Aracanthus (Say) Schönherr, Gen. et Sp. Curc., vol. 5, 1840, pt. 2, p. 822.

The originally designated type is *pallidus* Say.

Genus EUDIAGOGUS Schönherr (1840).

Eudiagogus Schönherr, Gen. et Sp. Curc., vol. 6, 1840, pt. 1, p. 307.

The originally designated type is *episcopalis* Gyllenhal, of Brazil.

Subfamily TANYMECINÆ Pierce (1911).

Table of tribes of Tanymecinæ.

1. Ocular vibrissæ always present; front coxæ contiguous..Tanymecini Horn (1876).
2. Ocular vibrissæ frequently lacking; front coxæ separated.
Pandeleteini, new tribe.

Tribe TANYMECINI Horn (1876)

Table of genera of Tanymecini.

1. Thorax feebly lobed behind the eyes, and bisinuate at base; eyes transversely oval, pointed beneath ..... *Pachnæus* Schönherr.
2. Thorax not lobed, base truncate, eyes round or longitudinally oval.
   a^1. Anterior femora normal, tibiæ simple.
      b^1. Posterior coxæ moderate in size, normally separated..... *Tanymecus* Germar.
      b^2. Posterior coxæ small, very widely separated.
         c^1. Ocular vibrissæ almost obsolete..... ...*Minyomerus* Horn
         c^2. Ocular vibrissæ very evident..... ....*Elissa* Casey.
   a^2. Anterior femora much longer and stouter than the others, the tibiæ denticulate within.....*Hadromeropsis*, new genus.

Genus PACHNÆUS Schönherr (1826).

Pachnæus Schönherr, Curc. Disp. Meth., 1826, p. 121.
Pachnëus Gemminger and Harold, Cat. Coleopt., vol. 8, 1871, p. 2224.

The originally designated type was *opalus* Olivier.

Genus TANYMECUS Germar (1817).

Tanymecus Germar, Mag. der Ent., vol. 2, 1817, p. 341.

Schönherr (1826) designated the type as *palliatus* Fabricius.

Genus MINYOMERUS Horn (1876).

Minyomerus Horn, Proc. Amer. Philos. Soc., vol. 15, 1876, p. 17.
Pseudelissa Casey, Ann. New York Acad. Sci., vol. 4, 1888, p. 273.

The type of *Minyomerus* is hereby designated as *innocuus* Horn. *Pseudelissa* is monotypic, based on (*cinerea* Casey) = *languidus* Horn.

Genus ELISSA Casey (1888).

Elissa Casey, Ann. New York Acad. Sci., vol. 4, 1888, p. 271.

We may hereby designate *laticeps* Casey as type of this genus.

HADROMEROPSIS, new genus.

Hadromerus Schönherr, Gen. et Sp. Curc., vol. 2, 1834, p. 125 [not Schönherr 1826].

Schönherr's (1826) genus *Hadromerus* has as its type *sagittarius* Olivier. Schönherr made an unfortunate mistake in his second volume (1834) in overturning his twice designated type of *Hadromerus* (1826, 1833) and giving the genus a new type, *nobilitatus* Gyllenhal. In addition he described *Siderodactylus* with *sagittarius* as type, thus making it an isogenotypic synonym of the true *Hadromerus*. For the genus with *nobilitatus* as type we may take a new name, *Hadromeropsis*. Our *opalinus* Horn belongs here.

PANDELETEINI, new tribe.

Pachyrhynchinæ Pierce, Proc. Ent. Soc. Wash., vol. 13, 1911, p. 49.

The separation of the anterior coxæ seems to be a good character for separating the Tanymecinæ into tribes. The genera placed here

have no relationship to the Pachyrhynchinæ, which also have the anterior coxæ separated, and at the same time need to be separated from the Tanymecini proper. The genus *Anypotactus* is very similar to *Polydacrys*, differing only by having the anterior coxæ contiguous. It must be placed in the Psallidiinæ.

Table of genera of Pandeleteini.

I. Tarsal claws free.

1. Humeral angles absent; apterous forms; anterior tibiæ denticulate: nasal plate very small..... *Isodacrys* Sharp.

2. Humeral angles present.

a.[2] Nasal plate large and distinctly outlined: ocular vibrissæ lacking. *Polydacrys* Schönherr.

a.[1] Nasal plate small or lacking; ocular vibrissæ present. *Pandeleteius* Schönherr.

II. Tarsal claws connate; humeral angles present; nasal plate obsolete; ocular vibrissæ represented by two or three setæ..... *Isodrusus* Sharp.

The first three genera are exceedingly closely allied, and yet Champion has described still another and suggested a new genus for one of our species. We can with mental reservations accept the four genera tabulated above, for the present, and may in the future find it advisable to permanently retain them, because of a multiplicity of forms.

Genus ISODACRYS Sharp (1911).

Isodacrys SHARP, Biol. Centr.-Amer., Coleop., vol. 4, 1911, pt. 3, p. 175.

The type of this genus is hereby designated as *guatemalensis* Sharp.

ISODACRYS OVIPENNIS Schaeffer.

Pandeleteius ovipennis SCHAEFFER.

The nasal plate is very small and triangular. This species was taken at Victoria, Texas, November 25, 1907, by J. D. Mitchell and C. R. Jones.

Genus POLYDACRYS Schönherr (1834).

Polydacrys SCHÖNHERR, Gen. et Sp. Curc., vol. 2, 1834, p. 130.

The originally designated type is *modestus* (Dejean) Gyllenhal.

POLYDACRYS DEPRESSIFRONS Boheman

Pandeleteius cavirostris SCHAEFFER.

This synonymy is according to Champion.[1]

The nasal plate is very large, the raised margin beginning at the lateral corners of the beak and forming a broad ogival area which is depressed, shining glabrous; the anterior margin is concave with an abruptly deep median concave emargination. This species was taken at Victoria, Texas, April 22, 1907, on *Cratægus*, April 23 and June 19, 1907 (Mitchell).

[1] Biol. Centr.-Amer., Coleop., vol. 4, pt. 3, p. 217, May, 1911.

Genus PANDELETEIUS Schönherr (1834).

Pandeleteius SCHÖNHERR, Gen. et. Sp. Curc., vol. 2, 1834, p. 129.
Pandeletius GEMMINGER and HAROLD, Cat. Coleop., vol. 8, 1871, p. 2208.
Pandeletejus HORN, Proc. Amer. Philos. Soc., vol. 15, 1876, p. 86.
Pandeleteinus CHAMPION, Biol. Centr.-Amer., Coleopt., vol. 4, 1911, pt. 3, p. 206.

The originally designated type of *Pandeleteius* is (*pauperculus* Gyllenhal) = *hilaris* Herbst. The monotype of *Pandeleteinus* is *submetallicus* Schaeffer. The available characters do not seem to the writer to warrant making three genera out of *Pandeleteius*, for our North American species, as suggested by Champion.[1]

European writers make a great mistake in quoting this genus as a synonym of *Sitona* Germar, which has as a type *lineata* Linnæus. The two genera are very greatly removed from each other by many good characters.

Table of species of Pandeleteius.

I. Antennal funicle 7-jointed.
  1. Anterior coxæ not more widely separated than middle coxæ; scrobes passing beneath. Beak truncate at apex; nasal plate exceedingly minute or obsolete.
    a^1. First joint of antennal funicle longer than the two following joints; basal thoracic constriction short and feeble; anterior tibiæ straight on inner edge almost to apex; nasal plate invisible.....*simplarius* Fall.
    a^2. First joint of antennal funicle as long as the two following joints.
      b^1. Anterior tibiæ straight on inner edge almost to apex; nasal plate exceedingly minute, triangular.....*hilaris* Herbst.
      b^2. Anterior tibiæ strongly sinuate on the inner edge from base; nasal plate invisible or obsolete.....*dentipes*, new species.
  2. Anterior coxæ separated by about twice the distance between the middle coxæ; apex of beak with nasal plate distinct.
    c^1. Scrobes long, passing beneath.
      d^1. Head between the eyes feebly convex or flat; thorax as wide or very slightly narrower at apex than at base; scales of upper surface variegated, producing a more or less distinct design.
        e^1. Prothorax broadly arcuate at sides; head and beak in front of eyes concave; nasal plate small, ogival, deeply emarginate....*depressus*, new species.
        e^2. Prothorax feebly arcuate at sides.
          f^1. Beak not separated from head by distinct transverse impressions; alternate elytral intervals only slightly elevated; general color gray; nasal plate short and very broadly triangular, very shallowly arcuately emarginate.....*cinereus* Horn.
          f^2. Beak separated from head by strong transverse impression; alternate elytral intervals elevated; scales of upper surface brownish with a more or less metallic luster; nasal plate broadly elliptical, small. *subtropicus* Fall.
      d^2. Head when viewed laterally, very convex; thorax cup-shaped, distinctly wider at apex than at base; scales of uniform greenish metallic color; nasal plate small, shallowly crescentiform.....*submetallicus* Schaeffer.
    c^2. Scrobes short, nearly straight, not passing beneath; form large and robust. *robustus* Schaeffer.

II. Antennal funicle 6-jointed; head and beak in front of the eyes concave; nasal plate with margin rimmed, convex, basally emarginate.....*rotundicollis* Fall.

[1] Biol. Centr.-Amer., Coleopt., vol. 4, 1911, pt. 3, p. 186.

PANDELETEIUS HILARIS Herbst.

New material has been studied from Mobile, Alabama, April 18 1910, on *Quercus*, W. D. Pierce; Natchez, Mississippi, June 15, 1909, E. S. Tucker; Trinity, Texas, March 20, 1907, on *Quercus phellos*, Pierce and Cushman; Beaumont, Texas, March 18, 1908, on *Quercus aquatica*, E. S. Tucker.

PANDELETEIUS DENTIPES, new species.

Described from two specimens collected in the Chisos Mountains, Brewster County, Texas, June 10–12, 1908, Mitchell and Cushman.

Dark brown mottled with black, of the size and stature of *hilaris*. Length 4–4.5 mm. Beak flat, apically truncate, with medially impressed line; scrobes oblique passing beneath very close to eyes, funicular joints elongate. Prothorax as long as wide, convex, strongly arcuate at sides, constricted immediately in front of base and at one-third from apex; coarsely but not closely punctate, scales mottled without definite pattern. Elytra distinctly wider than thorax at base, feebly rounded to apex. Anterior tibiæ strongly sinuate on inner margin and coarsely denticulate with about 14 denticles. Anterior coxæ not more widely separated than the median coxæ. Undersurface closely covered with brown iridescent metallic scales.

This species may be easily differentiated from all of the others by the characters given in the table.

Type.—Cat. No. 14653, U.S.Nat.Mus.

PANDELETEIUS DEPRESSUS, new species.

Described from one specimen collected in the Chiricahua Mountains, Arizona, June 6, on oak in the Hubbard and Schwarz collection. This species was wrongly determined as *robustus*.[1] Eight specimens are in the United States National Museum collections.

Mottled grey, with markings almost as in *hilaris*. Length 5.5 mm. Beak concave, apically triangularly emarginate with triangular smooth space and with medially impressed line; scrobes arcuately oblique passing beneath at a distance from the eyes; funicle seven-jointed, last five funicular joints moniliform. Prothorax wider than long, convex, strongly arcuate at sides, constricted near apex and base, moderately punctate, scales mottled grey to black with a broad median band; elytra distinctly wider than prothorax, sides straight, slightly diverging to apical fourth, thence oblique to apex; anterior tibiæ slender, slightly sinuate, bent at apex, denticulate within; anterior tarsi unusually long and slender, almost as long as tibiæ, the last joint equaling the three preceding. Anterior coxæ separated by about twice the distance between the middle coxæ. Undersurface clad with iridescent coppery scales.

Type.—Cat. No. 14654, U.S.Nat.Mus.

[1] Pierce, Proc. U. S. Nat. Mus., vol. 37, 1909, p. 360.

PANDELETEIUS CINEREUS Horn.

Dallas, Texas, March 6, 1908, on *Prunus*, Jones and Hood; March 6, 1909, breeding in twigs of *Phoradendron flavescens* on *Hicoria alba*, Pierce and Tucker; April 13, 1910, on *Quercus*, Pierce and Pinkus; April, 25, 1907, F. C. Pratt; May 12, 1907, E. A. Schwarz; Handley, Texas, on *Physostegia*, April 27, 1905, W. D. Pierce; Devils River, Texas, May 2–5, Schwarz, Pratt, and Bishopp. The writer can not find any structural differences between the specimens from these two widely separated localities.

PANDELETEIUS ROBUSTUS Schaeffer.

This is by far the most robust species seen by the writer, and also the darkest in color. The nine specimens at hand vary from 3.5 mm. to 5 mm. in length and also vary greatly in robustness. They are from the Chisos Mountains, Brewster County, Texas, June 10–12, 1908, Mitchell and Cushman.

Mr. Champion refers in the Biologia to specimens identified by the writer as *robustus* and having a six-jointed funicle. The specimens actually identified by the writer have never left the United States National Museum and are, as stated above, *depressus*. There are several unidentified species in the collection related to *depressus*, which the writer has not had time to study. It is quite possible that some of this unstudied material, being from the same localities as determined material, were selected and sent to Mr. Champion, purporting to be determined by the writer. In the Washington series there are still some specimens with six-jointed funicle awaiting study, and from the identical localities from which the species with seven-jointed funicle were taken.

PSALLIDIINÆ, new subfamily.

Brachyderinæ Pascoe, 1870.

Table of tribes of Psallidiinæ.

I. Elytra wider than prothorax at base; humeri angulate, often prominent.
1. Claws free.
a^1. Corbels of posterior tibiæ open or very feebly cavernous.
b^1. Rostrum smooth, often medially carinate.....Alceidini, new tribe.
b^2. Rostrum very rough or tricarinate above.....Prypnini, new tribe.
a^2. Corbels of posterior tibiæ cavernous.....Cyphini Horn (1876).
2. Claws connate .....Polydrusini, new tribe.
II. Elytra not wider than prothorax, emarginate or truncate at base; humeri absent or rounded, wings absent or rudimentary.
3. The three intermediate segments of the abdomen equal, separated from each other and from the first by straight sutures.....Blosyrini, new tribe.
4. Abdominal segments unequal, separated from the first by an arcuate or angulate suture.
a^1. Head and prothorax normal.
b^1. Third joint of all the tarsi wider than the second and deeply bilobed.
c^1. Tibiæ normal, not dilated at tip.

d^1. Mandibles robust, with persistent or deciduous apical piece; in the latter case the supports are more salient than usual and depressed.
PSALLIDIINI, new tribe.

d^2. Mandibles with deciduous piece, the supports short, conical and truncate.

e^1. Antennæ scaly or coarsely pubescent, body beneath densely scaly.

f^1. Claws connate.

g^1. Scrobes curved downward and directed toward the constriction between the head and beak.....SCIAPHILINI, new tribe.

g^2. Scrobes directed toward or just beneath the eyes.
THYLACITINI, new tribe.

f^2. Claws free.....EPICÆRINI Pierce (1909).

e^2. Antennæ shining, sparsely hairy, body beneath nearly naked.
BARYNOTINI Bedel (1885).

c^2. Anterior tibiæ dilated at tip; scape long, passing the eyes.
TRIGONOSCUTINI, new tribe.

b^2. Third joint of tarsi not wider than second, and feebly emarginate.
CALYPTILLINI, new tribe.

a^2. Head and prothorax very elongate, cylindrical.
RHADINOSOMINI, new tribe.

The tribes Prypnini, Psallidiini, and Rhadinosomini are not represented in our fauna.

ALCEIDINI, new tribe.

The only North American genus which can properly be assigned here is the following one, which has since its original publication been unnoticed in our North American literature. It has not yet been recognized by the writer.

Genus PACTORRHINUS Ancey (1881).

Pactorrhinus C. F. ANCEY, Le Naturaliste, vol. 1, 1881, Année 3, p. 485.

The following description is translated from the French original:

Beak very thick, inclined, very short, almost square, slightly attenuate at apex, lightly convex and tricanaliculate above, emarginate at tip, not separated from the head. Scrobes deep, arcuate, infraocular. Antennæ short, submedian; scape not attaining the middle of the eyes; funicle seven-jointed, first joint short and subconical, second much more elongate and conical, the following joints about the same dimensions as the first and subequal; club elongate, normal. Prothorax without ocular lobes or vibrissæ, subtransverse, narrowed in front, rounded on the sides, apically truncate, lightly bisinuate at base, posterior angles acute. Scutellum very small, sunken, triangular. Elytra convex, oval, subnavicular, with humeri salient, obtuse; larger than the prothorax; striate, with the striæ slightly diverging at apex. Abdomen and legs normal; femora clavate; corbels of posterior tibiæ open; anterior tibiæ arcuate at their extremity. Tarsi quite large, spongy beneath; fourth joint larger, claws small, free. Body black, elongate, squamose.

PACTORRHINUS GRISESCENS C. F. Ancey.

The following description is translated from the Latin original:

Length 14.5 mm.; breadth 5.5 mm.

Elongate, black, strongly convex, grayish squamulose, scales occasionally faintly tinged with red. Head and beak thick, punctulate; beak trisulcate, with the median sulcus deeper and longer. Prothorax convex, somewhat flattened on the middle of

the disk, punctulate, basally lightly bisinuate. Elytra with shining surface; ten-striate, striæ impressed, punctate. Legs rather robust.

Arizona.

This insect might be taken for a genus near *Pachnæus*, but a close study has caused me to place it in the group of *Naupactides* (according to Lacordaire), following *Sitones* and *Pandeleteius*, with which it presents a few characters in common. Its size is very large and it resembles somewhat a *Cleonus*. It is of a very brilliant black, covered with dark gray squamules, very lightly rosy on the elytra when viewed in a certain aspect.[1]

Tribe CYPHINI Horn (1876).

Table of genera of Cyphini.

1. Genæ emarginate behind the mandibles.
   - a^1. Tenth striæ confluent with ninth.....Group *Compsi*.
     - b^1. Articular surface of hind tibiæ scaly; scape passing eyes; nasal plate glabrous; beak gradually widened anteriorly.....*Compsus* Schönherr.
     - b^2. Articular surface of hind tibiæ glabrous; scape not passing the eyes. *Cyphus* Germar.
   - a^2. Tenth striæ not confluent with the ninth.....Group *Pseudocyphi*.
     - c^1. Rostrum not widened anteriorly, the upper portion narrowed and deeply excavate toward the apex, the nasal plate squamose; anterior tibiæ unarmed at apex .....*Pseudocyphus* Schaeffer.
2. Genæ not or hardly emarginate behind the mandibles.
   - d^1. Tenth striæ confluent with the ninth.....Group *Glaphyrometopi*.
     - c^1. Articular surface of hind tibiæ glabrous; scape not passing the eyes; beak deeply trisulcate, front very deeply transversely depressed, vertex strongly bifoveate .....*Glaphyrometopus*, new genus.
   - d^2. Tenth striæ not confluent with the ninth.....Group *Evoti*.
     - f^1. Submentum not pedunculate; mentum broad; thorax bisinuate at base. *Lachnopus* Schönherr.
     - f^2. Submentum pedunculate; mentum narrow; thorax truncate at base. *Evotus* LeConte.

Genus COMPSUS Schönherr (1826).

Compsus Schönherr, Curc. Disp. Meth., 1826, p. 109.

The originally designated type was *acrolithus* Germar.

Genus CYPHUS Germar (1824).

Cyphus Germar, Ins. Spec. Nov., 1824, p. 427.

Schönherr (1826) designated *gibber* Pallas, as type.

Genus PSEUDOCYPHUS Schaeffer (1905).

Pseudocyphus Schaeffer, Brooklyn Inst. Mus. Sci., Bull. 1, pt. 7, 1905, p. 179.

This genus is monotypic, based on *flexicaulis* Schæffer.

GLAPHYROMETOPUS, new genus.

The name of this remarkable new genus is derived from γλαφυρός (hollow) + μέτωπον (forehead, frons), signifying that the frons is hollowed out.

[1] Translated from the French original.

Body squamigerous, robust. Rostrum short, but little longer than head, almost as broad as long, trisulcate; nasal plate triangular, glabrous; scrobes visible from above at apex, strongly arcuate passing beneath eyes. Mentum large, almost circular, concave. Antennæ short; funicle 7-jointed, slightly longer than scape; club ovate. Head deeply transversely depressed between eyes, but with a strong superocular ridge laterally bounding the depression. Head with two smaller foveiform depressions behind the large transverse impression. Prothorax transverse with sides arcuate. Elytra globular, with moderate humeral angles; tenth elytral striæ confluent at basal third with the ninth. Front coxæ contiguous; middle coxæ narrowly separated; hind coxæ widely separated. Legs short; femora mutic; articular surface of hind tibiæ oblique, glabrous, but with the corbels practically terminal or cavernous; tibiæ unguiculate; third tarsal joint broadly bilobed; claws separate. Meso- and meta- thorax short. Mesosternal sidepieces uneven. Intercoxal process of abdomen large, quadrate. Abdominal sutures straight; abdomen strongly inclosed by elytra.

GLAPHYROMETOPUS ORNITHODORUS, new species.

Described from five more or less perfect specimens taken from the stomach of a meadow lark, *Sturnella magna neglecta*, which was shot at Navasota, Texas, December 12, 1907 in an open prairie by Mr. V. Bailey. (Biological Survey, No. 57705.) The unusual appearance of this insect has led me to call it *ornithodorus*, meaning a gift from the birds.

Length 4.5–5 mm., breadth 2.2–3 mm. Black; robust, strongly sculptured, densely scaly. Vestiture brownish cinereous with white fasciæ. Beak densely scaly, except near tip; scales striate, brownish with a metallic luster. Nasal plate triangular glabrous, apically notched, laterally rimmed. A short carina leads from the apex of this plate but soon passes into a median sulcus which is very deep and extends to the transverse depression of the front. The two lateral sulci begin even with this and also terminate in the frontal depression. The areas between these sulci are strongly convex. Scrobes becoming somewhat wider on sides, terminated at lower edges of eyes. Antennal scape squamose, not passing the eyes; funicular joints all short, but the first two are longer than wide, the remainder becoming gradually more transverse; club indistinctly annulate; funicle and club pubescent. Head with strong transverse frontal impression, almost as long as the eyes but separated from them by a strong superocular ridge. Occiput with two foveiform impressions; cephalic scales strongly metallic.

Prothorax apically truncate, basally convex, laterally strongly arcuate; transverse; strongly, deeply and irregularly punctate, with

a large deep irregularly punctate median impression. Vestiture densely squamose with chocolate brown scales and with a median and two lateral white longitudinal vittæ.

Scutellum minute. Elytra shining black, considerably broader at humeri than prothorax, somewhat inflated behind, strongly inclosing abdomen, separable, and faintly separately rounded at apical sutural angle. Strial punctures large, deep. Striæ not impressed. Interspaces moderately convex. Vestiture consisting of flat scales and erect scales clustered or single. The general color of the vestiture is chocolate brown. A basal white fascia arises at the humeri and passing back to the basal fourth then transversely to the middle, forms a brown quadrate basal area. On the fourth interspaces a longitudinal process leaves this transverse white band, but does not reach the second white band. This latter is transverse and post-median. The sutural interspace from the middle to apex is clad with golden scales. The erect scales are placed in a row on each interspace but are clustered in many spots in front of the middle. The strial punctures are closely covered with flat scales.

Ventral parts closely squamose, with cinereous scales on the thorax and sides of abdomen and brown scales on remainder of abdomen. Mesosternum transversely impressed. The intercoxal portion of the metathorax and the first abdominal segment is strongly depressed. Second segment almost as long as third and fourth. Fifth as long as the three preceding.

Type.—Cat. No. 14645, U.S.Nat.Mus.

Genus LACHNOPUS Schönherr (1840).

Ptilopus SCHÖNHERR, Curc. Disp. Meth., 1826 [not Meigen].
Lachnopus SCHÖNHERR, Gen. et Sp. Curc., vol. 6, 1840, pt. 1, p. 380.

The type of *Ptilopus* was *aurifer* Drury. *Lachnopus* was proposed to take the place of this preoccupied name, and hence has the same type.

Genus EVOTUS LeConte (1874).

Evotus LECONTE, Amer. Nat., 1874, pp. 458, 459.

The monotype of this genus is *naso* LeConte.

POLYDRUSINI, new tribe.

Table of genera of Polydrusini.

1. Beak with nasal place small and inconspicuous.....*Polydrusus* Germar.
2. Beak very short and massive, with nasal plate large, as wide as beak and distinctly margined.....*Scythropus* Schönherr.

Genus POLYDRUSUS Germar (1817).

Polydrusus GERMAR, Mag. der Ent., vol. 2, 1817, pp. 339-341.
Polydrosus SCHÖNHERR, Curc. Disp. Meth., 1826.

Schönherr (1826) designated *undatus* Fabricius as type.

Genus SCYTHROPUS Schönherr (1826).

Scythropus SCHÖNHERR, Curc. Disp. Meth., 1826, p. 140.

The originally designated type is *mustela* Herbst.

BLOSYRINI, new tribe.

Table of genera of Blosyrini.

1. Scape attaining the middle of the eyes, the latter moderately prominent, without posterior orbit ..... *Hormorus* Horn.
2. Scape barely attaining the anterior margin of the eye, the latter spherical, prominent, and with posterior orbit ..... *Agasphærops* Horn.

Genus HORMORUS Horn (1876).

Hormorus HORN, Proc. Amer. Philos. Soc., vol. 15, 1876, p. 23.

The genus is monotypic, based on *undulatus* Uhler.

Genus AGASPHÆROPS Horn (1876).

Agasphærops HORN, Proc. Amer. Philos. Soc , vol. 15, 1876, p. 24.

The genus is monotypic, based on *nigra* Horn.

It is possible that future study may separate these genera from the Blosyrini typical, as suggested by Horn, but for the present it is best to adhere somewhat closely to the Lacordaire classification.

SCIAPHILINI, new tribe.

Table of genera of Sciaphilini.

1. Body slender, cylindrical; antennæ attenuate; scrobes very broad at angle, thence narrowing to termination ..... *Mitostylus* Horn.
2. Elytra robust, oval; antennæ stouter; scrobes not so broad at angle. *Sciaphilus* Schönherr.

Beyond the general facies there are few tangible generic differences between these two genera.

Genus MITOSTYLUS Horn (1876).

Mitostylus HORN, Proc. Amer. Philos. Soc., vol. 15, 1876, p. 107.
Derosomus SHARP, Biol. Centr.-Amer., Coleop., vol. 4, 1891, pt. 3, p. 168.

Sharp's genus is perfectly congeneric with Horn's. We designate as type of *Derosomus* the first species, *fragilis* Sharp, as it is the only one illustrated. The monotype of Horn's genus is *tenuis* Horn. The genus as now known includes six species for which a table is presented. The two species not before the writer are *scutellaris* Sharp (1911) and *glaucus* Champion (1911). There is scarcely any doubt but that *Chætopantus* Sharp is also a synonym of *Mitostylus*, but no specimens are before the writer.

Table of species of Mitostylus.

1. Body not clad with long fine hairs.
   - a^1. First funicular joint as long as, or longer than, the second and third together.
     - b^1. Vestiture green, setæ very short, but erect (Texas)..... *tenuis* Horn.
     - b^2. Vestiture grayish with two more or less interrupted prominent brown fasciæ, setæ inconspicuous, decumbent (Lower California)..... *gracilis* Horn.
   - a^2. First funicular joint not as long as the second and third combined; vestiture grayish, with two more or less interrupted brown fasciæ, setæ visible, subrecumbent (Yucatan)..... *fragilis* Sharp.
2. Body clad with long fine hairs.
   - a^1. Scutellum squamose, on level with elytra; tibiæ squamose and hispid (Texas, Mexico)..... *setosus* Sharp.
   - a^2. Scutellum a broad shining tubercle; tibiæ with depressed setæ, but without erect hairs (Guatemala)..... *scutellaris* Sharp.

Mr. Champion's species *glaucus* belongs near *setosus*, but is separated by the shorter and more abundant erect setosity on the elytra, the scales uniformly glaucous, and the prothorax as finely punctured as in *scutellaris*.

A full description of *setosus* is presented below, as this had been drawn up as a description of a new species.

MITOSTYLUS SETOSUS Sharp.

Form slender, body black, surface densely covered with broad truncate white scales and small patches of ochreous scales, and bristling with slender hairs. Length, 4.5–5.5 mm.

Beak short, narrowed toward apex, triangularly emarginate at apex with an apical concave depressed smooth triangular area bounded by a raised rim; surface very roughly punctured, irregularly squamose, bristling with long hairs; scrobes visible from above, broad at apex, arcuate, upper line directed toward eyes, then suddenly flexed toward angle between head and beak beneath, lower line more moderately curved, making scrobes widest at angle and narrowest in downward projection. Antennæ elongate and very slender; scape slender, clavate, reaching thorax; funicle elongate, first and second joints long, clavate, the first a little longer than the two following; joints 3–7 shorter, diminishing toward club; club very elongate, slender, about as long as the last three funicular joints. Thorax a little wider than long; base and apex equal, truncate; sides moderately convex; surface very coarsely pitted, with median carina; scaly vestiture white with a median ochreous vitta. Elytra not wider at base than thorax, without humeri, elongate-oval; striæ formed by closely approximate quadrate punctures; intervals each with a single row of erect black bristles; scales moderately close but not overlapping, white, except with small ochreous spots before the middle and a larger transverse vitta behind the middle. Femora scaly and bristly; tibiæ straight and clothed as femora, tarsi slender,

pubescent. Underside clothed as above, but with bristles shorter and finer; last abdominal with a circular pubescent depression without scales.

Described from 26 specimens collected by J. D. Mitchell and R. A. Cushman in the Chisos Mountains, Brewster County, Texas, June 10–12, 1908.

Genus SCIAPHILUS Schönherr (1826).

Sciaphilus SCHÖNHERR, Curc. Disp. Meth., 1826, p. 98.

The originally designated type is *muricatus* Fabricius.

THYLACITINI, new tribe.

Brachyderini HORN, 1876.

Table of genera of Thylacitini.

1. Second abdominal with anterior edge straight or nearly so; scape not passing the eyes; scrobes usually prolonged under eyes; eyes very prominent. *Strophosoma* Billberg.
2. Second abdominal with anterior edge arcuate; scape passing the eyes; scrobes evanescent before the eyes..... *Thylacites* Germar.

Genus STROPHOSOMA Billberg (1820).

Strophosoma BILLBERG, Enum. Insect. Mus. Billb., 1820.
Strophosomus SCHÖNHERR, Curc. Disp. Meth., 1826, p. 97.

The type is *coryli* Fabricius, as designated by Schönherr (1826).

Genus THYLACITES Germar (1817).

Thylacites GERMAR, Mag. der Ent., vol. 2, 1817, pp. 339–341.
Brachyderes SCHÖNHERR, Curc. Disp. Meth., 1826, p. 102.

Six species were originally included in the genus, from which Leach (1819, 1824) selected *incanus* Linnæus as type. *Brachyderes* is isogenotypic. Schönherr in 1826 designated *fritillum* Panzer (*robiniæ* Herbst) as type of *Thylacites*, and in 1833 designated *catarrhactus* (*cataractes*) Sahlberg as type of the same genus. The latter species is type of Sahlberg's (1823) genus *Cycloderes*, which therefore takes the place of Schönherr's erroneously named genus, *Thylacites*.

Tribe EPICÆRINI Pierce (1909).

Table of genera of Epicærini.

I. Side pieces of mesosternum very unequal, the episternum larger and attaining the elytral margin, epimeron usually small, sometimes very small...Group *Epicæri.*
1. Articular face of hind tibiæ scaly; support of deciduous piece of mandibles very prominent; antennæ rather slender, club distinct..... *Anomadus* Horn.
2. Articular face of hind tibiæ glabrous; support of deciduous piece of mandibles moderately prominent.
a^1. Scutellum transverse, T-shaped, the lobes separated from the base by projections of the elytra ..... *Cleistolophus* Sharp.

a^2. Scutellum basal, not as above.

b^1. Head strongly constricted behind the eyes; eyes truncate behind.

Bradyrhynchoides, new genus.

b^2. Head not constricted behind eyes; eyes evenly convex.

c^1. Eyes with smooth margin, especially behind.

d^1. Antennæ stout, last joint of funicle short, broad, and very close to club; alternate elytral intervals elevated.....*Graphorhinus* Say.

d^2. Antennæ more slender, joints of funicle conical, the last distant from the club; elytral intervals equal in convexity..*Epicærus* Schönherr.

c^2. Eyes without smooth margin.....*Stamoderes* Casey.

II. Side pieces of mesosternum diagonally divided and equal or very nearly so, the episternum distant from the elytral margin, from which it is separated by the epimeron.....Group *Artipi*.

3. Tenth elytral striæ entire.

a^1. Genæ feebly emarginate; anterior tibiæ not denticulate within but with a row of sharp spines; second segment of the abdomen not longer than the two following.....*Omileus* Horn.

a^2. Genæ strongly emarginate; anterior tibiæ denticulate within; second segment of abdomen usually as long as or longer than the two following.

b^1. Funicular joints elongate, second joint as long as or longer than the first.

Pantomorus Schönherr.

b^2. Funicular joints short, second joint shorter than the first.

Lepidocricus Pierce.

4. Tenth elytral striæ confluent with the ninth; second segment of abdomen longer than the two following; genæ strongly emarginate.....*Artipus* Sahlberg.

Genus ANOMADUS Horn (1876).

Anomadus Horn, Proc. Amer. Philos. Soc., vol. 15, 1876, p. 21.

The monotype of this genus is *obliquus* Horn.

BRADYRHYNCHOIDES, new genus.

This genus is erected for *Bradyrhynchus rugicollis* Sharp and a new species. The three species placed by Sharp in *Bradyrhynchus* are placed by Champion in the genus *Epagrius* Schönherr. A careful examination of seven species placed by Champion in *Epagrius* (not *Epagrius* Sharp, which Champion renames *Epagriopsis*) disclose two types of eyes. The type species of *Bradyrhynchus* is *brevirostris* Sharp which has an evenly convex eye and no constriction of the head behind the eyes. Four of the other species at hand agree as to this character. However, *constrictus* and *rugicollis* have a deep constriction behind the eyes, which are strongly convex and sharply truncate behind. In other respects the genus is very similar to the various other genera in the group.

Type of genus.—Bradyrhynchoides constrictus, new species.

Table of species of Bradyrhynchoides.

1. Prothorax strongly foveate; beak medially broadly depressed, frontal constriction arcuate (Mexico).....*rugicollis* Sharp.
2. Prothorax feebly foveate; beak medially sulcate, frontal constriction straight (Texas).....*constrictus*, new species.

BRADYRHYNCHOIDES CONSTRICTUS, new species.

Described from three specimens collected at San Diego, Texas, April 25, 27, by E. A. Schwarz.

Length 6.5–7 mm , width 3–3.2 mm. Oval, black, densely clothed with pinkish white, gray, and brown scales arranged in fasciæ, with a few translucent yellowish recumbent squamiform setæ.

Beak short and broad, not longer than head; head with a very deep, straight transverse depression immediately behind the eyes; nasal plate strongly rimmed by a broad and deep convex line, concave, shining, minutely punctate, arcuately emarginate; fovea elongate, merging into a deep median sulcus; vestiture dense, overlapping, with sparse openings for the setæ. Eyes very prominent, convex, truncate behind. Scrobes strongly arcuate; scape short, stout, reaching but little beyond the middle of the eyes; funicular joints subequal, the first two slightly longer, all but little longer than wide, white pubescent; club as long as the three preceding joints, oval, brown pubescent, but with white pubescence at base. Prothorax as long as wide, truncate at base, convex at apex and sides, base almost twice as wide as apex; median line faintly indicated; surface irregularly pitted; vestiture densely squamose, sparsely setose, white with a broad darker fascia on median line. Elytra not wider than prothorax at base, not greatly inflated; striæ not impressed; punctures large, rounded, shallow, and distinctly separated; interspaces almost flat; vestiture white with a sinuate brown postmedian fascia, and with grayish scales in form of basal and apical fasciæ. Setæ sparse. Undersides densely squamose. Tibiæ denticulate.

Type.—Cat. No. 14649, U.S.Nat.Mus.

Genus GRAPHORHINUS Say (1831).

Graphorhinus SAY, Descr. N. A. Curc., 1831, New Harmony, Indiana.
Graphorrhinus GEMMINGER and HAROLD, Cat. Coleopt., vol. 8, 1821, p. 2241.

This genus originally contained two species, of which Schönherr selected in 1833, *vadosus* Say to serve as type. Though it presents a different habitus from *Epicærus* this genus can only be separated by very poor structural characters.

Genus EPICÆRUS Schönherr (1834).

Epicærus SCHÖNHERR, Gen. et Sp. Curc., vol. 2, 1834, p. 323.

The originally designated type of the genus is *mexicanus* Boheman.

Since publishing a table of the species of this genus [1] other material has come to hand making it worth while to restudy the genus.

[1] Jour. Econ. Ent., vol. 3, pp. 359-361.

Table of species of Epicærus.

A. Scutellum small, triangular.
1. Frontal fovea round or very shortly oval and not merging into a sulcus.
a^1. Elytral strial punctures very large, much wider than the intervals; beak medianly broadly impressed, subsulcate; pronotal punctuation minute, with few large depressions, median line broadly impressed; scales rusty in color ..... *mexicanus* Boheman.
a^2. Elytral intervals at least as wide as striæ.
b^1. Beak smooth on median line, but with two broad sulci at sides; frontal puncture round, small, or moderate. Strial punctures round, deep and almost as wide as the intervals; all funicular joints longer than wide, seventh joint shortest; elytral vestiture distinctly fasciate. ..... *imbricatus* Say.
b^2. Beak broadly impressed on median line; fourth, fifth, and sixth funicular joints about as wide as long, moniliform; seventh longer; elytral vestiture unicolorous, grayish ..... *wickhami*, new species.
2. Frontal fovea elongate, merging into frontal sulcus of beak.
a^1. Funicular joints elongate.
b^1. Very large species (16 mm.), elytra not more than one-half longer than wide; prothorax shallowly impressed along middle ..... *lucanus* Horn.
b^2. Smaller species (under 10 mm.); elytra almost twice as long as wide; prothorax medianly sulcate ..... *texanus* Casey.
a^2. Funicular joints 3–6, about as wide as long.
c^1. Elytra from one-half to two-thirds longer than wide.
d^1. Seventh funicular joint evidently longer than sixth; median line of prothorax sulcate; length 8–10 mm ..... *sulcatus* Casey.
d^2. Seventh funicular joint hardly if any longer than sixth; median line hardly indicated; elytra about one-half longer than wide; length 4.5–6.5 mm ..... *lepidotus* Pierce.
c^2. Elytra but slightly longer than wide ..... *formidolosus* Boheman.
B. Scutellum transverse, broadly oval; frontal fovea small, round; beak smooth on median line; funicular joints elongate, seventh shortest; vestiture fasciate ..... *benjamini*, new species.

EPICÆRUS IMBRICATUS Say.

This species while quite variable in form, due to the inflation of the abdomen in the female, nevertheless has a facies different from any of our other species. Typical specimens are at hand from Washington, District of Columbia; Travilah and Locust Grove, Maryland; Sharpsburg, Virginia; Catoosa, Georgia; St. Louis and Sedalia, Missouri, and Tonganoxie, Kansas (T. B. A.). A series of smaller individuals with somewhat smaller strial punctures is at hand from Arkansas (taken on strawberry, June 11), and Texas. Another similar series is at hand from Nebraska. Western Kansas and Texas forms frequently are almost unicolorous, gray.

EPICÆRUS WICKHAMI, new species.

Described from eight specimens from New Mexico, collected by Professor Wickham, in whose honor the species is named. One specimen from the Continental Divide of New Mexico (Townsend), two from Colorado, and one from Wasatch, Utah, June 27 (Hubbard and Schwarz) are also at hand.

Length 7.5–9 mm., width 3–4 mm. Form elongate, oval, robust in female, slender in male. Body black, moderately densely clothed with oval, flat scales of a grayish color with no color pattern. Beak a little longer than head, longer than wide, not separated from front by a depression; nasal plate very broad, ogival, basally angulately emarginate, smooth, rimmed; fovea deep and round, median line impressed from a short distance in front of fovea to tip, the impression broadened in front; lateral impressions deep, short; surface of head and beak closely punctate, especially toward apex of beak, vestiture moderately dense except on a triangular, strongly punctate, impressed area surrounding the nasal plate; setæ sparser. Scrobes deep; scape reaching beyond middle of eyes; funicle with third to sixth joints about as wide as long, others longer. Prothorax a little wider than long, deeply and broadly impressed on median line, finely punctate with few large impressions; vestiture not very dense. Elytral strial punctures round, small, setigerous; intervals wide, the alternate intervals somewhat more convex at base; vestiture moderately densely squamose with sparse decumbent setæ. Undersides squamose and more densely setose.

Type.—Cat. No. 14647, U.S.Nat.Mus.

EPICÆRUS BENJAMINI, new species.

This very interesting species differs from all other species in the United States by the shape of its scutellum.

Length 11 mm., width 5.2 mm. Form robust. Black, densely clothed with white and coppery brown scales of various shades arranged in definite patterns. Beak as long as head, as wide as long, not separated from the front by a depression; nasal plate broad, ogival, deeply arcuately emarginate, smooth, concave, rimmed; fovea small, round; median area very broadly and shallowly impressed; lateral impression short and deep; surface of head and beak irregularly punctate, closely squamose, sparsely setose; funicular joints a little longer than wide. Eyes evenly and broadly, but not strongly, convex. Prothorax finely punctate, coarsely foveate; densely squamose, with white median and lateral fasciæ; median line faintly impressed. Elytral strial punctures round, separated, almost filled with scales; intervals wide. Vestiture of elytra dense, cupreous brown with unconnected whitish spots representing the usual bands, and with the sides white.

Type.—Cat. No. 14648, U.S.Nat.Mus.

Described from a single specimen from Texas, and named in honor of Dr. Marcus Benjamin, in acknowledgment of many courtesies.

In form of scutellum this species presents an approach to *Cleistolophus*, which has been included in the foregoing table of genera for purposes of comparison. A study of typical specimens shows that this species does not share the essential characters of *Cleistolophus*.

Genus STAMODERES Casey (1888).

Mimetes SCHÖNHERR, Mantiss. Sec. Curc., 1847, p. 23 [not Eschscholtz, 1818].
Stamoderes CASEY, Ann. New York Acad. Sci., vol. 4, 1888, p. 236.

The type of Schönherr's preoccupied genus is *setulosus* (Schönherr) Lacordaire. The monotype of Casey's genus is *uniformis* Casey. Colonel Casey [1] has pointed out the possibility of these genera being synonymous and the descriptions would so indicate. Both species are Californian and are possibly synonymous also. The only material at hand may be considered *setulosus*. It is from Scotia, California, May 20 (H. Soltau), and was formerly placed by the writer under the name *seniculus* Horn.

In appearance this genus is nearer the group Artipi, but the available characters place it close to *Epicærus*.

Genus OMILEUS Horn (1876).

Omileus HORN, Proc. Amer. Philos. Soc., vol. 15, 1876, p. 102.

The monotype of the genus is *epicæroides* Horn.

Genus PANTOMORUS Schönherr (1840).

Pantomorus SCHÖNHERR, Gen. et Sp. Curc., vol. 5, 1840, p. 942.
Aramigus HORN, Proc. Amer. Philos. Soc., vol. 15, 1876, p. 93.
Phacepholis HORN, Proc. Amer. Philos. Soc., vol. 15, 1876, p. 95.

An examination of the typical species of Pantomorus (*albosignatus* Boheman), Aramigus (*tesselatus* Say), and Phacepholis (*elegans* Horn) causes the writer to consider these genera identical, as Champion has already stated in the Biologia Centrali-Americana.[2]

The following table is proposed for the species of the United States:

Table of species of Pantomorus.

I. Posterior tibiæ with, at most, a double row of spines at tip.
Subgenus *Pantomorus* Schönherr.
1. Denticulation of anterior tibiæ fine; surface densely scaly.....*tesselatus* Say.
2. Denticulation of anterior tibiæ strong; surface not densely scaly...*fulleri* Horn.
II. Posterior tibiæ with an oval scaly disk at tip.....Subgenus *Phacepholis* Horn.
3. Anterior tibiæ only denticulate. Funicular joints elongate, the second much longer than the first and considerably longer than the two following.
a^1. Prothorax squarely truncate.
b^1. Denticulation of anterior tibiæ fine; color of vestiture yellowish green.
elegans Horn.
b^2. Denticulation of anterior tibiæ very strong; second funicular joint about equal to the three following joints; vestiture brilliant bluish green.
viridis Champion.
a^2. Prothorax obliquely truncate; denticulation of anterior tibiæ moderately strong; vestiture brownish.....*nebraskensis*, new species.
4. Anterior and median tibiæ denticulate, the latter sometimes very minutely; prothorax obliquely truncate.

[1] Ann. New York Acad. Sci., vol. 4, 1888, p. 238. [2] Coleoptera, vol. 4, pt. 3, p. 232.

a^1. Second funicular joint much longer than the first and considerably longer than the two following.

b^1. Vestiture green; second abdominal segment longer than or as long as the two following segments.....*metallicus*, new species.

b^2. Vestiture grayish; second abdominal segment longer than the two following segments.....*texanus*, new species.

a^2. Second funicular joint subequal to the first, or but slightly longer, and subequal to the two following.

c^1. Elongate, elytra at least twice as long as wide.....*candidus* Horn.

c^2. Small and stout, elytra not twice as long as wide.

d^1. Strial punctures plain; scaly vestiture not overlapping, erect setæ squamiform, truncate.....*pallidus* Pierce.

d^2. Strial punctures almost covered by vestiture; scaly vestiture closely overlapping; erect setæ, long, hair like, black and white.....*obscurus* Horn.

PANTOMORUS (PANTOMORUS) TESSELATUS Say.

Aramigus tesselatus Horn.

The nasal plate in this species is very short and broad. The posterior rim is distinct and broadly angulate, reaching the lateral margin of the beak. This gives the appearance of a deep emargination. The nasal plate is so short and depressed that it is likely to be overlooked; the margin is biconvex, emarginate at center. Mandibles squamose.

PANTOMORUS (PANTOMORUS) FULLERI Horn.

Aramigus fulleri Horn.
Pantomorus olindæ Perkins.
Pantomorus fulleri Champion.

The nasal plate in this species is entirely different, being ogival, much deeper than in *tesselatus* and occupying at base about one-third the width of the beak; it is concave, and angulately emarginate. Mandibles squamose.

PANTOMORUS (PHACEPHOLIS) ELEGANS Horn.

Phacepholis elegans Horn.

The nasal plate is crescentiform. The mandibles are squamose. Champion calls attention to a row of tubercles on the second ventral segment of the abdomen in the male and states that this species has 5. In the series before the writer are 20 without tubercles and 3 with them (from San Diego, Texas). Only two tubercles are strong and there is a varying number of minute granulations.

PANTOMORUS (PHACEPHOLIS) VIRIDIS Champion.

Epicærus viridis Dugès in a letter.
Phacepholis viridis Chittenden, manuscript.
Phacepholis elegans (*viridis* Chittenden) Pierce, 1909.
Pantomorus viridis Champion, Biol. Centr.-Amer. Coleop., vol. 4, pt. 3, p. 336, Dec., 1911.
Pantomorus viridis Chittenden, Proc. Ent. Soc. Wash., vol. 14, pp. 106, 107, June 19, 1912.

This beautiful weevil was formerly considered by Mr. E. A. Schwarz and the writer as a variant of *elegans*. When the writer quoted Doctor Chittenden's manuscript name in print he was under the distinct impression that it had been published, otherwise he would not have used it. Since Mr. Champion has published a colored illustration and a brief statement concerning its characters the species may be credited to him. Of the six specimens of Doctor Chittenden's typical material before the writer in 1909 one was presented by the United States National Museum to Mr. Champion and this was figured. The series in the United States National Museum bears the type number 9756. It is very regrettable that this confusion has arisen. Doctor Chittenden's description unfortunately comes too late to give him the credit that should belong to him for discovering the species.

In making the present study the conclusion had already been reached that *viridis* was sufficiently distinct to be given specific rank and it was so placed in the present manuscript when Mr. Champion's notes came to hand.

The characters given in the table will assist in differentiating it from *elegans*, but the following are also of value: nasal plate small, triangular, emarginate, and somewhat obscured by the long hairs surrounding it; mandibles squamose; ventral tubercles on the second segment of the male merely granulations.

PANTOMORUS (PHACEPHOLIS) NEBRASKENSIS, new species.

Described from a single specimen from Lincoln, Nebraska (Wickham).

Length 6 mm., width 2.3 mm. Elongate, of the form of *fulleri*, reddish, densely covered with light brownish scales and sparsely with erect squamiform setæ. Head and beak nearly as long as prothorax; head hardly constricted behind the eyes; densely covered with pale round, striate scales and white squamose setæ; nasal plate very small strongly crescentiform, behind which is a large squamose, depressed ogival area; median line deeply and sharply sulcate to apex of depressed area. Eyes evenly convex. Antennæ with scape surpassing the eyes; funicular joints all longer than wide, the second joint longer than the first and longer than the two following. Prothorax slightly wider than long, apically convex, basally sinuate, laterally convex; apex obliquely truncate; disk moderately convex, medially sulcate, densely squamose; scales arranged in longitudinal fasciæ of dark and light brown, the middle fascia brown. Elytra oval, sides feebly arcuate, surface striate, strial punctures close, squamigerous; intervals densely squamose, sparsely setose; undersides not so densely squamose. Anterior tibiæ moderately strongly denticulate; median tibiæ not denticulate.

Type.—Cat. No. 14650, U.S.Nat.Mus.

PANTOMORUS (PHACEPHOLIS) METALLICUS, new species.

Described from four specimens from Onaga, Kansas (Wickham). Another specimen from Kansas is also at hand.

Length 6 mm., width 2.5 mm. Very similar to *elegans* in form and color, from which it differs mainly by having the median tibiæ minutely denticulate. The nasal plate is triangular but very deeply emarginate and more nearly resembles that of *viridis* than of *elegans*.

It is possible that future collecting will connect this Kansas form as a race of one of the Texas species.

Type.—Cat. No. 14651, U.S.Nat.Mus.

PANTOMORUS (PHACEPHOLIS) TEXANUS, new species.

Described from two specimens from Texas (C. V. Riley collection). A third specimen is at hand labeled Kansas.

Length 7 mm., width 3 mm. This species is of the color and form of *candidus* Horn but differs so strongly in the antennal characters that it seems necessary to separate it. It is of course possible that these represent the two sexes or two races of a species intermediate as to antennal structure. The funicular joints are all very elongate, and the second is considerably longer than the first and also than the third and fourth combined. The nasal plate is very small, and strongly arcuate on both margins.

Type.—Cat. No. 14652, U.S.Nat.Mus.

The Kansas specimen is a male and has several tubercles in the second ventral segment.

PANTOMORUS (PHACEPHOLIS) CANDIDUS Horn.

Phacepholis candida Horn.

The nasal plate is very small, convex, and strongly emarginate. The males have a row of tubercles on the second ventral segment.

PANTOMORUS (PHACEPHOLIS) PALLIDUS Pierce.

Phacepholis pallida Pierce.

The nasal plate is tiny, triangular and strongly emarginate. In this species the strial punctures vary from minutely setigerous to squamigerous. The material studied is from Corpus Christi, Wades, Beeville, Sharpsburg, Brownsville, and San Antonio, Texas. Specimens from Kingsville, Texas, May 12, 1912 (E. E. Scholl), were recorded as injurious to cotton. The male has a row of minute granulations on the second ventral segment.

PANTOMORUS (PHACEPHOLIS) OBSCURUS Horn.

Phacepholis obscura Horn.

The nasal plate is tiny, triangular and emarginate. The vestiture of the strial punctures also varies in this species in the single series from Mineral Wells, Texas, in the same manner as in preceding species. The ventral segment in the male has a row of small tubercles.

Genus LEPIDOCRICUS Pierce (1910).

Lepidocricus PIERCE, Journ. Econ. Ent., vol. 3, 1910, p. 362.

The genus is monotypic, based on *herricki* Pierce.

LEPIDOCRICUS HERRICKI Pierce.

Material of this species in addition to the types, which were from Easter, Mississippi, are at hand from Waveland, Mississippi; Fort Scott and Onaga, Kansas; and Lincoln, Nebraska. The Onaga specimens were taken from stomachs of *Sturnella magna*, the meadow lark, by F. F. Crevecoeur, April 24, 1895. The nasal plate is very indistinct and is not defined by a distinct rim. It is in general convex in outline and emarginate at tip.

Genus ARTIPUS Sahlberg (1823).

Artipus SAHLBERG, Peric. Ent. Spec. Ins., 1823, p. 22.

The genus is monotypic, based on *corycæus* Sahlberg.

Tribe BARYNOTINI, Bedel (1885).

Table of genera of Barynotini.

1. Claws free..... *Barynotus* Germar.
2. Claws connate..... *Barypeithes* Duval.

Genus BARYNOTUS Germar (1817).

Barynotus GERMAR, Mag der Ent., vol. 2, 1817, pp. 339–341.

The genus included two species, of which Schönherr (1826) designated *obscurus* Fabricius as type.

Genus BARYPEITHES J. Duval (1855).

Barypeithes J. DUVAL, Gen. Col. Curc., 1855, p. 13.
Barypithes GEMMINGER and HAROLD, Cat. Coleopt., vol. 8, 1871, p. 2284.

The originally designated type is (*rufipes* J. Duval) *sulcifrons* Boheman.

TRIGONOSCUTINI, new tribe.

The only American genus is *Trigonoscuta* Motschulsky, which has the articular surfaces of the hind tibiæ strongly cavernous and scaly, and the claws free.

Genus TRIGONOSCUTA Motschulsky (1852).

Trigonoscuta MOTSCHULSKY, Etud. Ent., vol. 1, 1852, p. 79.

The genus is monotypic, based on *pilosa* Motschulsky.

CALYPTILLINI, new tribe.

The only American genus is *Calyptillus* Horn, which has the maxillæ slightly visible at the sides of the mentum, and the claws free.

Genus CALYPTILLUS Horn (1876).

Calyptillus HORN, Proc. Amer. Philos. Soc., vol. 15, 1876, p. 27.

The monotype of the genus is *cryptops* Horn.

BRACHYRHININÆ, new subfamily.

Table of tribes of Brachyrhininæ.

I. Elytra scarcely surpassing width of prothorax at base, humeral angles rounded; body apterous; metasternum short, intercoxal piece large, broad.
  1. Tarsal claws free.
    a^1. Corbels of posterior tibiæ cavernous.....CELEUTHETINI, new tribe.
    a^2. Corbels of posterior tibiæ open.
      b^1. Antennæ more or less long and slender; outer joints of funicle long. BRACHYRHININI Bedel (1885).
      b^2. Antennæ at least moderate, robust for the most part; outer funicular joints short or moniliform .....TRACHYPHLŒINI, new tribe.
  2. Tarsal claws connate.
    c^1. Corbels of posterior tibiæ cavernous.....OOSOMINI, new tribe.
    c^2. Corbels of posterior tibiæ open.
      d^1. Antennal club oval, rarely oblong-oval.....SIMOINI, new tribe.
      d^2. Antennal club slender, elongate.....LAPAROCERINI, new tribe.

II. Elytra wider than prothorax at base.
  1. Body apterous; metasternum short, intercoxal piece large; tarsal claws connate; corbels of posterior tibiæ cavernous .....EPISOMINI, new tribe.
  2. Body usually winged; metasternum elongate; intercoxal piece variable.
    a^1. Tarsal claws free.
      b^1. Corbels of posterior tibiæ cavernous .....EUSTYLINI, new tribe.
      b^2. Corbels of posterior tibiæ open; intercoxal piece small, ogival. MYLLOCERINI, new tribe.
    a^2. Tarsal claws connate; corbels of posterior tibiæ open; intercoxal piece small ogival ..... PHYLLOBIINI Bedel (1885).

No representatives of the Oosomini, Episomini, Laparocerini, or Myllocerini occur in North America.

CELEUTHETINI, new tribe.

Only one American genus, *Agraphus* Schönherr, may be provisionally referred here. It bears a strong resemblance to *Celeuthetes*, but differs in important respects.

Genus AGRAPHUS Say (1831).

Agraphus SAY, Descr. N. A. Curc., 1831, p. 13.

The monotype of this genus is *bellicus* Say. It was originally used as a subgenus in Peritelus.

Tribe BRACHYRHININI Bedel (1885).

Table of genera of Brachyrhinini.

1. Metasternal side-pieces entirely concealed by the elytra; suture obliterated. Hind tibiæ with two short fixed spurs .....*Brachyrhinus* Latreille.
2. Metasternal suture distinct in entire length.
  a^1. Metasternal side-pieces linear.
    b^1. Hind tibiæ with two short, fixed, terminal spurs; first suture of abdomen feebly arcuate. Front slightly transversely impressed....*Sciopithes* Horn.
    b^2. Hind tibiæ without terminal spurs; first suture strongly arcuate at middle. Front not impressed .....*Agronus* Horn.
  a^2. Metasternal side-pieces moderately wide. Hind tibiæ without terminal spur; first suture of abdomen strongly arcuate at middle.....*Neoptochus* Horn.

Genus BRACHYRHINUS Latreille (1802).

Brachyrhinus LATREILLE, Hist. Nat. Gen. et Part. Crust et Ins., vol. 3, 1802, p. 200.
Otiorhynchus GERMAR, Ins. Spec. Nov., 1824, p. 343.

The type of the genus is *ligustici* Linnæus, designated by virtue of elimination by Latreille (1807) and Bedel (1881). Latreille's (1810) designation of *viridis* as type is not acceptable as that species was not originally included. The type of *Otiorhynchus* is *clavipes* (Olivier) Bonsdorff designated by Schönherr (1826) and is congeneric with *ligustici*, but represents a different subgenus.

Genus SCIOPITHES Horn (1876).

Sciopithes HORN, Proc. Amer. Philos. Soc., vol. 15, 1876, p. 62.

The genus is monotypic, based on *obscurus* Horn.

Genus AGRONUS Horn (1876).

Agronus HORN, Proc. Amer. Philos. Soc., vol. 15, 1876, p. 63.

Of the two original species we hereby designate the first, *cinerarius* Horn, as type.

Genus NEOPTOCHUS Horn (1876).

Neoptochus HORN, Proc. Amer. Philos. Soc., vol. 15, 1876, p. 64.

This genus is monotypic, based on *adspersus* Boheman.

TRACHYPHLŒINI, new tribe.

Table of genera of Trachyphlœini.

1. Metathoracic side pieces entirely concealed; eyes with distinct orbital groove.
   a^1. Scrobes superior, very short and deep, not reaching the eyes; anterior and middle tibiæ feebly mucronate ..... *Cercopeus* Schönherr.
   a^2. Scrobes lateral, long, passing directly backward and inclosing the eyes; tibiæ strongly mucronate..... *Chætechus* Horn.
2. Metathoracic side pieces visible; suture at least moderately distinct.
   b^1. Beak with a fine arcuate groove between the anterior extremities of the eyes; scrobes lateral, rather narrow, deep anteriorly, gradually evanescent, feebly arcuate, directed upon or nearly attaining the eyes..... *Panormus* Casey.
   b^2. Beak with deep transverse impression at base; scrobes lateral, deep, moderately arcuate and passing directly backward to the eye ..... *Trachyphlœus* Germar.

Genus CERCOPEUS Schönherr (1843).

Cercopeus SCHÖNHERR, Gen. et Sp. Curc., vol. 7, 1843. pt. 1, p. 154.
Cercopius GEMMINGER and HAROLD, Cat. Coleopt., vol. 8, 1871, p. 2287.

The type of the genus is *chrysorhœus* Say by original designation.

Genus CHÆTECHUS Horn (1876).

Chætechus HORN, Proc. Amer. Philos. Soc., vol. 15, 1876, p. 77.

The genus is monotypic, based on *setiger* Horn.

Genus PANORMUS Casey (1888).

Panormus CASEY, Ann. New York Acad. Sci., vol. 4, 1888, p. 269.

The monotype of the genus is *setosus* Casey.

Genus TRACHYPHLŒUS Germar (1817).

Trachyphlœus GERMAR, Mag. der Ent., vol. 2, 1817, pp. 339–341.

The monotype of the genus is *scabriculus* Linnæus.

SIMOINI, new tribe.

Table of genera of Simoini.

I. Side pieces of mesosternum very unequal, the episternum larger and attaining the elytral margin, epimeron usually small, sometimes very small.

1. First abdominal suture straight or extremely nearly so.....Group *Paraptochi.*

a^1. Scrobes lateral.....*Paraptochus* Seidlitz.

a^2. Scrobes superior.

b^1. Antennal scape not attaining the prothorax; eyes small; second ventral segment shorter than the two following together.....*Stenoptochus* Casey.

b^2. Antennal scape long and slender, passing distinctly beyond the anterior margin of the prothorax; eyes large; second segment as long as the two following together.....*Orthoptochus* Casey.

2. First abdominal suture arcuate.....Group *Periteli.*

a^1. Cotyloid surface of the hind tibiæ glabrous; eyes with or without orbital groove.

b^1. Integuments sparsely pubescent.....*Omias* Germar.

b^2. Integuments squamose.

c^1. Scrobes superior and convergent above.

d^1. Beak narrowed to tip.

e^1. Beak longer than head; scrobes very short, terminal.
Thricolepis Horn.

e^2. Beak shorter than head; scrobes attaining the eyes.
Peritelopsis Horn.

d^2. Beak dilated at apex, short; scrobes very feebly convergent, short, not attaining the eyes; second ventral segment as long as the third and fourth.

f^1. Posterior tibiæ with two short fixed spurs.....*Peritelodes* Casey.

f^2. Posterior tibiæ without fixed spurs.....*Peritelinus* Casey.

c^2. Scrobes more lateral, not convergent above.

g^1. Scape about as long as the funicle.

h^1. Scrobes not attaining the eyes.....*Geoderces* Horn.

h^2. Scrobes attaining and partially enveloping the eyes.
Geodercodes Casey.

g^2. Scape much shorter than the funicle.....*Aragnomus* Horn.

a^2. Cotyloid surface of the hind tibiæ squamose.

i^1. Scrobes superior, slightly convergent above. Eyes indistinctly surrounded by a groove. Scape feebly arcuate.....*Dysticheus* Horn.

i^2. Scrobes lateral, not at all convergent. Orbital groove deep.

j^1. Scape arcuate and slightly twisted; scrobes lateral, deep and attaining the eyes.....*Eucyllus* Horn.

j^2. Scape straight or very feebly arcuate.

k^1. Scrobes very shallow, posteriorly, not attaining the eyes.
Thinoxenus Horn.

k^2. Scrobes deep, attaining the eyes.....*Rhypodillus* Cockerell.

II. Side pieces of mesosternum diagonally divided and equal or very nearly so, episternum distant from the elytral margin, separated by the epimeron.

Group *Aphrasti.*

3. Elytra oval, humeri rounded, body apterous ..... *Aphrastus* Schönherr.

Genus PARAPTOCHUS Seidlitz (1868).

Paraptochus Seidlitz, Berl. Ent. Zeit., Beiheft., 1868, p. 35 note.

The genus is founded on *californicus* Seidlitz.

Genus STENOPTOCHUS Casey (1888).

Stenoptochus Casey, Ann. New York Acad. Sci., vol. 4, 1888, p. 259.

The genus is monotypic, based on *inconstans* Casey.

Genus ORTHOPTOCHUS Casey (1888).

Orthoptochus Casey, Ann. New York Acad. Sci., vol. 4, 1888, p. 261.

The genus is monotypic, based on *squamiger* Casey.

Genus OMIAS Germar (1817).

Omias Germar, Mag. der Ent., vol. 2, 1817, pp. 339–341.
Mylacus Schönherr, Gen. et Sp. Curc., vol. 7, 1843, pt. 1, p. 144.

The type of *Omias* is *rotundatus* Fabricius, designated by Schönherr (1826), and of *Mylacus* is *murinus* Boheman, as originally designated. *Omias* Gemminger and Harold (1871) is therefore preoccupied and may be known as *Rhinomias* Reitter (1894).

Genus THRICOLEPIS Horn (1876.)

Thricolepis Horn, Proc. Amer. Philos. Soc., vol 15, 1876, p. 68.

Of the two original species we designate the first, *inornata* Horn, as type.

Genus PERITELOPSIS Horn (1876).

Peritelopsis Horn, Proc. Amer. Philos. Soc., vol. 15, 1876, p. 70.

The genus is monotypic, based on *globiventris* LeConte.

Genus PERITELODES Casey (1888.)

Peritelodes Casey, Ann. New York Acad. Sci., vol. 4, 1888, p. 262.

The genus is monotypic, based on *obtectus* Casey.

Genus PERITELINUS Casey (1888).

Peritelinus Casey, Ann. New York Acad. Sci., vol. 4, 1888, p. 263.

The genus is monotypic, based on *variegatus* Casey.

Genus GEODERCES Horn (1876).

Geoderces Horn, Proc. Amer. Philos. Soc., vol. 15, 1876, p. 70.

The designated type is *melanothrix* Kirby.

Genus GEODERCODES Casey (1888).

Geodercodes CASEY, Ann. New York Acad. Sci., vol. 4, 1888, p. 265.

The genus is monotypic, based on *latipennis* Casey.

Genus ARAGNOMUS Horn (1876).

Aragnomus HORN, Proc. Amer. Philos. Soc., vol. 15, 1876, p. 72.

The genus is monotypic, based on *griseus* Horn.

Genus DYSTICHEUS Horn (1876).

Dysticheus HORN, Proc. Amer. Philos. Soc., vol. 15, 1876, p. 73.

The genus is monotypic, based on *insignis* Horn.

Genus EUCYLLUS Horn (1876).

Eucyllus HORN, Proc. Amer. Philos. Soc., vol. 15, 1876, p. 74.

The genus is monotypic, based on *vagans* Horn.

Genus THINOXENUS Horn 1876).

Thinoxenus HORN, Proc. Amer. Philos. Soc., vol. 15, 1876, p. 74.

The genus is monotypic, based on *squalens* Horn.

Genus RHYPODILLUS Cockerell (1906)

Rhypodes HORN, Proc. Amer. Philos. Soc., vol. 15, 1876, p. 75 (not Stål. 1874).
Rhypodillus COCKERELL, Ent. News, vol. 17, 1906, p. 243.

Cockerell's name was proposed as a substitute for Horn's preoccupied name. We may consider the first of the two original species, *dilatatus* Horn, as type.

Genus APHRASTUS Say (1831).

Aphrastus SAY, Descr. N. A. Curc., 1831, p. 9.

The genus is monotypic, based on *tæniatus* Say.

EUSTYLINI, new tribe.

Table of genera of Eustylini.

1. Scape short, stout, scrobes short, suddenly arcuate. Scutellum rather large, oval ..... *Brachystylus* Schönherr.
2. Scrobes widely open from above, cavernous in front, very shallow posteriorly, slightly arcuate and directed toward eyes. Scutellum moderate, oval. *Achrastenus* Horn.

Genus BRACHYSTYLUS Schönherr (1845.)

Brachystylus SCHÖNHERR, Gen. et Sp. Curc., vol. 8, 1845, pt. 2, p. 433.

The genus is monotypic, based on *acutus* Say.

Genus ACHRASTENUS Horn (1876).

Achrastenus HORN, Proc. Amer. Philos. Soc., vol. 15, 1876, p. 97.

The genus is monotypic, based on *griseus* Horn.

Tribe PHYLLOBIINI Bedel (1885).

Scrobes in the form of fossets, subterminal.....*Phyllobius* Germar.

Genus PHYLLOBIUS Germar (1824).

Phyllobius GERMAR, Ins. Spec. Nov., 1824, p. 447.

The type of this genus is *pyri* Linnæus, designed by Schönherr (1826).

UNIDENTIFIED BRACHYRHINID GENUS.

Genus LEPESOMA Motschulsky (1845).

Lepesoma MOTSCHULSKY, Bull. Mosc., vol. 2, 1845, p. 105.

The monotype of this genus is *californica* Motschulsky.

THE SIMPLE ASCIDIANS FROM THE NORTHEASTERN PACIFIC IN THE COLLECTION OF THE UNITED STATES NATIONAL MUSEUM.

By William E. Ritter,

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INTRODUCTION.

Although the collection of Ascidians which is the subject of this memoir is not of exceptional magnitude or interest, and although much time and labor have been expended on it, yet I am aware that much more study could have been profitably devoted to it. Particularly might the descriptions have been carried further in the direction of the number of individuals examined for each species. It is not at all impossible that had this been done the specific groups recognized would have been different in several instances. Furthermore, I am convinced that the methods currently employed in systematic ascidiology, particularly for counting structures the characteristics of which are given quantitatively, ought to be more refined and accurate than they are. Were our observational procedure to be improved in the two respects mentioned, and were statistical methods to be made more use of, I have no doubt that highly rewarding results over and above those now reached by systematic studies would come forth; not only would the central aim of classificatory research, namely, the delimitation and definition of groups, be made more trustworthy, but various interests beyond those of classification proper would be at least formulated.

The value of systematic studies as a revealer of problems comes from the circumstance that, bringing, as of necessity they do, before the student large numbers of individuals and kinds of individuals every one of which is different in some way from any of the others, they inevitably raise questions almost as numerous and varied as the organisms themselves.

Looking upon systematic zoology in this way and so taking it for granted that the collection now in hand will be worked over again in the future by other zoologists employing more rigorous methods, I have prepared, as far as possible in tabular form, considerable matter not usually included in papers on systematic ascidiology.

While much regretting that a larger number of dissections could not be made and the data ascertained with greater accuracy, one con-

sideration goes a long way in the direction of alleviation of this regret. No amount of accurate work on the specimens that come into one's hands can make up for deficiencies in the collections themselves. Deficiencies in collections are usually of three sorts, mainly: Insufficiency of number of individuals; insufficiency of representation of the various parts of the geographic range, horizontal and vertical, of the groups; and poorness of preservation of the specimens. Inadequacy of locality and other incidental data is also not infrequent, but on the whole this is less serious according to my experience than the other items mentioned, especially as concerns collections made in later years. The collection is very rich in number of individuals of some of the species; but in no case is the distribution of these individuals with respect to the geographic range of the species what one would like to have it. Again, several of the species, even some of those treated as new to science, are represented by only one or a very few individuals. This is unfortunate. On the whole, the state of preservation of the specimens is better than might have been expected considering the conditions under which the collecting was done. Special reference ought to be made, I feel, to the extent to which the value of the collection is due to the work as a collector done by Dr. W. H. Dall in the early seventies of the last century, when Alaska was hardly more than a map to most persons in the United States. The services of Doctor Dall in this connection are notable in view of the adverse conditions under which his natural history work was carried on.

The part played by the United States Fisheries Bureau steamer *Albatross* in gathering material is dealt with in a special section.

I am glad to acknowledge the helpfulness of the officials of the United States National Museum, particularly in granting small sums of money to aid in the work and also for the efficiency and patience of Dr. Myrtle E. Johnson in making dissections, rough sketches, and finished illustrations.

Although a considerable number of papers, old and new, now exist dealing with the ascidians of the north Pacific, the recent extensive summarization not only of these but of the literature of the whole group given by Hartmeyer in his Tunicata of Bronn's Tierreich, makes a general review of the work to which reference is made in this report unnecessary. No student would presume to work seriously on ascidians from any part of the world now or for many years to come without Hartmeyer's writings constantly at hand; and with these it would hardly be possible for him to miss altogether any of the literature with which he should be concerned. It is a great pleasure to me to speak of the comprehensiveness and accuracy with which Hartmeyer has done his work, and I genuinely regret that in a few important matters I am unable to follow him, at least for the present. To the very recent paper by Huntsman, 1911, dealing with the ascidians of the Canadian coasts, Pacific as well as Atlantic, ample reference is made in other connections.

SPECIES IN THE COLLECTION ARRANGED BY FAMILIES.

MOLGULIDÆ.

1. *Molgula oregonia*, new species.
2. *Molgula retortiformis.*
3. *Molgula crystallina.*
4. *Molgula siphonalis.*
5. *Eugyrioides dalli*, new species.
6. *Eugyrioides rara.*
7. *Rhizomolgula ritteri.*

HALOCYNTHIIDÆ.

8. *Halocynthia washingtonia*, new species.
9. *Halocynthia haustor.*
10. *Halocynthia haustor foliacea*, new subspecies.
11. *Halocynthia aurantium.*
12. *Halocynthia echinata.*
13. *Halocynthia villosa.*
14. *Halocynthia castaneiformis.*
15. *Halocynthia okai.*
16. *Halocynthia johnsoni.*
17. *Boltenia ovifera.*
    Hartmeyeria, new genus.
18. *Hartmeyeria triangularis*, new species.
19. *Culeolus sluiteri*, new species.

STYELIDÆ.

20. *Styela macrenteron*, new species.
21. *Styela hemicæspitosa*, new species.

STYELIDÆ—Continued.

22. *Styela sabulifera*, new species.
23. *Styela loveni.*
24. *Styela gibbsii.*
25. *Styela yakutatensis.*
    Styela, species.
26. *Styelopsis grossularia.*
27. *Dendrodoa tuberculata.*
28. *Dendrodoa subpedunculata.*
29. *Dendrodoa adolphi.*
30. *Pelonaia corrugata.*

RHODOSOMIDÆ.

31. *Chelyosoma columbianum.*
32. *Chelyosoma productum.*
33. *Corella willmeriana.*
34. *Corella japonica.*
    Corella, species.
35. *Corellopsis pedunculata.*
36. *Corynascidia herdmani*, new species.
37. *Agnesia beringia*, new species.

PHALLUSIIDÆ.

38. *Phallusia vermiformis*, new species.
39. *Phallusia unalaskensis*, new species.
40. *Phallusia adhærens.*

CIONIDÆ.

41. *Ciona intestinalis.*

DISTRIBUTION.

It would be possible to treat the data under this head in considerably more detail, but I have done as much as seems profitable for the amount and character of the collection.

The collections so far made in the northeastern Pacific are sufficient to give a general picture only of the ascidian life of the regions, and a manipulation of the data in great detail would produce results in large measure not only unreliable, but deceptive, for they would have the appearance of a significance which in reality they would not possess.

HORIZONTAL DISTRIBUTION.

The 41 species and subspecies recognized in the report fall into three of the five latitude zones into which Hartmeyer has divided the seas of the earth, namely, ARCTIC, SUBARCTIC, and TROPIC. Since, however, nearly all the collecting to which the report pertains

was done in the first two zones, the species belonging to the Tropic are so few as to hardly figure in the results.

This distribution among the zones is shown in Table 1.

TABLE 1.

Zonal distribution of the species.

Arctic exclusively.	Subarctic exclusively.	Common to Arctic and Subarctic.
Species.	Species.	Species.
Molgula retortiformis. *Molgula crystallina.* *Molgula siphonalis.* *Eugyrioides dalli.* *Eugyrioides rara.* *Rhizomolgula ritteri.* *Boltenia ovifera.* *Hartmeyeria triangularis.* *Styela macrenteron.* *Styela sabulifera.* *Styelopsis grassularia.* *Dendrodoa tuberculata.* *Dendrodoa subpedunculata.* *Dendrodoa adolphi.* *Pelonaia corrugata.* *Corellopsis pedunculata.* *Corynascidia herdmani.* *Agnesia beringia.* *Phallusia unalaskensis.*	*Molgula oregonia.* *Culeolus sluiteri.* *Halocynthia washingtonia.* *Halocynthia haustor.* *Halocynthia haustor foliacea.* *Halocynthia villosa.* *Halocynthia castaneiformis.* *Halocynthia okai.* *Halocynthia johnsoni.* *Styela gibbsii.* *Styela yakutatensis.* *Styela loveni.* *Chelyosoma productum.* *Chelyosoma columbianum.* *Corella willmeriana.* *Corella japonica.* *Phallusia vermiformis.*	*Halocynthia aurantium.* *Halocynthia echinata.* *Styela hemicæspitosa.* *Phallusia adhærens.* *Ciona intestinalis.*
19 species, 46 per cent.	17 species, 41 per cent.	5 species, 12 per cent.

Considering the species with reference to the seas in which they occur and disregarding latitude zones, we get

TABLE 2.

Common to the Pacific and Atlantic Oceans.	Pacific only.
Molgula retortiformis. *Molgula crystallina.* *Eugyrioides rara.* *Rhizomolgula ritteri.* *Halocynthia echinata.* *Boltenia ovifera.* *Styela loveni.* *Styelopsis grossularia.* *Dendrodoa adolphi.* *Pelonaia corrugata.* *Ciona intestinalis.*	*Molgula oregonia.* *Eugyrioides dalli.* *Halocynthia aurantium.* *Halocynthia washingtonia.* *Halocynthia haustor.* *Halocynthia haustor foliacea.* *Halocynthia villosa.* *Halocynthia castaneiformis.* *Halocynthia okai.* *Halocynthia johnsoni.* *Hartmeyeria triangularis.* *Culeolus sluiteri.* *Styela macrenteron.* *Styela hemicæspitosa.* *Styela sabulifera.* *Styela gibbsii.* *Styela yakutatensis.* *Dendrodoa tuberculata.* *Dendrodoa subpedunculata.* *Chelyosoma productum.* *Chelyosoma columbianum.* *Corella willmeriana.* *Corella japonica.* *Corynascidia herdmani.* *Agnesia beringia.* *Phallusia vermiformis.* *Phallusia unalaskensis.* *Phallusia adhærens.*
11 species, 28 per cent.	28 species, 72 per cent.

Considered with reference to distribution in different parts of the Pacific Ocean, we get

TABLE 3.

Bering Sea.	South of Bering Sea only.	Common to Bering Sea and southward.
Molgula crystallina.	*Molgula oregonia.*	*Molgula retortiformis.*
Molgula siphonalis.	*Halocynthia washingtonia.*	*Halocynthia aurantium.*
Eugyrioides dalli.	*Halocynthia haustor.*	*Halocynthia echinata.*
Eugyrioides rara.	*Halocynthia haustor foliacea.*	*Culeolus sluiteri.*
Rhizomolgula ritteri.	*Halocynthia castaneiformis.*	*Styela hemicæspitosa.*
Boltenia ovifera.	*Halocynthia okai.*	*Styela loveni.*
Hartmeyeria triangularis.	*Halocynthia villosa.*	*Phallusia adhærens.*
Styela macrenteron.	*Halocynthia johnsoni.*	
Styela sabulifera.	*Styela gibbsii.*	
Styelopsis grossularia.	*Styela yakutatensis.*	
Dendrodoa tuberculata.	*Chelyosoma productum.*	
Dendrodoa subpedunculata.	*Chelyosoma columbianum.*	
Dendrodoa adolphi.	*Corella willmeriana.*	
Pelonaia corrugata.	*Corella japonica.*	
Corynascidia herdmani.	*Corellopsis pedunculata.*	
Agnesia beringia.	*Phallusia vermiformis.*	
Phallusia unalaskensis.	*Ciona intestinalis.*	
17 species, 41 per cent.	17 species, 41 per cent.	7 species, 17 per cent.

Table 3 brings out the sharpness with which the Bering Sea is separated from the main Pacific Ocean as an ascidian province.

There is doubt as to what province species occurring on the south as well as on the north shores of the Aleutian Islands should be assigned. The principle I have followed is that species like *Dendrodoa tuberculata*, which are abundant in Bering Sea and are unknown southward except along the south shore of the Aleutian chain, should be counted as exclusively Bering Sea species.

On the other hand, *Culeolus sluiteri*, for example, is assigned to south of Bering Sea only, though it occurs near the Aleutian Islands, but on the south side. Only more extensive collecting can resolve these questions.

VERTICAL DISTRIBUTION.

Table 4 exhibits the depth range of the species as indicated by the data accompanying this collection.

TABLE 4.

Species.	Shore.	Shore to 25 fathoms.	25 to 50 fathoms.	50 to 100 fathoms.	100 to 200 fathoms.	200 to 300 fathoms.	300 to 500 fathoms.
1. *Molgula oregonia*			×				
2. *Molgula retortiformis*		×	×				
3. *Molgula crystallina*		×	×	×	×		
4. *Molgula siphonalis*			×				
5. *Eugyrioides dalli*		×	×				
6. *Eugyrioides rara*		×					
7. *Rhizomolgula ritteri*		×					
8. *Halocynthia washingtonia*					×		
9. *Halocynthia haustor*	×				×		
10. *Halocynthia haustor foliacea*			×				
11. *Halocynthia aurantium*		×	×	×			
12. *Halocynthia echinata*		×	×				
13. *Halocynthia villosa*		×					
14. *Halocynthia castaneiformis*			×				
15. *Halocynthia okai*			×				
16. *Halocynthia johnsoni*	×						
17. *Boltenia ovifera*		×	×	×			
18. *Hartmeyeria triangularis*		×					
19. *Culeolus sluiteri*						×	
20. *Styela macrenteron*		×	×	×			
21. *Styela hemicæspitosa*			×	×		×	
22. *Styela sabulifera*		×	×				
23. *Styela loveni*		×					×
24. *Styela gibbsii*	×		×				
25. *Styela yakutatensis*				×			
26. *Styelopsis grossularia*	×						
27. *Dendrodoa tuberculata*	×		×	×			
28. *Dendrodoa subpedunculata*	×	×					
29. *Dendrodoa adolphi*		×					
30. *Pelonaia corrugata*			×				
31. *Chelyosoma columbianum*				×	×		
32. *Chelyosoma productum*	×	×					
33. *Corella willmeriana*		×					
34. *Corella japonica*					×		
35. *Corellopsis pedunculata*				×			
36. *Corynascidia herdmani*							×
37. *Agnesia beringia*		×	×				
38. *Phallusia vermiformis*			×				
39. *Phallusia unalaskensis*						×	
40. *Phallusia adhærens*	×	×					
41. *Ciona intestinalis*	×						

Since practically all the specimens collected by dredging and accompanied with data as to depth are collections made by the Bureau of Fisheries steamer *Albatross*, an examination of this vessel's operations with reference to the ascidians obtained has been made. Townsend's "Dredging and Other Records, etc." (1901) makes such an examination practicable.

The total number of hauls contained in this list as made since the *Albatross* entered the waters of the Pacific in 1888, and which belong to areas from which ascidians covered by this report were derived, is 676.

The depths at which these hauls were made is shown in Table 5.

TABLE 5.

Depth at which 676 dredge and trawl hauls were made in the north Pacific from May, 1888, to May, 1896.

100 fathoms and less.	100 to 200 fathoms.	200 to 300 fathoms.	300 to 500 fathoms.	500 fathoms and more.
524	52	37	30	34
77.5 per cent.	7.6 per cent.	5.5 per cent.	4.4 per cent.	5.0 per cent.

At 77, or 1 per cent of these 676 stations, ascidians were obtained. The quantitative distribution of the species according to depth is shown in table 6.

TABLE 6.

	100 fathoms and less.	100 to 200 fathoms.	200 to 300 fathoms.	300 to 500 fathoms.	500 fathoms and more.
Hauls	524	52	37	30	34
Hauls taking ascidians	68	4	3	1	1
Per cent	13—	7.6—	8.1	3.3	3—

NOMENCLATURE.

It is very unfortunate that the efforts of Hartmeyer to reform the nomenclature of the Tunicata in accordance with the international rules should not have met with greater success. In view of the failure of some writers, as, for instance, Herdman, to accept any of the changes, and of the dissent by Huntsman, especially, from Hartmeyer's application of the rule of priority in one of the most important cases, I find myself in some perplexity as to what course to pursue. Undoubtedly, as matters now stand, the nomenclature of the group is in a worse state of confusion than ever, and until agreement can be reached as to the changes really required by the rules it has seemed to me that in the interest of the prime desideratum for a system of naming, namely, stability, it is best to adhere to the generic and family names that had been in use without exception for many years previous to Hartmeyer's revision. This decision does not, I would remark, enroll me among those who oppose the strict application of the rule of priority. As a matter of fact I am in favor of such application. But, according to my understanding, the question with which I am confronted at this moment is not as to whether, in general, the rule should be followed; but, admitting that it should be, whether *in the specific cases* at hand it should be applied.

The proposed changes with which I am here concerned are *Cæsira* for *Molgula; Pyura* for *Halocynthia; Tethyum* for *Styela;* and *Phallusia* for *Ascidia.*

My decision has been influenced by the fact that the names to be set aside are long and well established not only in technical treatises on ascidian classification, but as well in general zoological and biological literature. The principle in accordance with which this consideration has influenced me is that names thus well established should have the benefit of any reasonable doubt about the applicability of the rule. It seems to me that evidence for the suppression of such names as those here in question ought to be as unequivocal as that required to convict a man of murder in a criminal court. Viewed in the light of this principle I believe the first three indicted names, *Molgula*, *Halocynthia*, and *Styela*, would be retained.[1]

Concerning *Cæsira*, it appears to me that Hartmeyer has not removed the doubt that has for years surrounded Fleming's proposal to make Savigny's "Cynthie Dione" the type-species of a genus *Cæsira*. Indeed, Hartmeyer's inability to include *dione* in the list of "good species" in his Tierreich catalogue (Hartmeyer, 1909*a*), and his explicit statement (Hartmeyer, 1908, p. 18) that the type-species of *Cæsira* "bedarf allerdings einer Nachuntersuchung, da die Beschreibung in einigen Punkten zu lückenhaft ist, um eine hinreichende Kennzeichnung innerhalb der Gattung zu ermöglichen," places the animal used by Fleming as the type of *Cæsira* among the *species inquirendæ*, which are excluded by the international rules from competency to serve as generic types.

The doubts about *Pyura* are of a very different nature. While it is quite probable that the "piure" of modern Chilean fishermen sent to Michaelsen (Michaelsen, 1904, p. 15) is specifically identical with Molina's *P. chilensis*, the evidence before us is not conclusive. For instance, the tendency of fishermen to apply the same name to animals which much resemble one another, even though they may be very different zoologically considered, is well known. The ordinary fisherman would be quite unlikely to distinguish between some Halocynthias and some Styelas, for example; so before we could be certain that the animals examined by Michaelsen belong to Molina's species we should have to be sure that there is but one species called "piure" by the fishermen. More exhaustive collecting on the Chilean coast may sometime remove this uncertainty, but in the meanwhile *Halocynthia* should have the benefit of the doubt.

Tethyum is put into a peculiarly unfortunate condition by Huntsman's disagreement with Hartmeyer. Into the merits of the case I do not need to go. It affords a striking illustration of the inability of the rule of priority to save nomenclature from confusion so long as

[1] It seems as though a permanent international court or commission of nomenclatorial experts may be necessary (if the present commission is not charged with this duty) to take evidence and hear arguments both for and against as to whether changes in particularly important instances are compelled by the rules. At any rate, as matters now stand, if our experience in tunicate nomenclature is any guide, there is little prospect of improvement in the consistency and stability of zoological names.

there is lack of agreement as to its application in particular instances. From Hartmeyer's published statement (1909*b*) it appears that he and Huntsman discussed the question privately to some extent before Huntsman published on it; so we must understand that the perplexity was introduced by Huntsman with deliberation. Until an adjustment is reached on the points at issue in this case the principle of "benefit of the doubt" seems particularly appropriate. Accordingly *Styela* stands pending unanimity of view as to what name has the prior claim.

Hartmeyer's argument to the effect that *Ascidia* should give way to *Phallusia* I accept, and the more readily that *Phallusia* has well-nigh as good a place in general literature as has *Ascidia*.

I believe usage should be a factor in adjudicating conflicting claims between natural history names, as well as in certain classes of cases at law.

DESCRIPTIONS OF SPECIES.

MOLGULA OREGONIA, new species.

Superficial characteristics.—Ovate, the long axis transverse, stiff and hard in general consistency, this due partly to the rigidity of the test and partly to the incrustation of sand which forms a nearly uniform layer over the whole surface in most specimens, the sand grains being embedded in the test itself rather than adherent to the coarse filiform test processes which are restricted to a few patches or tufts. Excepting for irregularities apparently due to post-mortem changes, general outline rather regular though test somewhat wrinkled in some specimens; a few individuals having worm tubes, and other smaller ascidian species clinging to them. Siphons entirely absent so far as can be determined; orifices very small, discoverable only by the most careful scrutiny; situated on the side, nearly equally distant from the two ends, the branchial being somewhat nearer the anterior than the atrial is to the posterior; distance apart slightly greater than the distance of the atrial from the posterior end. Dimensions of one of the largest specimens, 22 by 15 by 13 mm.; of a second specimen, 18 by 13 by 10; of a third, 18 by 14 by 15. Test less than 1 mm. thick, dense, thick, and not at all transparent. Mantle rather thick, yellowish opaque over the anterior third, thin and semitransparent elsewhere except for the voluminous gonads; muscle bands of the mantle radiating from the orifice, entirely hidden in the vicinity of the openings by the thickened yellowish epithelial mantle tissue, reaching back to about the middle of the body all around; lobing of the orifices (six, branchial; four, atrial) obscure, even when test is removed.

Respiratory system.—Branchial tentacles about 15, possibly a few more minute ones, 8 or 10 of larger size, some of these large and thick and copiously branched, the branching being secondary as well as

primary. Dorsal tubercle small, the hypophysis mouth a simple, narrow horseshoe in shape. Branchial sac with six folds on each side, none of the folds with less than 6 longitudinal vessels, and some with 12 or 13, never more than one vessel between the folds, more frequently none at all, the individual vessels on the folds broad and strong and usually close together; transverse vessels very few, entirely absent for long stretches in the spaces between the folds; infundibula reaching deep into the prominent folds, but not easily seen on surface views of the inside of the sac on account of the crowded condition of the longitudinal vessels of the folds; stigmata long, rather regular, and usually straight and directed lengthwise in the spaces between the folds. Dorsal lamina with plain edge throughout its course.

Alimentary system.—The narrow intestinal loop situated on the left side, but far back and extending across the entire body; the two limbs of the loop almost in contact with each other except at the closed end, this end again bent sharply forward making a short second double-tubed loop. Stomach but little greater in diameter than the gut; the wall presenting a number of low, rather inconspicuous irregular lobes. Anus situated very close to the atrial orifice, the rim nearly or quite plain. Renal organ an elongate, bean-shaped body situated far back on the right side, somewhat concave on its anterior edge and convex on its posterior edge to correspond with the rounded outline of the body, length nearly equaling one-half the longest diameter of the body removed from the test.

Reproductive system.—Voluminous on both sides of the body, that of the left lying above and close along the intestinal loop; that of the right above and close along the renal organ, reaching down somewhat on the anterior end of the latter. Ovary and testes intimately commingled, the cylindric ovary occupying the middle and entirely surrounded by the testes; the mass of the left side as long as the intestinal loop and in addition extending into and quite filling the concavity of the secondary loop.

So far as I am able to determine this species has more in common with *M. impura* Heller, 1887, than any other species. From this it differs, however, in having a harder test, in possessing a maximum of a dozen or more longitudinal vessels on the largest branchial folds, and in the limited size of the gonad of the right side. According to Michaelsen, 1908, who had made a careful study of Heller's species, the right gonad extends around the anterior half of the renal organ. While in our species the testis part especially reaches well down across the anterior end of the organ, it does not pass around on to the posterior side.

Hartmeyer, 1912, has made a commendable effort to mark off a number of subgroups within the genus *Molgula*. The leading point made use of by him in this classification is the number of longitudinal

vessels in the folds of the branchial sac. The largest number in any group—the "*arenata* group"—is given as 4 to 6. On this basis *M. oregonia* would not fall into any of the recognized groups, for the number here is always and very definitely greater. The scheme of vessels in a typical specimen is:

$$\text{Endostyle}\begin{cases}7\text{–}0\text{–}9\text{–}1\text{–}10\text{–}1\text{–}10\text{–}1\text{–}11\text{–}0\text{–}8 \text{ L.} \\ 7\text{–}1\text{–}10\text{–}1\text{–}11\text{–}1\text{–}11\text{–}1\text{–}11\text{–}0\text{–}10 \text{ R.}\end{cases}$$

While in some genera of ascidians the variability in the number of vessels is so great, and the difficulty of counting so considerable that the excess in the numbers here given over the numbers in *M. impura* might not be regarded as significant unless based on the averages of many individuals, the numbers in the species of *Molgula* with which we are now dealing are so constant and so definitely determinable, that there can be no question about the specific significance of the differences, particularly since these are correlated with other small, but seemingly constant differences.

Albatross 3088 (type-locality), lat. 44° 28′ N.; long. 124° 25′ 30″ W., off Oregon, 46 fathoms, c. p., September 3, 1889, 16 specimens.

Albatross 3213, lat. 54° 10′ N.; long. 162° 57′ 30″ W., South Alaska Peninsula, 41 fathoms, bk. s., May 21, 1890, a single specimen.

Type.—Cat. No. 5682, U.S.N.M.

MOLGULA RETORTIFORMIS Verrill.

Molgula retortiformis Verrill, 1871, p. 56, fig. 3.

Molgula grœnlandica Traustedt, 1880, p. 425.—Wagner, 1885, pp. 124–150, pl. 15, figs. 1–9; pl. 16, figs. 1–8, 13, and 15; pl. 17, figs. 1–17; pl. 18, figs. 11 and 13; pl. 20, figs. 2, 3, and 16–18.

Molgula siphonalis Hartmeyer, 1899, p. 462, fig. B; pl. 22, fig. 2; pl. 23, figs. 2 and 13.

Molgula graphica Ritter, 1901, p. 230, pl. 28, figs. 6–9.

Molgula retortiformis Hartmeyer, 1903, p. 145.

Caesira retortiformis Hartmeyer, 1909*a*, p. 1324.—Van Name, 1912, p. 510, text figs. 18 and 19; pl. 52, figs. 50–52; pl. 69, figs, 139, 140.

There being available for comparison several specimens of *Molgula retortiformis* from Marthas Vineyard identified by Prof. A. E. Verrill, I do not now hesitate to confirm Hartmeyer's conjecture that *M. graphica* Ritter is only a synonym for *M. retortiformis*. The species is obviously a rather common inhabitant of the shallow waters of the northeastern Pacific and Bering Sea.

I have examined the single specimen on which *M. graphica* was founded, giving special attention to the network of jet black blood vessels in the test on which I relied so largely for the validity of the species. The vessels themselves differ in no recognizable way either in structure, abundance, or distribution from those in the test of the Marthas Vineyard specimens or specimens from Bering Sea. The

one peculiarity about the *graphica* vessel is the color. This is due to the coloration of the cells of the blood. These are exceedingly numerous and the vessels of about the outer half, in thickness, of the test, become greatly congested with these black cells. In one other specimen, a very large one from Bering Sea, the test vessels present something of the same condition, the congestion being, however, less general and the color a less pronounced black. What the meaning is of this condition of the blood cells in some individuals is far from clear. It ought to be stated that some of the internal parts of the *graphica* specimen are dark, almost black, in places. The hypophysis may be especially mentioned as an example. One might say that these specimens with so much black blood are melanic variants comparable to the black individuals which appear occasionally in several species of higher animals the normal color of which is some other than black. Or it may be surmised that the condition is one of disease; or there may be some other explanation. The color here appears to be quite a different thing from that in *Ascidia nigra*. Black pigment is so rare among tunicates that the question of its nature when it does occur is of considerable interest and would repay an investigator who would take it up.

The point of internal structure which has stood most in the way of identifying not only the single *graphica* specimen, but also several belonging to the present collection as *retortiformis*, is the dorsal lamina. In my original description of *graphica* I spoke of this as having "suggestions of a few remote processes on the edge" of the "rather broad membrane"; and in two or three of the specimens now examined our rough notes speak of "a slight serration" of the lamina or "intimations of teeth" on the edge. On reexamining most of these instances I find that "teeth" and "serration" and "processes," with the meaning that these terms usually have when used to describe the condition of the dorsal lamina of ascidians, is hardly applicable here. A more accurate statement would be that in some instances the dorsal membrane, or a portion of it, is uneven, or irregularly scalloped. This departure from a strictly "plain-edged" condition is, I think, a purely individual matter.

A few specimens from several of the lots are small (young?) for the species, and coated to a considerable extent with sand, a state of things which, though so characteristic for many species of Molgula, is strikingly absent in the larger individuals of *retortiformis*. Hartmeyer has noted the same thing in the collections of the species examined by him; so it may be safe to conclude that young animals are more apt to be sand covered than older ones.

The large size of some of the individuals deserves notice. One is 10 cm. in its greatest extension, and since all the animals approach the sphere in shape the mass of such an individual is great for an ascidian. Other specimens are only a little smaller.

Albatross stations: 3238 (1 specimen), lat. 58° 3′ 40″ N.; long. 158° 37′ 30″ W., 18 fathoms, fne. gy. s., June 7, 1890 (Bering Sea); 3292 (3 specimens), lat. 57° 14′ N.; long. 159° 35′ W., 32 fathoms, bk. s. g., July 18, 1890 (Bering Sea); 3293 (1 specimen), lat. 57° 30′ N.; long. 159° 33′ W., 30 fathoms, fne. gy. s., July 18, 1890 (Bering Sea); 3296 (2 specimens), lat. 57° 26′ 30″ N.; long. 158° 46′ W., 24 fathoms, gy. s. bk. sp., July 19, 1890 (Bering Sea); and 3303 (1 specimen), lat. 57° 27′ N.; long. 160° 23′ 30″ W., 33 fathoms, bk. s., July 21, 1890 (Bering Sea).

All these stations are in the southeastern part of Bering Sea.

Other stations: Nikolski, Bering Island (2 specimens), *Albatross* June 3, 1892; No. 2502, Commander Islands, Siberia (2 specimens), Leonhard Stejneger, collector, 1882–83.

Many of the specimens were associated with *Boltenia ovifera.*

MOLGULA CRYSTALLINA (Möller).

Clavelina crystallina Möller, 1842, p. 95.—Hartmeyer, 1903, p. 134.
Pera crystallina Verrill, 1872, p. 290, pl. 8, fig. 9.—Hartmeyer, 1899, p. 455, text fig. A; pl. 22, fig. 1; pl. 23, figs. 1, 16.
Caesira crystallina Hartmeyer, 1909*a*, p. 1323.—Van Name, 1912, p. 494, text figs. 12 and 13; pl. 48, figs. 31–33.

The Molgulids grouped together under this name have but five folds in the branchial sac, and for this reason have, with several other species possessing the same peculiarity, been made into a distinct genus, *Pera.* It is with some hesitation that I refuse to recognize this generic group. On the whole it seems to me advantageous to set off from so large a genus as *Molgula,* any smaller group when this can be done on the basis of so distinctive a character as that here mentioned. However, so long as *Molgula* as usually accepted, contains one lot of species having six folds, and another lot having seven, I conclude that on the whole, for consistency's sake, the species with five folds should also be retained.

Some of the specimens examined appear to be without the peduncle, as Hartmeyer, 1899, states is the case with some of the specimens in the collections studied by him. Hartmeyer found that whereas the species had been described as having about 12 tentacles, close study revealed to him 144, in 5 sizes, many of them being very small. My observation too, is to the effect that all but 20 or so of the largest are likely to be overlooked.

Localities.—Although the species was not taken in quantity anywhere, a few specimens are at hand from eleven stations. These are:

Albatross 3213, latitude 54° N.; longitude 162° 54′ W. (a little south of the Alaska Peninsula), 41 fathoms, bottom bk. s., May 21, 1890; two small specimens.

Albatross 3214, 54° 13′ N.; 163° 06′ W., 38 fathoms, gy. s. g., May 21, 1890; 1 small specimen.

Albatross 3262, 54° 49′ 30″ N.; 165° 02′ W., 43 fathoms, bk. s. r., June 24, 1890; 1 small specimen.

Albatross 3278 and 3282, near together in the southeastern part of the Bering Sea, the first in 47 fathoms, the second in 53, both on fne. gy. s. bottom, both in June, 1890. A single specimen from each station.

Albatross 3222, 54° 20′ N.; 165° 30′ W., 50 fathoms, bk. s. p. sh., five specimens.

Albatross 2848, 55° 10′ N.; 160° 18′ W., 110 fathoms, gn. m., July 31, 1888, one specimen.

Besides these *Albatross* specimens there is one lot of four collected in June, 1884, by Lieut. George M. Stoney, United States Navy, in 63° 50′ N.; 167° 21′ W. (well north in Bering Sea), 17 fathoms; a half dozen, small (immature?) specimens, probably, though not certainly, of this species, from Kyska Harbor, Alaska, 14 to 9 fathoms, sandy bottom, collected by W. H. Dall in 1873; also one small individual, probably this species, from Constantine Harbor, Alaska, 6 to 10 fathoms, sandy and stony bottom, collected by Doctor Dall in 1873; one specimen Arctic Ocean, 66° 45′ N.; 166° 35′ W., 10 fathoms, W. H. Dall collection, August, 1880.

MOLGULA SIPHONALIS Sars.

Molgula siphonalis M. SARS, 1858, p. 65.—KIAER, 1893, pp. 77, 101; pl. 4, figs. 37–40.—HARTMEYER, 1903, p. 157; 1909*a*, p. 1323.

So far as external characters are concerned, the single specimen under examination agrees so well with descriptions of *M. siphonalis* as to raise no question about the identification. And the two superficial characteristics of the species, namely, the long atrial siphon and the long hair-like processes of the test, being, as Hartmeyer has remarked, so unique, there can be little doubt, in spite of the slight obstacle presented by the branchial sac, to be noted presently, that Sars's Norwegian species is represented in Bering Sea.

The number of longitudinal vessels of the branchial sac is rather large in our specimen to be regarded as an individual variation of the number given by Kiaer for *siphonalis*. The scheme of vessels in our individual is as follows:

$$\text{Endostyle}\begin{cases}0\text{–}3\text{–}0\text{–}8\text{–}0\text{–}9\text{–}0\text{–}10\text{–}0\text{–}10\text{–}0\text{–}10\text{–}0\text{–}9\text{–}0 \text{ L.}\\ 0\text{–}6\text{–}0\text{–}6\text{–}0\text{–}9\text{–}0\text{–}8\text{–}0\text{–}5\text{–}0\text{–}5\text{–}0\text{–}6\text{–}0 \text{ R.}\end{cases}$$

For *siphonalis* Kiaer gives: 0–5–0–6–0–6–0–5–0–5–0–5–0–4–0 //=36, with no statement as to whether this is right or left. But since in all other points of internal structure the agreement is very close, this difference in the vessels ought not, I think, to stand in the way of the identification.

One specimen, *Albatross* No. 3560, latitude 56° 40′ N.; longitude 169° 20′ W. (near St. Paul Island), 43 fathoms, fne. gy. s. bk. sp., September 3, 1893.

EUGYRIOIDES DALLI, new species.

Plate 33, figs. 1–3.

Superficial characteristics.—Quite regular in form, varying from nearly spherical to oblong; siphons conspicuous because of their opaque whiteness as contrasted with the transparency of the test generally; projecting distinctly, though not greatly above the general surface, considerably harder than the rest of the body, so that the general appearance of the structures is that of two warts; the siphons rather near together, the atrial more toward the end of the body in oblong individuals. Test transparent, permitting the internal organs to be distinctly seen where the adhering sand grains (abundant in some individuals) are not too numerous. A great number of fine, flaccid filaments on the surface of the test, these almost uniformly distributed over the whole body. Animals unattached, apparently living on sandy bottoms. Largest individual about 30 mm. in diameter and nearly spherical; most individuals smaller. Mantle rather thin, musculature not strongly developed. Radial fibers much larger and stronger than circular, the former reaching back radially from each siphon not quite to the equator of the body; regularly spaced.

Respiratory system.—Branchial orifice 6-lobed, atrial 4-lobed, both sets of lobes rather obscure. The small lobes of the branchial orifice irregularly notched (pl. 33, fig. 1). Branchial tentacles about 50 of various sizes, about 12–15 large ones; sparsely and very irregularly branched, secondary branches being present though scarcely more than buds (fig. 2). Hypophysis mouth round, horseshoe-shaped, turned strongly to the right, the ends of the shoe simple, approaching each other rather closely. Ganglion very close to the hypophysis. Dorsal lamina undivided, smooth. Branchial sac without folds, but with seven prominent, longitudinal membranes occupying the position of the folds, each of these having a thickened, rounded edge which may be regarded as a single longitudinal vessel. Stigmata mostly strongly curved and disposed in infundibula which are of two orders, those with apices along the longitudinal vessels and those between the vessels and so with apices entirely independent of the vessels (pl. 33, fig. 3).

Alimentary system.—Situated on the left side, the whole forming roughly a semicircle with a double periphery from the intestines bending back rather sharply on itself, and so making the rectal portion run for some distance nearly parallel to the esophagus and stomach. Stomach not distinctly set off from the intestine, its wall thrown into a number of large irregular convolutions (pl. 33, fig. 1). (The course of the intestinal canal in the specimen here figured is not quite typical in that the space left between the two limbs at the point of doubling back is wider than usual.)

Reproductive system.—On both sides, consisting of intermingled lobes—not numerous—of ovary and testes; most of the left gonad situated within and in front of the intestinal loop.

The species is undoubtedly closely akin to *Eugyrioides arctica* Bonnevie, 1896; in fact, resembles it so closely that I have hesitated about making a separate species. However, as the descriptions of *arctica* now stand, the two differ in the following particulars: *dalli* grows to a considerably larger size than *arctica*. The latter is devoid of the surface filaments that are characteristic of *dalli*. The branchial tentacles of *arctica* are described by Bonnevie as being "lobed like an oak leaf." As my figure 2 shows, this is quite different from the tentacles of *dalli*. Finally the wide separation of the two geographically makes a presumption against their specific identity.

The specimens of *E. rara* (which see) were mingled with those of *dalli* in one of the bottles from Kyska Harbor, and a complete separation of the two without dissection of every one is somewhat doubtful. The superficial characters on which I have relied in sorting them are the more prominent and wartlike siphons, somewhat farther apart, of *E. dalli*. But since the differences here are neither great nor entirely constant, it is not impossible that more dissections would find that my sorting is not altogether accurate. As the evidence now stands *E. dalli* reaches a much larger size than does *rara*. This criterion, I suspect, will hold, but too much reliance should not be placed upon it till more evidence is at hand. The particular internal differences between these two species are the larger number of longitudinal vessels or membranes in *dalli;* the larger, more numerous and more highly branched tentacles of *dalli;* and the second order, or "free" infundibula of the branchial sac of *dalli*. These infundibula are a very striking feature of the inner surface of the respiratory membrane. They are of different sizes, are irregularly distributed, and make the impression, when seen under a low magnification, of foreign bodies of some sort clinging to the membrane.

Special mention should be made of the hundred and more small, excessively sand-covered individuals contained in one of the Kyska Harbor lots. I assume them to be the young of *dalli*. For one thing, the siphons, though recognizable on surface views of most of the individuals by their light color, are far less prominent either in color or in size than in the larger specimens. But differences in stage of development may well account for the difference. The siphons are also on the whole relatively farther apart in the smaller than in the larger individuals. This, however, is by no means invariably true, so I can not consider the peculiarity to be of great significance for classificatory purposes. In internal structure the tentacles of the small animals seem to be simpler, the secondary branches being wholly or almost wholly wanting. But this again may well be a juvenile

deficiency. On the whole there is little question about the identification of the small specimens.

The collection contains several lots of this species, all but one obtained by Dr. W. H. Dall. One lot of three individuals is from Chichagof Harbor, Attu, Alaska, 5 to 7 fathoms, gravel and sand bottom, 1873. Three lots, containing over 200 specimens, many very small, from Kyska Harbor, also from the Aleutian Island region, 7 to 12 fathoms; and still another lot of 5 large, very sandy individuals from Kyska Harbor (type-locality). A half dozen specimens, *Albatross* station 3637, 57° 06′ 30″ N.; 170° 28′ W., 32 fathoms, crs. g., July 18, 1896.

Type.—Cat. No. 5678 U.S.N.M.

A bottle labeled "Kyska Harbor, 9–12 fathoms, 1873," of the Alaskan collections by W. H. Dall, contains about 35 specimens which externally much resemble the specimens from the same locality which I have regarded as the young of *Eugyrioides dalli*. The only difficulty, so far as surface appearances go, in thus disposing of these is the fact that no siphons or orifices can be seen on them, while the young *E. dalli* show the siphons in almost all cases, as already described. But dissection of the animals discovers a remarkable state of things. Besides the siphons and some of the mantle immediately adjacent to these, no ascidian organs can be made out. In most specimens examined a large number of spherical, amber-colored, semitransparent hard bodies are present. These, one would say offhand, are eggs, and such they may be; but no nuclei or other structures characteristic of ascidian eggs are recognizable. Aside from these ova-like bodies, the material filling the test (for such the sand-covered outer coat seems undoubtedly to be) consists partly of a dark, hard, amorphous mass, and two, generally irregular, elongated, granular, dull, white bodies. As to what all this means I can offer only the most dubious conjecture. The materials described call to mind what has been regarded by several observers and what I myself have seen some of, in some of the social and compound ascidians, as reserve material in a degenerative or hibernating state of the colonies, this to be made use of as food in the rejuvenation of the colony. But such a thing is wholly unknown, so far as I am aware, in simple ascidians, and I consider the suggestion as of barely sufficient probability to make it worth mentioning pending an opportunity of further examination.

EUGYRIOIDES RARA (Kiaer).

Paramolgula rara KIAER, 1896, p. 17, pl. 5, figs. 16–19.—HARTMEYER, 1903, p. 132.—REDIKORZEW, 1907, p. 3.
Eugyrioides rara HARTMEYER, 1909*a*, p. 1321.

There are about 30 specimens from Kyska Harbor mingled with *E. dalli*, which I assign to Kiaer's species, hitherto known only from the coasts of Norway and European Siberia. There is no difficulty

that seems to me of consequence in the way of the identification. The tentacles of *rara* are "almost unramified," according to Kiaer, the branches being only "small buds." This description does not quite apply to my specimens, since the branches, though small and simple, are more than buds. Again, Kiaer speaks of the dorsal lamina as being "very powerful and high." This structure in the specimens now under consideration is undoubtedly wide for an ascidian of this size, but not excessively so. At first I was inclined to identify the specimens with *E. symmetrica* (Drasche, 1884, p. 161), a species very close of kin to *rara*. But the form of the infundibula and of the intestinal bend seems decisive, the infundibula of *symmetrica* being flat, while in *rara* they are distinctly elevated. In the "wide rapidly rising look" of the intestine, too, the Alaskan specimens agree closely with *rara*. It should be mentioned, however, that in the number of stigmata to each infundibulum our specimens seem to correspond more nearly with *symmetrica*, the number being at least 8 in ours, whereas 6 or 7 is the number for the typical *rara*. But this disagreement does not seem to me to go far toward offsetting the agreements above mentioned.

Specimens collected by W. H. Dall at Kyska Harbor, Alaska, 9 to 12 fathoms (No. 1000).

RHIZOMOLGULA RITTERI Hartmeyer.

Rhizomolgula ritteri HARTMEYER, 1903, p. 168, pl. 6, fig. 1; pl. 9, figs. 5–9.—HARTMEYER, 1909*a*, p. 1321.

Comparison of the numerous specimens of this species in the collection with *R. arenaria* Ritter, reveals the following well-marked differences: The sand coating of *arenaria* is distinctly thicker than in any of the specimens of *ritteri*, where at its minimum the sandiness is sparse, leaving considerable areas of the test entirely exposed. The mantle musculature, particularly the bands radiating from the orifices, is much stronger in *arenaria*. The branchial folds are higher in *arenaria*, the number of longitudinal vessels on them being somewhat greater. Hartmeyer has pointed out all these differences, except that of the difference in extent of the sand covering. He also notices the apparent absence of stigmata between the folds of *arenaria* as being distinctive. I have to correct my description of *arenaria* by stating that stigmata do occur between the folds. They are, however, fewer as compared with those in the folds than in *ritteri*, and are disposed more definitely in spirals and low infundibula. In no instance have I seen them in the serpentine partly coiled form characteristic of these stigmata in *ritteri*.

Albatross stations: 3229, 8 fathoms, 58° 40′ N.; 157° 15′ W. (Bering Sea), May 31, 1890, 80 specimens.—3266, 24 fathoms, 55° 08′ 30″ N.; 163° 30′ 30″ W. (Bering Sea), June 25, 1890, 50 specimens.—

3271, 25 fathoms (very near station 3266).—1 specimen, Granite Cove, Port Althorp, June 18, 1880, Dall collection.—1 specimen Chamisso Harbor, Eschscholtz Bay, Alaska, 5 to 8 fathoms, W. H. Dall, 1880.

HALOCYNTHIA WASHINGTONIA, new species.

Plate 33, figs. 4–6.

Superficial characters.—Somewhat egg-shaped, the thick end forward; attached along whole ventral side, the area of attachment much flattened and bordered by a distinct but irregular flange, the test here smooth and thin as compared with that of other regions; surface marked by a number of low, rather regular wrinkles generally running lengthwise of the body (pl. 33, fig. 4). Siphons not prominent, the branchial situated well forward, the atrial more prominent than the branchial, situated near the median dorsal line and about midway between the two ends; branchial orifice four-lobed, atrial obscurely six- or seven-lobed. Color dark brown, except area of attachment, which is dull gray. Test stiff and dense, scarcely thicker than heavy paper generally, still thinner over area of attachment. Length 2 cm., width 1.5 cm. Mantle rather thin, even for this genus, radial muscle fibers around and adjacent to the siphons as usual much the stronger, the circular fibers being very fine, especially on the ventral half of the body.

Respiratory system.—Tentacles 26 large ones, and about as many more very small ones, a few of the large being still larger than the others, the larger copiously branched; branchial membrane with six folds on each side, from 10–18 longitudinal vessels on the folds and generally 2 between the folds. Stigmata straight, long, and regular, about 6 in a mesh; dorsal languets of reddish color, those at posterior end of series somewhat longer. Hypophysis mouth simple, horseshoe-shaped, the opening directed forward.

Alimentary system.—On the left side, the rather wide loop occupying a nearly vertical position well toward the posterior end; stomach hardly distinguishable from the intestine in size; the lobulated gland (liver?) in two widely separated sections, one much more voluminous and elaborately branched than the other (pl. 33, fig. 6).

Reproductive system.—On both sides, left wholly within intestinal loop; about 35 hermaphroditic lobes on right and 30 on left, lobes on each side not crowded together, all connected to a common strand probably containing both oviduct and vas deferens.

The most unique feature about this species is the lobing of the atrial orifice. Exactly how many lobes are present in the one specimen at hand is not certain, but there are clearly five and these do not make up the complete circuit (fig. 5). I know of no other species of the genus to which more than four lobes of either orifice have been

ascribed According to the older valuation of the lobes the present individual would, therefore, probably be counted as the type of a new genus. However, the animal is a very typical *Halocynthia* in all other respects, so I have no hesitation in placing it here.

Within the genus it belongs among the species with six branchial folds, its nearest of kin seeming to be *H. michaelseni* Oka, 1906, and *H. karasvoja* Oka. But from both of these it differs in several ways in addition to its larger number of atrial lobes. For example, *michaelseni* has about 10 vessels to the fold and 9 between, while the hypophysis mouth is described by Oka as presenting a "kompliziertes Muster." A very simple U-shape characterizes the organ in *washingtonia*. Furthermore, in the Japanese species the "liver" does not seem to be separated into the two distinct portions as is the case in *washingtonia*. In fact, this condition of the organ is rare for the genus.

Type-locality.—A single specimen, *Albatross* station 3450, lat. 48° 26′ 50″ N.; long. 124° 39′ 35″ W. (in the Strait of Juan de Fuca), 151 fathoms, bottom g., August 28, 1891.

Type.—Cat. No. 5680, U.S.N.M.

HALOCYNTHIA HAUSTOR (Stimpson).

Cynthia haustor STIMPSON, 1864, p. 159.—VON DRASCHE, 1884, p. 372, pl. 3, figs. 3 and 8.—HERDMAN, 1898, p. 257, pl. 14, figs. 1, 2.—RITTER, 1900, p. 601, pl. 18, figs. 8, 9, 10.

Pyura haustor HARTMEYER, 1909*a*, p. 1340.—HUNTSMAN, 1911, p. 134.

There are a dozen and a half of this common Puget Sound species sent to the museum by Dr. O. B. Johnson in 1889. They were collected from shore rocks between tides and show nothing needing comment.

Puget Sound, Dr. C. B. Kennerly, Northwestern Boundary Survey, 25 specimens, cotypes.

The assignment to this species of two small specimens from *Albatross* station 3451 is open to some though but little doubt. Perhaps the most questionable point is the almost entire absence of siphons in these specimens, these structures being usually though not always particularly prominent in the typical *haustor*. The ridging and tuberculation of the test of the individuals now under consideration are furthermore somewhat less definitely expressed than in *haustor* from the littoral zone. The available evidence from internal structure contains nothing against the identification excepting possibly the tentacle number, which is here 30, somewhat high for *haustor*. What makes the assignment of these specimens particularly interesting is the fact that they were taken in much deeper water, 106 fathoms, than *haustor* generally inhabits.

Albatross 3451, lat. 48° 25′ 10″ N.; long. 124° 37′ 50″ W., in the Strait of Juan de Fuca, 106 fathoms, August 28, 1891.

Type.—Cat. No. 3239, U.S.N.M.

HALOCYNTHIA HAUSTOR FOLIACEA, new subspecies.

Plate 33, fig. 7.

The specimens of *Halocynthia* which I am considering, provisionally, as a subspecies of *H. haustor* stand, according to the evidence now at hand, about midway in their resemblances between *H. johnsoni* and *H. haustor* with features sufficiently different from both to entitle them to independent specific rank should the examination of more material establish the constancy of the characters used for separating them as a subspecies.

The strikingly distinctive features about them pertain to the general external appearance. Irregular in form as individuals of both *johnsoni* and *haustor* usually are, the animals now before me are far more so than anything I have ever seen in these species. The irregularity is due chiefly to the extent and character of the outgrowths on the test. Some of these, particularly on the siphons and toward the anterior end of the body, are quite remarkable, being long, more or less flattened,and broadest at the distal end. They may reach a length of nearly 12 mm. and these largest longest ones are quite flexible or pendulous. They might properly be spoken of as foliaceous (pl. 33, fig. 7). On portions of the body where there are no such elaborate outgrowths the test is still deeply, though irregularly corrugated, the sharply projecting ridges being clearly of the same general nature as the foliaceous warts. In these regions the surface is not greatly different from that of the typical *haustor*.

The color is dark brown, the processes and higher ridges inclining to reddish.

On the whole the animals appear to be shorter in proportion to the greatest transverse diameter than is either *haustor* or *johnsoni*, though in proportions, as well as in surface features, the irregularity is very great.

The height, exclusive of the siphons and processes, of the specimen shown in figure 7 is about 2 cm., and the greatest transverse diameter is 3.5 cm. But some of the individuals are higher proportionally.

In external characters the animals undoubtedly resemble *haustor* more than they do *johnsoni*.

On the other hand, as regards the one internal feature to which, so far as is now known, *haustor* and *johnsoni* are distinct from each other, namely, the tentacle number, the specimens now under consideration resemble more *johnsoni*. In four specimens examined the numbers counted were 34, 30, 28 or 30, and 26, the last being a small individual. The average number for typical *haustor* is about 21, while the average for *johnsoni* is 42.

The scheme of internal longitudinal vessels for the right side of two specimens was:

First. D. L. ?–*9*–3–*21*–1–*21*–1–*23*–5–*18*–3–*11*–2 = 118.
Second. D. L. ?–?–2–*20*–3–*18*–2–*16*–7–*12*–6–*12*–3 = 101.

Neither these series nor those of other specimens counted indicate anything distinctive in comparison with either *haustor* or *johnsoni;* and the same remark must be made concerning the other internal systems—with the possible exception of the "liver." This structure is not large in our animals and an extensive comparative study of it might, perhaps, prove it to present constant differences.

Type-locality.—*Albatross* 3088, lat. 44° 28′ N.; long. 124° 25′ 30″ W., 46 fathoms (close to the Oregon coast), September 3, 1889.

Type.—Cat. No. 5681, U.S.N.M.

HALOCYNTHIA AURANTIUM (Pallas).

Ascidia aurantium PALLAS, 1787, vol. 2, p. 240, pl. 7, fig. 38.
Cynthia pyriformis DALL, 1872, p. 157.
Cynthia superba RITTER, 1900, p. 590, pl. 18, fig. 1; pl. 19, figs. 16, 17, 18, and 20; pl. 20, fig. 19.
Cynthia deani RITTER, 1900, p. 592, pl. 18, figs. 2, 3; pl. 19, figs. 21, 22, 23.
Halocynthia aurantium HARTMEYER, 1903, p. 195.
Halocynthia superba OKA, 1906, p. 41.
Pyura aurantium HARTMEYER, 1909*a*, p. 1339.
Tethyum aurantium HUNTSMAN, 1911, p. 136.

For full synonymy see Hartmeyer, 1903.

Table 7 gives the tabulated result of the examination of 26 specimens of the *aurantium* group of *Halocynthia* representing the full extent of the geographic range of the group. Study of this table shows that the specimens from the Pacific Ocean and Bering Sea are undoubtedly separable from those of the Atlantic Ocean by the number of gonads and probably also by the ratio of length to thickness of the individual animals, and the character of the spines of the test.

TABLE 7.

No. of specimen.	Collector.	Locality.	Depth in fathoms.	Size. L.	Size. D.	Size. Ratio L/D.	Lobes of orifices. R.	Lobes of orifices. A.	Spines on test in circles or not. Yes.	Spines on test in circles or not. No.	Tentacles.	Folds of sac. R.	Folds of sac. L.	Longitudinal vessels of sac.	Total vessels.	Average vessels on folds.	Average vessels between folds.	Stigmata in mesh.	Gonads. R.	Gonads. L.
1	*Albatross* 3505.	Bering Sea....	44	13	7.5	1.73	4	?	×	.....	24	9	11	R. 4-26-4-34-4-34-3-30-3-30-3-28-3-25-3-16-2-4-1. L. 3-28-4-30-4-31-2-28-4-29-2-27-3-21-2-14-2-4-1.	257 239	24.4−	2.8+	15	2	3
[1] 2	Columbia Univ. Exp.	Puget Sound..	Shore.	12	6	2.00	2	18	×	.....	18	8	10	R. 2-23-3-25-3-24-6-22-6-22-3-23-3-18-2-8-2.... L. 3-21-4-26-3-27-3-27-7-25-3-20-2-13-2-6.....	195 185	20.4	3.1+	8-16	7?	3?
[2] 3	Alaska Commer. Co.	Alaska.....	?	10	4	2.50	4	4?	×	.....	26	9	10	R. 1-17-0-26-2-31-1-28-1-27-0-27-1-22-3-14-3-10-3. L. 0-21-1-29-2-28-1-27-0-27-3-17-2-16-0-15-0-4-1.	217 194	21.4+	1.25	9	3	4 or 5?
4	*Albatross*.....	Unalaska.....	?	9.5	7	1.36	4?	4?	×	.....	24	8	10	R. 3-31-4-32-6-32-3-30-4-26-3-22-3-18-3-10-0.... L. 3-27-3-34-0-35-0-29-3-27-3-26-2-21-0-14-0....	230 227	25.9−	2.4−	15-17	3	2
5	T. H. Strects..	Kasaan Bay ..	?	8	5	1.60	4	4	.....	×	30	9	11	R. 2-14-4-24-0-26-1-23-3-23-3-20-4-17-3-14-2-5-1. L. 0-21-0-28-2-27-2-25-3-21-3-20-3-18-2-6-0....	196 181	20.0−	2.0	7-18	3	2
[3] 6	C. M. Coffin...	Grand Banks.	.....	8	5	1.60	4	?	.....	×	27	8	10	R. 0-19-3-25-1-26-3-25-3-24-3-20-4-17-2-10-0.... L. 0-21-0-29-2-29-2-23-2-22-1-21-0-17-0-13-3...	185 185	21.3+	1.6−	12	7	6
7	*Albatross* 3213.	S.of Alask. Pen.	41	7	3.5	2.00	4	?	×	.....	27	8	10	R. 3-21-3-21-1-25-3-23-3-19-4-20-4-17-4-7-2.... L. 1-25-1-25-1-23-2-27-2-23-3-20-3-15-2-6-2....	180 186	20.1+	2.45+	6-10	2	4
8	*Albatross* 3513-b.	Bering Sea....	35	6.5	5	1.30	4	?	×	.....	29	9	10	R. 1-14-3-27-0-27-1-26-2-23-2-20-3-16-3-13-1-7-0. L. 0-22-3-22-1-23-2-25-3-23-3-20-3-18-5-9-1....	194 188	20.3−	1.9+	15	3	3
[4] 9	N. Pacific Explor. Exp.	Arctic Ocean..	?	6.5	4.3	1.51	4	?	×	.....	24?	?	?	?	?	?	?	Many.	?	?
[4] 11	*Albatross* 2442.	Off Newfoundland.	33	6	6	1.0	4	4	.....	×	24	9	9	R. 2-13-3-23-2-23-3-24-2-24-2-23-1-17-1-13-1-3-0 L. 2-16-3-23-2-26-2-18-2-21-2-17-3-16-2-9-1-7-1	180 173	17.6−	1.85−	15	5	7
12	T. H. Streets..	Ward Cove....	?	6	3.5	1.71	4	2	×	.....	31	8	10	R. 0-15-2-23-2-23-1-20-2-17-2-17-3-12-2-5-2.... L. 3-16-3-24-0-24-2-24-1-18-3-15-3-11-3-6-1....	148 157	16.9−	1.9+	16	3	3
[5] 13	W. Stimpson..	Eastport and Gr. Manan.	.....	5.5	4.5	1.22	4	4	.....	×	22	8	9	R. 3-10-7-20-4-20-3-19-4-19-3-15-3-14-0-4-0.... L. 0-16-4-16-5-20-3-21-3-18-4-19-3-14-2-4-2....	148 154	15.6−	2.9+	19	5	7
14	*Albatross*.....	Kodiak.....	.....	5.5	3.5	1.57	4	4	×	.....	27	8	9	R. 2-16-2-23-2-22-1-23-2-20-1-21-1-12-2-5-1.... L. 1-19-0-23-2-22-2-21-2-19-1-16-2-13-2-4-2....	155 150	17.3+	1.6−	15	3	4?
15	*Albatross* 2842.	Akutan Id....	72	5	2.2	2.27	4	4	×	.....	23	8	9	R. 0-20-1-21-1-23-1-18-1-10-1-16-1-13-2-3..... L. 0-17-2-21-2-22-0-19-2-20-2-19-2-8-1.....	141 137	17.3−	1.2−	14	3	4

[1] Name previously applied, *Cynthia superba* (type).
[2] Name previously applied, *Cynthia superba*.
[3] Name previously applied, *Halocynthia pyriformis*.
[4] Name previously applied, *Cynthia pyriformis*.
[5] Name previously applied, *Halocynthia pyriformis*.

TABLE 7—Continued.

No. of specimen.	Collector.	Locality.	Depth in fathoms.	Size. L.	Size. D.	Size. Ratio L/D.	Lobes of orifices. D.	Lobes of orifices. A.	Spines on test in circles or not. Yes.	Spines on test in circles or not. No.	Tentacles.	Folds of sac. R.	Folds of sac. L.	Longitudinal vessels of sac.	Total vessels.	Average vessels on folds.	Average vessels between folds.	Stigmata in mesh.	Gonads. R.	Gonads. L.
16	Dall (1455)....	Chugachik....	20–60	4	2.7	1.48	4	4?	×	.....	30	7	9	R. 1–9–2–16–0–17–2–17–1–17–4–16–2–10–0..... L.	114	14.6–	1.5	14	3	4 or 5
17	No label	.....	?	4	2.25	1.78	4	4?	×	.....	25	7	?	R. 1–9–1–15–1–16–1–15–1–17–1–13–1–9–2..... L.	103	14.1+	1.1+	7-13	3	4
[1]18	Young Naturalist Club, Seattle.	Puget Sound..	?	3.8	2.2	1.73	4	4?	×	.....	26	8	9	R. 1–10–1–16–1–16–1–16–1–15–1–12–1–7–0–2–1..... L.	102	11.8–	.9–	19	3	?
[2]19	*Albatross* 2439.	Off Newfoundland.	?	3.5	3.3	1.06	4	4?	Few.	.....	25	...	9	R. 2–14–3–22–2–21–2–21–2–19–2–18–2–13–2–7–2–4–1 L. 2–11–4–20–2–21–2–20–3–19–3–17–4–13–2–8–1–4–0	159 162	15.4+	2.15	.....	7	7
[3]20	Zool. Station, Naples.	Naples.....	.....	2.3	1	2.3	4	?	.....	×	23	9	8	R. 3–9–1–15–1–17–1–18–1–17–1–15–2–13–3–12–1–6–2 L. 0–3–1–11–1–15–1–24–0–19–1–15–2–19–2–19–1–14–2–4–1.	138 155	13.9+	1.3+	15	2	2
[4]21	W. Stimpson..	Eastport and Gr. Manan.	.....	3.25	2	1.13	4	4	.....	Not distinct.	17	8	8	R. 0–13–2–18–2–18–2–18–2–15–2–14–1–11–0–6–0.... L. 2–11–2–19–2–17–2–17–1–14–1–12–2–11–0–4–0....	134 117	13.6+	1.3–	15	11	11
[5]23	Columbia Univ. Exp.	Puget Sound..	?	2	1	2.0	4	?	×	.....	16	7	8	R. 0–7–0–11–1–10–2–9–3–10–3–7–0–3–3..... L. 3–8–1–6–2–8–3–6–3–6–0–3–1.....	69 50	7.2+	1.7–	13	2	2
24	F. M. Chamberlain.	Loring.....	.....	1.7	1.2	1.41	4	?	×	.....	22	7	8	R. 2–0–9–1–12–2–10–2–10–1–10–0–6–1..... L. 6–1–11–0–15–2–11–1–10–0–8–0–4–0.....	56 69	8.9–	.79–	12	2	2
25	*Albatross*.....	Unalaska and Cook Inlet.	42	1.5	.7	2.14	4	?	×	.....	16+	7	?	R. 0–5–1–10–0–14–1–12–1–10–0–11–0–9.....	74	10.1+	.4+	3-6	?	?
26	.....do.....	Loring.....	.....	1.2	.9	1.33	4	?	×	.....	32	7	6	R. 2–0–6–0–10–0–9–1–8–1–5–2–2..... L. 3–0–7–0–8–1–9–1–7–0–4–2–1.....	46 43	5.9+	.5	13	2	2

[1] Name previously applied, *Cynthia deani.*
[2] Name previously applied, *Cynthia pyriformis.*
[3] Species, *Halocynthia papillosa* = *Cynthia papillosa.*
[4] Name previously applied, *Halocynthia pyriformis.*
[5] Name previously applied, *Cynthia deani.*

Table 8, made by arranging the specimens on the basis of the number of gonad lobes, brings out the fact that all the Atlantic specimens (5) fall into a group with 12 or more gonads, while all the Pacific-Bering Sea specimens (16), with one exception, fall into a group having 8 or fewer gonads. This result is in agreement with Huntsman's conclusion that the Pacific animals have fewer gonads than have those from the Atlantic-Arctic region, and favors the recognition of two specific groups. Whether a single difference ought ever to be considered sufficient for separating species may be a question; but when, as in this case, it is associated with one or more other highly probable differences there should be no hesitation. As shown by Table 7, it is almost certain that the spines of the test are arranged in circular groups more definitely in the Pacific animals. The greater average ratio of length to diameter shown by the Pacific specimens—1.77:1 as against 1.20:1 for the Atlantic animals—is likely to prove a good character also, but the distorted condition of many of the preserved specimens makes measurement rather unsatisfactory.

Since the specimens upon which Pallas based his *Ascidia aurantium* were from the Kurile Islands, that specific name will stand for the Pacific animals, and the name of the Atlantic species will be *H. pyriformis* (Rathke.)

TABLE 8.

Data of the Aurantium group of Halocynthia arranged with reference to the number of gonads and bringing out the distinctness of H. pyriformis from H. aurantium.

No. of specimen.[1]	Gonads.	Ratio of width to length of individual.	Arrangement of spines on test.	Tentacles.	Folds of sac.	Average vessels per fold.	Locality.	
6	13	1:1.6	No circles	27	8	23	Grand Banks.	*H. pyriformis.*
11	12	1:1	do	24	9	19.6	Newfoundland.	
13	12	1:1.2	do	22	8	19	Grand Manan.	
19	14	1:1.06	Few circles	25	9	18	Newfoundland.	
21	15	1:1.13	No circles	17	8	15.7	Eastport.	
Average	13.2	1:1.2		23	8	19	All Atlantic stations.	
1	5	1:1.73	Circles	24	9	27.6	Bering Sea.	*H. aurantium.*
2	10	1:2	do	18	8	23.8	Puget Sound.	
3	8	1:2.5	do	26	9	23	Alaska.	
4	5	1:1.36	do	24	8	28.6	Unalaska.	
5	5	1:1.6	No circles	30	9-8	22	Kasaan Bay.	
7	4	1:2	Circles	27	8	23	South of Unimak.	
8	6	1:1.3	do	29	9-8	21.3	Bering Sea.	
12	6	1:7	do	31	8	19	Ward Cove, Alaska.	
14	7	1:1.57	do	27	8	18	Kodiak, Alaska.	
15	7	1:2.27	do	23	8-7	18.6	Akutan Id.	
16	8	1:1.48	do	30	7	16.3	Chugachik, Alaska.	
23	4	1:2	do	16	7-6	9	Puget Sound.	
24	4	1:1.4	do	22	7	9.6	Loring, Alaska.	
26	4	1:1.33	do	32	7	6.4	Do.	
Average	6	1:1.77		23	8	19		

[1] The numbers correspond to the numbers of the individuals in Table 7.

The variation of the hypophysis should be mentioned, since it is impossible to present this in the table. In small individuals the hypophysis mouth is generally broadly horseshoe-shaped, the horns being rolled in at the tips to the extent of one or two turns. With increase of size this simple condition is lost, seemingly in all cases,

the inrolling of the horns progressing to form spirals having four, five, or more turns. In some cases these spirals remain flat, but in others they take on a cone shape, the cones in some projecting prominently. Frequently secondary cones are formed on various parts of the tubercle, in one instance as many as seven of different sizes being present. The range of variation and complication is here somewhat similar to but greater than that found in *H. johnsoni* Ritter, 1909.

"*Albatross*" COLLECTIONS.

Station 2842, lat. 54° 15′ N.; long. 166° 03′ W., off Akutan Island, Alaska, 72 fathoms, p., July 23, 1888, 1 specimen.

Station 2851, lat. 54° 55′ N.; long. 159° 52′ W., Shumagins, 35 fathoms, gy. s. brk. sh., August 4, 1888, 3 specimens.

Station 3213, lat. 54° 10′ N.; long. 162° 57′ 30″ W., southwest of Sannak Islands, 41 fathoms, bk. s., May 21, 1890, 2 specimens.

Station 3504, lat. 56° 57′ N.; long. 169° 27′ W., Bering Sea, 34 fathoms, fne. gy. s. bk. s., July 28, 1893, 3 specimens.

Station 3505, lat. 57° 09′ N.; long. 168° 17′ W., Bering Sea, 44 fathoms, fne. gy. s., July 28, 1893, 15 specimens.

Station 3512, lat. 57° 49′ 30″ N.; long. 169° 27′ W., Bering Sea, 38 fathoms, fne. s. gn. m., August 1, 1893, 1 specimen.

Station 3513, lat. 58° 27′ N.; long. 169° 01′ W., Bering Sea, 35 fathoms, fne. s. gn. m., August 1, 1893, 2 specimens.

Unalaska, June 16, 1890, 2 specimens.

Kadiak, Alaska, August 14, 1888, 1 specimen.

Loring, Alaska, April 29, 1903, 5 specimens, small.

OTHER THAN "*Albatross*" COLLECTIONS.

Chugachik, Alaska, 20–60 fathoms, W. H. Dall, June 30, 1880, 1 specimen.

Chiniak Bay, Kodiak, Alaska, 16–25 fathoms, W. H. Dall, July 12, 1880, 1 specimen.

Unalaska, Alaska, L. M. Turner, October, 1878, 1 specimen.

Kasaan Bay, Prince of Wales Island, Alaska, T. H. Streets, 1 specimen.

Ward Cove, Revilla Gigedo Island, Alaska, T. H. Streets, 2 specimens.

St. Paul Island, Pribilof Islands, M. C. Marsh, Bureau of Fisheries, March, 1912, 1 specimen.

HALOCYNTHIA ECHINATA (Linnæus).

Ascidia echinata LINNÆUS, 1767, vol. 1, part 2, p. 1087, No. 6.
Cynthia echinata STIMPSON, 1854, p. 20.
Halocynthia echinata VERRILL, 1879, p. 148.
Halocynthia arctica HARTMEYER, 1903, p. 190, pl. 11, figs. 10, 11.
Halocynthia arctica REDIKORZEW, 1907, p. 130.
Pyura echinata HARTMEYER, 1910, p. 231, figs. 1–12.
Boltenia echinata HUNTSMAN, 1911, p. 133.
Pyura echinata VAN NAME, 1912, p. 523, text fig. 23, pl. 54, figs. 61–65; pl. 70, figs. 143, 144.

(For fuller synonymy, see Van Name, 1912.)

Thanks to Hartmeyer (1910) the delimitations of this species are now pretty well established.

The specimens at hand from Plover Bay belong, with little doubt, to this old species. Although the number of tentacles is high—about 18 or 20, while *echinata* is said to possess 12—the difference I do not believe to be specifically significant. The difficulty, rather common in this genus, of counting the tentacles; namely, of determining in some cases whether one has to do with a small tentacle proper or a basal branch of one of the large members of the circlet is encountered here. Examination of a specimen from Grand Manan off the Atlantic coast of North America, recognized as the home of *echinata,* convinces me that the tentacle number and scheme do not differ from those of the Bering Sea specimens more than they may between specimens from either locality. This is in full agreement with the recent description of the species by Hartmeyer and Van Name.

There are also three small specimens from Loring, Alaska, which I assign to this species, though with somewhat more hesitation than in the case of the Plover Bay animals. The spinulation of the Loring specimens is certainly not typical, only comparatively few of the spines presenting the regular ring of crowning secondary spines so characteristic of *echinata.* A majority of the spines resemble more closely the single axis spines of *H. villosa* and its congeners than the radical spines of *echinata.* However, the stellate variety does occur, particularly on one of the specimens; so on the whole I have not considered the difficulty here sufficiently great to invalidate the identification. Again, well-defined dorsal languets occur in the Loring animals, and this is perhaps a more serious obstacle in the way of assigning them to this species than is the departure from the type of the surface spines. But since the series of processes does not extend all the way back to the posterior end of the lamina, there is the same justification here as in the case of the Plover Bay animals for the assignment made.

Plover Bay, Siberia, 15 to 20 fathoms, W. H. Dall, 1880, 3 large specimens.

Loring, Alaska, Alaska Salmon Investigations, *Albatross,* Apr. 30, 1903.

A single specimen from Aberdore Channel east of Alger Island, Baldwin-Ziegler Polar Expedition, June, 1901.

A small specimen from *Albatross* station 3213, southwest of Sannak Islands, Alaska, 41 fathoms, is perfectly typical as to the spines. I am unable to determine the number of branchial folds, but there can be little or no doubt about the identification.

HALOCYNTHIA VILLOSA (Stimpson).

Cynthia villosa STIMPSON, 1864, p. 160.—HERDMAN, 1898, p. 258, pl. 12, figs. 7–11.
Pyura villosa HARTMEYER, 1909*a*, p. 1342.
Boltenia villosa HUNTSMAN, 1911, p. 134.

The only point in which the specimens at hand appear to differ from *H. villosa*, as redescribed by Herdman in 1898, is in the length of the peduncle. The individual figured by this author can scarcely be called pedunculate at all. In fact, Herdman speaks of the species as being "narrower at the posterior end and sometimes attached by a short stalk." Stimpson, however, states in the original description that the test at the point of attachment "is produced into a peduncle which is sometimes as long as the body is thick." In none of the specimens under observation is the peduncle shorter than the body is thick, and in most of them it is considerably longer. Judging, however, by other well-known pedunculated species, we would expect the structure to be subject to much individual variation in length, and hence would not, according to prevailing notions as to specific differences, regard the differences noted as of specific importance.

It is worth while to note that considerable variation occurs among the individuals in the number of branchial folds. One specimen had 7 folds on each side at the anterior end, and only 6 at the posterior end on the left side. A second specimen had 8 folds on the left, and 9 on the right, the ninth being small, while a third had 8 folds on each side.

The formula for the internal longitudinal vessels of a specimen from Loring, Alaska, was:

Endostyle { 2–*5*–2–*13*–2–*17*–3–*20*–2–*20*–1–*15*–1–*22*–0 L.
2–*10*–1–*14*–1–*19*–2–*21*–2–*18*–1–*12*–1–*18*–1 R.

A specimen from Puget Sound had the following:

Endostyle { 1–*7*–2–*10*–3–*15*–3–*17*–4–*16*–3–*20*–2–*15*–1–*21* L.
1–*4*–2–*10*–3–*11*–3–*15*–4–*13*–7–*19*–5–*11*–6–*11*–6–*9* R.

The Loring specimens are very uniform in external appearance and the echination is decidedly closer and longer than that of the specimens of *H. castaneiformis* with which I am familiar; Loring, Alaska, 3 to 4 fathoms, Alaska Salmon Investigations, April 30, 1903, 26 specimens.

Puget Sound, on rocks between tides, O. B. Johnson, July, 1889. The 22 specimens in the Puget Sound lot are somewhat less uniform among themselves in external form than the Loring ones. Some of them are almost without the peduncle, as was the one figured by Herdman, while in others the peduncle is quite as long as in the

Loring specimens generally. The echination of the Loring and Puget Sound specimens do not differ in any recognizable way.

Huntsman, 1911, asserts that he has collected specimens from one locality on the Canadian coast showing a range of variation so great as to include *H. villosa*, *H. castaneiformis* v. Drasche, and *Boltenia echinata* Ritter! The evidence for this we shall await with much interest.

HALOCYNTHIA CASTANEIFORMIS (v. Drasche).

Cynthia castaneiformis VON DRASCHE, 1884, p. 373, pl. 2, figs. 9, 10.—RITTER, 1900, p. 599, pl. 18, figs. 6, 7; and pl. 19, fig. 25.
Pyura castaneiformis HARTMEYER, 1909*a*, p. 1339.

The single specimen in the collection that I identify as this species is from *Albatross* 3088, off the Oregon coast, lat. 44° 28′ N.; long. 124° 25′ 30″ W., 46 fathoms, bottom clay and pebbles, September 3, 1889.

The material is not sufficient to afford any new light on the interesting question of the relationships and distribution of the echinated group of Halocynthias. (See particularly Ritter, 1907, p. 12.)

The spines of the test are sparser and smaller in the specimen than is usual even for this species.

For the benefit of whoever may undertake the task at some future time of a critical study of this group I give the most important diagnostic features of the specimen at hand.

Branchial tentacles 33, rather large and well branched.

Folds of the branchial sac, 8 on each side.

Formula of longitudinal vessels:

Endostyle $\begin{cases} 0\text{–}4\text{–}2\text{–}12\text{–}2\text{–}17\text{–}1\text{–}17\text{–}0\text{–}21\text{–}0\text{–}21\text{–}0\text{–}21\text{–}1\text{–}17\text{–}1 \text{ L.} \\ 0\text{–}4\text{–}1\text{–}11\text{–}2\text{–}16\text{–}1\text{–}17\text{–}0\text{–}23\text{–}0\text{–}23\text{–}0\text{–}13\text{–}0\text{–}16\text{–}0 \text{ R.} \end{cases}$

Stigmata transversely elongated, but a few scattered ones longitudinally elongated in the spaces between the regular series of transversely elongated ones.

Gonads, one elongated mass on each side.

HALOCYNTHIA OKAI Ritter.

Halocynthia okai RITTER, 1907, p. 11, pl. 1, figs. 9–16.
Pyura okai HARTMEYER, 1909, p. 1340.

The number of tentacles is high in the specimens at hand as compared with those of the species from the California coast, there being as many as 37 in one specimen, and in none observed has the number been less than 29. On the other hand, 16 is the number reported in the original description. Since, however, there is no other difficulty in the way of the identification, it is probably safe to assume that further study would increase the number in animals from the original locality and diminish that for animals from the more northern region.

Albatross 2877, lat. 48° 33′ N.; long. 124° 53′ W. (coast of Washington), 59 fathoms, bk. s. m., September 25, 1888, 2 specimens.

Albatross 3052, lat. 44° N.; long. 124° 57′ W. (coast of Oregon), 48 fathoms, co. brk. sh. rky., June 8, 1889, 1 specimen.

Albatross 3088, lat. 44° 28′ N.; long. 124° 25′ 30″ W. (coast of Oregon), 46 fathoms, c. p., September 3, 1889, 5 specimens.

A bottle with half a dozen specimens, no label. The unlabeled bottle is particularly unfortunate, since it contains the largest specimens of the collection, one being 8.5 cm. by 5.5 cm. Another is so much elongated fore-and-aft as to make it almost pedunculated, though the posterior part is but little narrower than the anterior.

HALOCYNTHIA JOHNSONI Ritter.

Halocynthia johnsoni RITTER, 1909, pp. 65–98, pls. 7–14, figs. 1–17 excepting 9 and 10.

There are 5 very poorly preserved specimens of this species taken in San Diego Bay by the *Albatross*, March 21, 1894.

I am now adding to the United States National Museum collection 10 specimens from San Diego Bay taken from piles during the summer (July or August) 1911.

BOLTENIA OVIFERA (Linnæus).

Vorticelli ovifera LINNÆUS, 1767, vol. 1, pt. 2, No. 14.
Ascidia clavata MÜLLER, 1776, p. 226, No. 2740.
Boltenia ovifera SAVIGNY, 1816, pp. 88, 140, pl. 1, fig. 1; pl. 5, fig. 1.
Boltenia reniformis MACLEAY, 1825, p. 536, pl. 18, figs. 1–5.
Boltenia rubra STIMPSON, 1852, vol. 4, p. 232.
Boltenia bolteni RINK, 1857, vol. 2, p. 104.
Boltenia beringi DALL, 1872, p. 157.
Boltenia elegans HERDMAN, 1882, p. 86, pl. 7, figs. 1–5.
Boltenia ovifera HARTMEYER, 1903, p. 173, pl. 4, figs. 11, 12; pl. 10, figs. 1–4.
Boltenia thomsoni HARTMEYER, 1903, p. 185, pl. 5, fig. 1; pl. 10, figs. 5–9.
Pyura ovifera HARTMEYER, 1909*a*, p. 1340.
Boltenia ovifera HUNTSMAN, 1911, p. 133.
Pyura ovifera VAN NAME, 1912, p. 527, text fig. 24; pl. 55, fig. 66; pl. 56, figs. 68–70; pl. 67, fig. 133; pl. 70, fig. 145.

(This synonymy covers only names that have been used considerably in the literature and those which have been recently proposed. For fuller lists see Hartmeyer, 1903, and Van Name, 1912.)

Hartmeyer has done a good service in bringing something of order out of the chaotic state into which knowledge of this widely distributed, rather variable, and long-known group of ascidians had fallen. But it is significant of the diversity of character and deceitfulness, as one might say, of the animals that, after having shown the untenability of many of the hitherto recognized species, he should have been led to establish still another that will have to be assigned to the list of synonyms. We shall see presently that his *B. thomsoni* can not be accepted.

But valuable as Hartmeyer's studies of these animals are, I can not but think he has taken a backward step in proposing to suppress the genus name *Boltenia* (Hartmeyer, 1909), page 336, and to transfer all the species to *Halocynthia* (*Pyura*). His low valuation of the presence or absence of the peduncle as a generic mark undoubtedly has much justification, though it would be interesting to see what would result were the argument employed by him in this connection to be rigorously applied throughout the whole of zoology and botany. Without doubt a considerable percentage of all the genera now recognized would be set aside. But assuming that the mere presence of the peduncle is not sufficient to save *Boltenia*, there remains the distinctive position of the branchial orifice in relation to the insertion of the peduncle. Hartmeyer considers this also of little importance, instancing in support of his view the fact that in some genera, as *Molgula* (*M. crystallina*), the position of the orifices relative to the peduncle is similar to that in *Boltenia* and *Halocynthia*. That is, he points out a transition of character not between *these two genera* but between *Boltenia* and some other genus. This way of treating resemblances and differences between groups of organisms certainly would play havoc with our classifications if consistently carried out. Much depends on one's views as to what characters are superficial and what are fundamental. As I observe and think about organic structure, I am unable to see that organs and parts located on the surface and so observable without dissection are necessarily superficial in a biological or logical sense; nor contrariwise is the internal position of a part the essence of fundamentality. Ought it to be assumed, for example, that the digestive tract, because internally located and hence literally a fundamental anatomical organ, is therefore more constant and hence more reliable for grouping animals than is the peduncle? Not necessarily. It is, if observation proves it to be so; not otherwise. As a matter of fact, I believe it would be quite as difficult to prove that the peduncle present here and there among ascidians is any more adaptive than is the branchial sac, the intestine, or the renal organs. Renal organs are present in some groups of ascidians, but not in others. Are they fundamental anatomical parts or not? When one compares an intestine as voluminous and elaborate as that of *Styela macrenteron* (see p. 466) with one so diminutive and simple as that of *Styela thelyphanes* Sluiter, 1904, page 68, he can hardly be impressed with the constancy of this anatomical organ.

The collection contains many specimens of many sizes, so that my conclusions rest on rather ample observations, so far as north Pacific representatives of the species are concerned.

The accompanying table (Table 9) exhibits something of the range of variation of the species.

TABLE 9.

No. of specimen.	Collector.[1]	Locality.	Depth in fathoms.	Size of body. L.	Size of body. W.	Length of peduncle.	Surface of test.	Tentacles.	Folds of sac. R.	Folds of sac. L.	Longitudinal vessels of sac.	Total vessels.	Average vessels folds.	Average vessels between folds.	Grooves in stomach wall.	Lobes, anus.	Gonad lobes. R.	Gonad lobes. L.
1	3292.....	Bering Sea....	32	9	6	15	Smooth.....	28	11	11	R. 27-3-25-3-25-4-34-3-27-4-24-3-24-3 -19-1-19-1-13-1-10-0 End.	273+	22.3	2.1	4	Three-fourths of margin finely lobed.	9-10	11
*2	2057.....	St. Georges Shoal off Cape Cod.	...	8	5	23	Fine spines on much of surface.	19	10	9	R. 31-3-26-2-34-6-34-6-31-6-27-5-27-5 18-6-13-6-7-3.	296	24.9	4.6+	4	.....do.....	7	?
											L. 4-43-4-27-3-32-6-31-8-28-6-23-5-19 5-13-5-9-3.	275						
3	2057.....	.....do	86	7	?	18	Fine spines nearly whole surfaces.	30	11	10	R. 3-26-7-23-4-26-9-33-10-21-14-12-6- 16-5-12-3-6-4-7-3-8-2	265	16.7+	5.3+	?	.....do.....	?	?
											L. 3-35-5-23-7-27-8-25-8-21-5-17-5-13 4-8-3-5-1.	256						
*4	Wm. Stimpson. U. S. Mus. No. 3206.	Chelsea Beach, Mass. Bay.	...	7	?	12	Rough.....	15	11	10	R. 28-?-21-?-27-?-33-5-28-5-23-2-28-4 19-8-12-7-7-6-5-2.	270	21.6—	4.9	?	Broad, low, irregular.	?	6
											L. 27-5-24-10-24-5-31-7-26-8-25-10-20 7-16-5-15-2-14.	291						
5	3298.....	Bering Sea....	20	6.5	3.5	20	Smooth.....	24	9	9	(20-?-19-?-23-?-16-?-21-?-18-?-18-?-15-?-8-?	158	17.6—	?	4	Three-fourths of margin lobed.	7	6
6	3524.....	.....do	36	6	3.3	....	.....do.....	17	10	10	R. 28-0-18-0-27-0-31-0-26-3-22-4-18-2 16-2-13-2-6-1.	213	19 7	1.4+	.....	.....	.....	.....
											L. 31-0-19-0-28-0-27-4-22-3-22-0-16-4 11-3-9-3-5-0.	207						
7	3238.....	.....do	18	6	3	12	Tubercles, spines?	18	9	9	(23-2-16-?-22-?-29-?-26-?-22-?-19-1-14 2-9-2.	187	20.0	.7	4	Three-fourths of margin finely lobed.	7	6
8	U. S. F. C. 1872, Cat. No. 2674.	Eastport.....	....	6	3	?	Covered with fine spines.	13	9	9	R. 24-0-23-3-24-3-31-4-26-3-27-4-23-3 14-4-11-5.	248	20.1—	3.2	3 or 4	.....do.....	7	?
											L. 23-3-15-5-23-5-21-6-18-4-20-3-15-3 13-3-5-2.	193						
9	L. Stejneger.	Kamchatka...	36	6	3	14	Smooth.....	18	10	10	L. 24-0-24-0-30-2-34-0-33-0-34-?-?-?-10-1-9-1.	202+	24.8	.5	4	.....do.....	7	6
10	3266.....	Bering Sea....	....	5.5	3	10.5	Tubercles and few spines.	18	9	9	R. ?24-0-19-1-33-3-22-3-20-3-16-1-15-1-11-1-7-3.	173	17.4+	1.6	3	Two-thirds of margin lobed.	Lobes smaller.	
											L. ?							
11	3553.....	.....do.....	57	5.5	2.25	19	.....do.....	18	9	9	25-2-20-1-22-2-27-2-24-2-24-0-20-2-13 3-10-4.	203	20.6	1.8	4	.....do.....	7	6
12	3276.....	.....do.....	18	5.25	3	20.5	Smalltubercles, no spines.?	19	9	9	(30-0-21-1-21-4-29-3-24-4-15-2-15-1-11 2-9-4.	174	19.3	2.2	4	.....do.....	7	6
13	3553?.....	.....do.....	51	5.5	2.25	....	Tubercles and spines.	18	9	9	(25-2-20-1-22-2-27-2-24-3-24-0-20-2-13 3-10-4.	203	20.3	1.8	.....	.....	.....	.....

14	3556	do	20	4.3	2.5	....	Spines very short.	18	9	9	R. *28-1-17-1-24-2-23-4-18-2-12-3-9-2-?-?* L. *21-2-17-?-19-2-22-4-17-3-17-4-14-3 12-3-3-1.*	155+ 169	16.8+	1.9+					
15	3303	do	33	3.5	2	7	Tubercles and spines.	19	10	10	*11-0-13-2-14-2-15-2-12-2-16-0-14-0-10 0-10-3-?-0.*	125+	12.8	1.0		2+	Two-thirds of margin lobed.	7	Small.
16	3278	do	68	3.5	2	8.5	Fine tubercles, no spines.?	15	10	10	*17-0-14-1-15-3-20-3-18-1-19-0-16-0-18-0-8-2-3.*	152	14.2	.9		4	do	7	6
[4]17		Eastport, Me.		3.5	1.5	23	Few spines.	15	9	9	*23-3-16-3-22-3-26-2-21-3-14-4-15-3-15-3-11-2.*	189	18.1	2.6		4	do	7	6
18	3495	East Bering Sea.	27	3	1.8	12	Tubercles and spines.	22	10	10	R. *16-?-14-?-20-?-22-?-18-?-20-?-17-?-17-?-13-?-3.* L. *25-?-16-?-21-?-20-?-22-?-17-?-15-?11-?-9-?-4.*	165 150	16.25	.0		4	do	10	10
19	3561	Bering Sea	66	1.5	3	....	Spiny	22	9	9	R. *16-0-13-0-17-0-23-0-22-0-19-0-15-0 12-0-10.* L. *23-0-17-0-18-0-23-0-21-2-16-1-12-1 8-1-5-1.*	148 150	16.1+	.4					
20	3510	do	27	1.2	.9	....	do	20	9	9	R. *9-0-8-1-10-1-12-1-13-0-11-0-10-0-5 0-1-0.* L. *13-1-10-1-13-2-13-2-13-0-9-0-6-2-3-0.*	82 90	8.9+	.55					
[2]21	U. S. F. C. Cat. No. 3156.	Eastport, Me.		2	.9	4	do	13	?	?	R. *13-1-7-1-13-?-17-3-13* L. *17-1-7-?-15*	89	13 —	1.4		?	?	?	?
22	3274	Bering Sea	19	1.0	1.2	4	do	17	9	10	R. *14-1-8-0-14-1-19-0-16-0-13-0-12-0-9-0-5-0.* L. *22-0-13-0-16-0-16-0-?-?-?-?-5-2-6 1-6-1-5-1.*	112 104+	11.7	.4—		4	Three-fourths of margin lobed.	7	5
[2]23	U. S. F. C. Cat. No. 3156.	Eastport, Me.		1.0	.7	1	Spines long over whole surface.	19	9	?	R. *1-10-2-5-1-10-2-12-2-14-1-10-2-6-1 5-1-3-1.*	89	8.3	1.4		4	?	?	?
24		Bay of Fundy.		.9	.5	2.5	Spines fine and short over surface.	15	7	7	R. *9-1-5-1-9-1-12-0-11-0-?-0-9* L. *15-1-7-1-12-1-11-1-10-1-8-1-?*	58+ 69+	9.8—	.7	Present..		Two-thirds of margin lobed.	?	?
25	3281	Bering Sea	36	.6	.4	....		14	7	7	R. *7-0-3-0-6-1-10-1-7-0-11-1-4-1* L. *10-0-4-0-9-0-10-0-6-0-5-1-3-1*	52 49	6.8—	.4—					
26	3553	do	57	.9	.7	....	Spiny	18	7	7	R. *11-0-8-0-12-0-14-0-13-0-12-1-8-4* L. *13-0-6-0-10-1-15-1-11-1-9-1-7-2*	83 77	10.6—	.7—	4		?	?	?

[1] Except where otherwise specified the numbers in this column are *Albatross* stations.
[2] Name previously applied, *B. bolteni*.
[3] Name previously applied, *B. rubra*. Cotype.
[4] Name previously applied, *B. clavata*.

Several points of considerable interest are brought out by the table. The one of perhaps most importance is that the surface of the test of young individuals is beset with spines. This is the character relied upon chiefly by Hartmeyer for the specific distinctness of *B. thomsoni*. An examination of a large number of small specimens forming a closely graded series of sizes leaves no room for question that the spininess is a juvenile mark—at least if small size can be relied upon as indicating youth.

The table also makes it obvious that the tentacles, the branchial folds and the internal longitudinal vessels increase in number with increase in size of the animal for a considerable period. The variation in tentacle number from 28 in the largest individual to 14 in the smallest is quite decisive on the point in spite of the fact that there are some notable departures from exact correspondence between body size and tentacle number.

The increase in number of vessels with size is even more positive though the correlation is not very close.

Another point clearly established by our dissections is that the extent of in-turning of the horns of the hypophysis mouth increases with the size of the animal.

It appears from the work done by the *Albatross* that *Boltenia ovifera* is abundant in the eastern and central parts of Bering Sea. According to Townsend (1900) the vessel has dredged at 225 stations in Bering Sea. At 29, or nearly 13 per cent, of these she took *Boltenia*. However, in some localities, particularly in Bristol Bay and about the Pribilof Islands, a majority of the hauls brought specimens. None at all were taken in the western or northern portion of the sea, but one specimen was collected in the south side of Ikaten Bay, Alaska, July 21, 1894. The collection contains one bottle of specimens from Kamschatka taken by Dr. Leonard Stejneger in 1882–83. There is also a bottle from Nunivak, Alaska, by Dr. W. H. Dall; one specimen from the coal station near Cape Lisburne, by Henry D. Woolfe, Sept., 1885, found on the beach after a northwest gale of four days; one specimen from Cape Smyth, John Murdoch, Point Barrow Expedition, Aug. 15, 1881; and one taken by the United States revenue steamer *Corwin* in 1885, exact locality not given.

The species appears to be rather narrowly limited in depth range in these waters, the shallowest record being 13.5 fathoms and the deepest 56 fathoms.

A sandy bottom seems to be distinctly preferred.

In view of the large number of specimens and the fact that they are nearly all not only from Bering Sea, but from a limited portion of it, I have departed from the usual course of giving locality data and have given merely a list of the *Albatross* stations with the depth of water.

The following is a list of *Albatross* stations in Bering Sea at which *Boltenia ovifera* was obtained: Station 3303, 33 fathoms; 3300, 15 fathoms; 3495, 56 fathoms; 3496, 41 fathoms; 3556, 49 fathoms; 3553, 51 fathoms; 3561, 48 fathoms; 3536, 40 fathoms; 3524, 36 fathoms; 3511, 39 fathoms; 3510, 27 fathoms; 3505, 44 fathoms; 3504, 34 fathoms; 3298, 20 fathoms; 3297, 26 fathoms; 3296, 24 fathoms; 3294, 30 fathoms; 3293, 30 fathoms; 3292, 32 fathoms; 3291, 26 fathoms; 3282, 53 fathoms; 3281, 36 fathoms; 3286, 37 fathoms; 3278, 47 fathoms; 3276, 18 fathoms; 3274, 19 fathoms; 3266, 24 fathoms; 3249, 13.5 fathoms; 3238, 18 fathoms.

HARTMEYERIA, new genius.

Plate 33, figs. 8–13.

Agreeing generally with *Microcosmus*, but:

1. Body with a slender, rather long peduncle.
2. Atrial tentacles, and a periatrial band quite similar to the peripharyngeal band present.

Type-species.—*Hartmeyeria triangularis*, new species.

HARTMEYERIA TRIANGULARIS, new species.

Superficial characteristics.—Body inclined to a triangular form, the two orifices marking the basal angles, and the peduncle the third angle; somewhat compressed laterally; the whole surface, excepting the siphons, covered with a layer of black, closely adhering sand grains. Test on the rather prominent siphons usually presenting a series of regular, parallel, closely set ridges or folds, these with the light color of the test in this region as opposed to the covering of black sand, setting the siphons off conspicuously from the rest of the body. Greatest diameter of largest specimen, 14 mm. Length of longest peduncle seen, 35 mm. Thickness of peduncle uniform and scarcely more than 1 mm. in the thickest part, possessing a well-defined coating of test to which the sand adheres as it does on the body. Surface of test beset with fine short processes to which the sand grains are attached; test itself thin and leathery. Mantle thin, musculature sparse, but very regularly spaced (pl. 33, fig. 9), circular bands more numerous than the radial, extending over the whole body—not limited to the siphonal regions. Circular bands external to the radial bands except on a portion of each siphon where they are internal to the radials.

Respiratory system.—Siphons rather prominent and distant from each other, distinctly 4-lobed. Tentacles, branchial, 20 to 35, of different sizes, branched knobs, quite irregular in arrangement. Hypophysis mouth horseshoe-shaped, the horns nearly touching each other, making the whole almost a circle. Peripharyngeal band unusually broad; an epithelial fold, *p. g'.* (pl. 33, fig. 11) or velum within the peripharyngeal field some distance from the inner lip of the peri-

branchial band, *p. g.*, and further toward the branchial orifice still another ridge, or fold, less prominent than the last, *e. f.* In all, consequently, four epithelial ridges encircling the branchial orifice, two (those of the peribranchial band proper) external to the tentacle circlet; and two within the circlet, *e. f.* and *e. f'.* Dorsal lamina a plain narrow ridge, with intimations of ribbing in some specimens. Branchial membrane, 6 folds (counting rudiments) on each side. The typical number of longitudinal vessels on the folds as follows:

Endostyle { 1–*6*–0–*7*–0–*9*–1–*11* L.
0–*4*–0–*6*–0–*9*–0–*9*–1–*11* R

From this it appears that the second and sixth folds on the left, and the second on the right are marked by a single longitudinal vessel. There are no vessels between the folds. This scheme, with slight variations, holds for the four specimens examined. Stigmata nearly straight, but irregular in length, from 14 to 20 in the mesh; about six prominent transverse folds or ridges on the outer surface of the sac; a series of large transverse vessels on the inner surface of the sac separating generally the series of stigmata, and a large number of fine vessels extending across the stigmata (fig. 13). Ganglion long and narrow, its anterior end adjacent to the hypophysis. Atrial tentacles very long in proportion to thickness, about 16 in number forming a circlet around the atrial orifice; within the circlet and close to the bases of the tentacles a ciliated epithelial fold which may be called a periatrial fold, *p. a. f.* (fig. 12).

In close association with the atrial tentacles numerous tubercles produced by parasites (suctoria), embedded in the epithelial lining of the region (fig. 12).

Alimentary system.—On the left side of body, loop simple but narrow; stomach not distinctly differentiated from intestine, two folds in stomach wall; "liver" well developed, consisting of a great number of more or less independent alveoli (fig. 10). Renal organ present (?) on right side near base of branchial sac.

Reproductive system.—On both sides of body, that of the left crossing the dorsal limb of the intestinal loop, more or less cylindrical, surrounded by the more voluminous many-lobed testes (fig. 10, *gon.*). A few structures, resembling the so-called endocarps of *Styela* and its allies present.

This unique species possesses a combination of characters that suggests relationships in various directions. The long, slender peduncle reminds one of the genus *Rhizomolgula,* and also of some of the Boltenias, and of *Culeolus.* With this feature, however, resemblance to these genera ends. On the whole the animal would seem to approach *Microcosmus* more closely than any known genus. Sluiter (1900, p. 31) has described a member of this genus, *M. minia-*

ceus, as having a short peduncle. However, the structure in this case is thick, and is accompanied by other root-like processes. Sluiter does not go into details as to the structure of these parts, but his description and figure would seem to indicate that they are quite different from the peduncle of *H. triangularis*.

Atrial tentacles are now known to occur in several quite widely separated groups of ascidians, so that this feature alone would probably not justify a new genus for the species. However, when taken in connection with the peduncle and the unusual supply of epithelial bands around the orifices, it would seem that to assign the species to any known genus would be forcing matters somewhat more than giving it a genus by itself.

An additional structural point in connection with the atrial tentacles may be mentioned. As is shown in figure 12, the attachment of each tentacle is some distance from the periatrial band. However, a minute strand, seemingly epithelial, extends from the root of the tentacle to the band. These strands would seem to be rudimentary and adherent portions of the tentacles.

I have mentioned the epithelial knobs on the inner surface of the periatrial field in the diagnosis on account of the possibility that they may be normal growths into which the parasites enter instead of products of the parasitic action.

Type-locality.—About two dozen specimens taken by Dr. W. H. Dall in 9 to 12 fathoms at Kyska Harbor, Aleutian Islands, Alaska.

Type.—Cat. No. 5679, U.S.N.M.

CULEOLUS SLUITERI, new species.

Plate 34, figs. 14–17.

Superficial characteristics.—Body irregularly conical, the base of the cone (posterior end of animal) not flat but sharply arched; only slightly, if at all, compressed, peduncle attached to apex of cone, the transition from body to peduncle being much the same all around (pl. 34, fig. 14). Branchial orifice at the summit of a broad, low mound situated about one-third of the distance between the insertion of the peduncle proper and the atrial orifice. The opening large, irregularly triangular, the base of the triangle directed forward and constituting an arched lip, smooth, except for a number of fine creases; border of the posterior apical part of the opening irregularly puckered and lobed. Atrial orifice a large transverse slit broadly notched in the middle of the anterior lip, situated far back on the dorsal side of the body. Entire surface covered with low, broad mounds, each of which bears at its summit a wartlike brownish knob, the knobs extending, gradually reduced in size, on to the apex of the body to the point at which the body is lost and the peduncle begins; also a few scattered small warts on the peduncle. Color a dull white, uniform except for

the scattered brownish warts above mentioned. Minute green-black sand grains evenly sprinkled over the entire surface. Greatest length of body, 6.5 cm.; diameter, 4 cm.; peduncle, 11 cm. long, about 3 mm. thick in the thinnest part, expanded to about 4 mm. at the end remote from the body. No holdfast present, indicating that a portion has been broken off. Test halfway between leathery and gelatinous in consistency, hardly more than 1 mm. thick, except in the mounds on the surface mentioned above; almost chalk white on the inner surface, the brown warts showing through in color, and each marked by a slight prominence. Mantle thin, semitransparent, somewhat resembling thin, crumpled parchment paper; muscles sparse, the encircling fibers disposed in very definite bands, these separated by wide regular intervals, and of nearly equal abundance throughout; longitudinal fibers present but disposed in less well-defined bundles; a few bundles of the type of the encircling bundles running diagonally. Little or no concentration of muscle fibers about the orifices.

Respiratory system.—At least 33 tentacles varying in size from almost minute with few small branches to large with many branches bearing numerous secondary branches (fig. 15). Branchial membrane with five prominent folds on each side, the scheme of longitudinal vessels as follows:

$$\text{Endostyle}\begin{cases}1\text{–}8\text{–}1\text{–}8\text{–}1\text{–}14\text{–}1\text{–}9\text{–}2\text{–}13\text{–}1\\1\text{–}5\text{–}2\text{–}11\text{–}1\text{–}15\text{–}1\text{–}5\text{–}1\text{–}10\text{–}1\end{cases}$$

As usual in *Culeolus* no true stigmata present, the membrane consisting entirely of the wide-meshed network of longitudinal and transverse vessels; transverse vessels of two or three sizes alternating more or less regularly, some of them, particularly the smaller ones, frequently interrupted. A dorsal languet for each transverse vessel. No spicules in any of the tissues of the branchial apparatus.

Alimentary system.—(In too advanced a state of disintegration for full characterization.) On left side, forming a wide evenly curved U; stomach apparently but little greater in diameter than intestine; bearing a number of lobes (liver?); rim of anus lobulated all around.

Reproductive system.—On both sides, those of the left within the intestinal loop (fig. 17), both ovary and testes clinging to the mantle. Ovaries elongated, sausage-shaped, one on each side of body (figs. 16, 17), surrounded by the testis masses, but easily separating from these and from the mantle; testes, a single series of eight large and several small widely separated masses on the left, and three series on the right, one with eight masses, one with seven masses, and one with six. The irregularly lobulated masses of each side all connected with a sperm duct closely adherent to the mantle.

The relation of the parts of the genital system to one another in this species is obscure. The statements about the male and female

gonads given in the diagnosis will almost certainly have to be modified when fuller knowledge is obtained. The masses called testes in the text and figures contain ova as well as sperm, and since these are both small and large they are obviously produced here. In other words the gonads are hermaphroditic in the sense in which this condition prevails with many ascidians. So far no unusual difficulty appears. The puzzle is as to the nature of the cylindrical body called ovary in the description. This contains ova in most of its length, these being in part large, apparently ripe, and in part small and immature. They cling to the inner wall of the canal forming a definite layer thereon, but show no true ovarian arrangement. The exact relation of these to the gonad lobes can not be made out owing to rupture and disarrangement of the parts. From what can be observed the cylinders would seem to be receptacles which receive the ova from the ovaries while still immature, and in which they ripen.

In external appearance this species considerably resembles *C. wyville-thomsoni* Herdman, though the body of *sluiteri* is somewhat longer proportionately and is more regular, the prominences on the test being here somewhat smaller and uniformly distributed. Perhaps the most distinctive feature about *sluiteri* is the small number, 5, of branchial folds, 6 being the prevailing number in the genus, though one species, *C. gigas* Sluiter has 7 folds. But it should be stated that intimations of folds occur at several places between the large, well-defined folds in *C. sluiteri*. Another feature, the absence of spicules from the tissues of the internal organs, would be, should it prove on further study to be true for all individuals and in all conditions of life, the most considerable differential mark of the species, and might even be considered sufficiently important to entitle *sluiteri* to be taken as the type of a distinct genus. Until, however, more specimens have been examined, and until we know more than we now do about the physiological significance of mineral deposits in the tissues of ascidians, I do not believe it is wise to place great emphasis on their value in classification. It is possible, too, that the much elongated ovaries and the sharp separateness of these from the testes may some time serve as characters of generic rank.

I am glad to name this well-marked, interesting species after Doctor Sluiter who has added so materially to our knowledge of the genus.

Type-locality.—A single specimen. *Albatross* station 3480, lat. 52° 06′ N.; long. 171° 45′ (just south of Aleutian Islands), 283 fathoms, bottom bk. s. co. rky., July 8, 1893.

Type.—Cat. No. 5688, U.S.N.M.

STYELA MACRENTERON, new species.

Plate 34, Figs. 18–20.

Superficial characters.—Large, specimens from 50 to 90 mm. in length not uncommon, in general cylindric in form, the length from two to three times the diameter. Usually attached by the whole posterior end and rising column-like. Smaller specimens more nearly spherical, often in clusters, though less closely crowded than some of the related species. Orifices at the anterior end usually separated by a wart-like or spine-like tubercle, the four distinct lobes rather small; *siphons* not high in the preserved specimens, but frequently rather tumid and conspicuous indicating that in life they may be of good length; branchial frequently bent over so that its orifice is directed ventralwards. Test thin and parchment-like, rather easily torn smooth on the inner surface, but the outer surface presenting a great number of nearly parallel circular ridges, sharply defined, and giving the animal a very characteristic appearance; these ridges more positively developed in older specimens. In addition to the ridges the surface of the test bearing short, thick, somewhat fleshy processes, in some specimens and in some areas of the surface these being so close together as to give the appearance of the plush of velvet. Occasional areas entirely devoid of either ridges or processes the test then being left smooth and glistening. Barnacles, hydroids, other ascidians, etc., frequently clinging to the surface. Color light gray, frequently obscured, especially in the grooves between the ridges, by dirt and other foreign substances. Mantle strong from the heavy uniform layer of external longitudinal muscle fibers and the somewhat less strong internal circular layer.

Respiratory system.—Branchial tentacles varying from 40 to 65, in a single circle, rather stout and crowded, of different lengths. Dorsal tubercle prominent, the hypophysis mouth horseshoe-shaped, the ends approaching each other closely and rolled in. Dorsal lamina entire. Branchial membrane with four folds on each side, these not high in proportion to the size of the sac as a whole; longitudinal vessels on the folds crowded, from 10 or 11 to 22, occasionally more (compare table), from 6 to 12 vessels between the folds; these not crowded. From 4 to 9 stigmata to the mesh.

Alimentary system.—On the left side, stomach very long and relatively narrow, bent almost at a right angle near its esophageal end, its posterior two-thirds or three-fourths standing nearly erect and reaching from the very base of the body to above its middle, it being thus more than half the length of the animal. The stomach wall with from 25 to 50 prominent internal longitudinal folds, these being visible on the external view of the organ. Intestine remark-

able for its great length and its convolutions (figs. 19, 20), these latter being at least two in number, the coils again often increased in length by their tortuous course. The intestinal coil packed between the concavity of the upright stomach and the dorsal edge of the body. A distinct, smaller, lighter colored rectal piece of intestine present with a portion of its wall furrowed lengthwise by numerous regular plications; the anus bordered by from 12 to 15 or more prominent rounded lobes.

Reproductive system.—One long sausage-like ovary on each side, with many testis lobes clustered around these, the ovarian cylinders extending diagonally lengthwise of the animal, sometimes bent, in a few individuals to a distinct V-shape. *Endocarps* present, but not abundant nor large.

TABLE 10.

No. of specimen.	*Albatross* stations.	Locality.	Depth in fathoms.	Size in mm.	Horn.	Tentacles.	Folds on sac.	Longitudinal vessels in sac.	Total vessels.	Average vessels on folds.	Average vessels between folds.	Stigmata in mesh.	Stomach folds.	Anal lobes.	Loops of intestine.
1	Summer, 1890.	Bering Sea	?	85 by 35.	Present	50	4	L. 4-*14*-5-*16*-5-*22*-5-*26*-7 R. 3-*16*-7-*14*-?-*15*-7-*22*-5 D. L.	104 89	19.5 16.75	5.25 5.5	6	25	15	2
2	?	Alaska	?	78 by 30.	Absent	54	4	L. 4- *8*-9-*12*- *8*-17- 8-*22*-8 R. 4-*10*-9-*14*-10-*11*-13-*21*-10 D. L.	94 102	15 14	7.4 8.25	6-9	35	15	2
3	3254	Bering Sea	46	90 by 30.	Obscure	49	4	L. 3-*12*-8-*17*-9-*16*-12-*22*-6 R. 4-*12*-9-*17*-9-*14*- 9-*22*-7 D. L.	105 103	16.75 16.25	7.4 7.6	6-10	About 43	15	2
4	3279	do	41	60 by 33.	do	44	4	L. 4-*11*-7-*14*-7-*13*-9-*18*-6 R. 4-*12*-8-*13*-8-*12*-7-*14*-9 D. L.	89 91	14 12.75	6.6 7.2	6-9	43	17	2
5	3523	do	39	60 by 35.	Present	60	4	L. 4-*12*- 9-*17*-7-*15*-10-*24*-3 R. 5-*11*-*11*-*13*-9-*15*- 9-*26*-4 D. L.	91 103	17 16.5	6.6 7.6	6-8	40	15	2
6	3305	do	44	55 by 30.	do	65	4	L. 3-*12*-6-*13*-9-*11*-8-*21*-3 R. 4-*13*-9-*11*-5-*15*-9-*16*-6 D. L.	86 88	16.25 13.75	5.8 6.6	7	50	?	2
7	3253	do	36	55 by 25.	do	54	4	L. 4-*11*-8-*13*-6-*11*-8-*18*-4. R. 6-*12*-11-*13*-9-*13*-8-*20*-4 D. L.	83 96	13.25 14.5	6 7.6	?	?	?	2
8	3512	do	38	50 by 25.	do	?	4	5-*16*-7-*19*-8-*18*-7-*21*-? D. L.	101	18.5	6.75	4-6	?	12	2
9	3292	do	32	55 by ?.	Obscure	52	4	L. 4-*10*-8-*16*-10-*13*-12-*18*-8 R. 5-*13*-9-*15*-10-*11*-12-*16*-7 D. L.	99 96	16.25 13.5	8.5 8.6	5-7	40	17	2 small
10	3282	do	53	45 by 35.	Absent	65	4	L. 4-*10*-8-*14*- 9-*15*-11-*24*-6 R. 3-*12*-9-*12*-10-*12*-10-*21*-8 D. L.	101 97	15.75 14.25	7.6 8	6-7	36	17	2
11	3506	do	36	40 by 30.	Obscure	46	4	L. 4- 9-7-*13*-9-*19*- 7-*19*-5 R. 4-*11*-9-*15*-7-*14*-11-*16*-8 D. L.	92 95	15 14	6.5 7.8	?	39	?	2
12	3642	do	16	35 by 25.	do	40	4	L. 3-*8*-4-*14*-5-*8*-5-*20*-3 R. 3-7-5-*10*-5-9-6-*13*-7 D. L.	70 65	12.5 9.75	4 5.25	6-9	42	Lobed.	2
13	3513	do	35	30 by 23.	Present	54	4	L. 5-9-7-*14*-6-*14*-7-*22*-5 R. 3-*6*-6-*13*-6- 9-7-*17*-8 D. L.	91 75	14.75 11.25	6 6	4-7	40	15-20	2
14	3303	do	33	30 by 20.	do	40	4	L. 2-*12*-2-*10*-3-7-?-*16*-4 R. 3-*10*-3- *8*-4-9-4-*13*-5 D. L.	56 59	11.25 10	3.75 3.8	5-6	40	17	2
15[1]	3317	do	165	27 by 17.	Prominent	26	4	L. R.		18-19	7	?	34	Very large.	1?
16	3553	do	51	20 by 17.	do	54	4	L. 3- 9-6-*10*-5- 9-4-*23*-5 R. 4-*11*-7-*14*-7-*12*-9-*14*-6 D. L.	74 84	12.75 12.75	4.6 6.6	6	?	15	2
17	3303	do	33	18 by 16.	?	?	4	2-*15*-2-*12*-2-*16*-3	52	14.3	2.25	6-8	40	?	2

[1] Identification doubtful.

In the length and voluminousness of the digestive canal this species is entirely unique among ascidians, so far as I know. In a specimen 80 mm. long the intestine, including the stomach, was 187 mm. long, or one and a third times the length of the animal. The intestine, exclusive of the stomach, was 142 mm. long in this individual. The gut of a dissected animal resembles that of a mouse quite as much as it does that of an ordinary ascidian.

So far as I have been able to determine the canal of *Styela nordenskjöldi* Michaelsen, 1900, from the region of Cape Horn, approaches that of this species more closely than any other. However, there is no such elaborate coiling of the organ in the South American species as in *S. macrenteron*, and there is little in common between the two species in other respects.

Many of the individuals possess a stout, hard, sometimes quite regularly pyramidal spike or horn between the siphons (fig. 18). In this the species strongly resembles a *Styela* that has been known as *S. monoceros* because of this structure. There is, however, no possibility of identifying the animals before us with the *S. monoceros* of the north European seas. Herdman (1893), who considers *monoceros* to be a good species, has described and figured the animal, and the simplicity of the intestine as shown by him would of itself be nearly conclusive as to the specific distinctness of the two creatures. But as a matter of fact they differ to some extent in almost every respect, *macrenteron* being somewhat larger in size and more cylindric in form; having a larger number of tentacles, more internal vessels on the branchial sac, both on the folds and between them; more stigmata between the vessels, and, seemingly, a larger number of folds in the stomach wall. Hartmeyer, 1899 and 1903, has returned to the older view that *monoceros* is only a form of *S. rustica*, there occurring, according to him, horned individuals of *rustica* which are indistinguishable, specifically, in any other way from hornless animals.

Not having had an opportunity to study the subject first hand in any critical way, I would not presume to pass upon the question of the specific distinctness of *monoceros*. At the same time it is worth while to point out that the presence of a horn very similar indeed to that present in *monoceros*, in most, though not in all, individuals of another very distinct species, shows the somewhat sporadic character of the structure, and so indicates its unreliability as a species mark. And it should be noted further that in most individuals of *S. macrenteron* there is a marked tendency to a tuberculation of the test around and between the siphons, even when the horn proper is doubtfully present, thus suggesting that the horn should be looked upon as one of the test tubercles specially well developed in most but not in all individuals.

The following are the partial locality data of the collection:

Albatross 3279, 4 specimens, lat. 56° 25′ 40″ N.; long. 162° 39′ 15″ W., 41 fathoms, fne. gy. s., June 28, 1890.

Albatross 3512, 12 specimens, lat. 57° 49′ 30″ N.; long. 169° 27′ W., 38 fathoms, fne. s. gn. m., August 1, 1893.

Albatross 3553, 1 specimen, lat. 56° 28′ N.; long. 169° 46′ W., 51 fathoms, fne. gy. s. m., September 2, 1893.

Albatross 3506, 1 specimen, lat. 57° 33′ N.; long. 165° 55′ W., 36 fathoms, gy. s. m., July 29, 1893.

Albatross 3523, 16 specimens, lat. 57° 39′ N.; long. 170° 02′ W., 39 fathoms gn. m. fne. s., August 4, 1893.

Albatross 3303, 3 specimens, lat. 57° 27′ N.; long. 160° 23′ 30″ W., 33 fathoms, bk. s., July 21, 1890.

Albatross 3305, 1 specimen, lat. 57° 51′ 30″ N.; long. 161° 40′ W., 23 fathoms, fne. gy. s., July 22, 1890.

Albatross 3282, 1 specimen, lat. 56° 30′ 45″ N.; long. 161° 50′ 15″ W., 53 fathoms, fne. s. gn. m., June 29, 1890.

Albatross 3642, 1 specimen, lat. 52° 57′ 45″ N.; long. 158° 36′ 30″ E., 16 fathoms, bk. m., August 19, 1896. (This station is in Avatcha Bay, Kamchatka.)

Albatross 3253, 2 specimens, lat. 57° 05′ 50″ N.; long. 164° 27′ 15″ W., 36 fathoms, m. s., June 14, 1890.

Albatross 3254, 8 specimens, lat. 56° 50′ N.; long. 164° 27′ 50″ W., 46 fathoms, gn. m. s., June 14, 1890.

Albatross 3505, 12 specimens, lat. 57° 09′ N.; long. 168° 17′ W., 44 fathoms, fne. gy. s., July 28, 1893 (type locality).

Albatross 3511, 10 specimens, lat. 57° 32′ N.; long. 169° 38′ W., 39 fathoms, fne. s. dk. m., August 1, 1893.

Albatross 3536, 4 specimens, lat. 57° 05′ N.; long. 170° 35′ W., 40 fathoms, gn. m. fne. s., August 8, 1893.

Albatross 3513, 9 specimens, lat. 58° 27′ N.; long. 169° 01′ W., 35 fathoms, fne. s. gn. m., August 1, 1893.

Albatross 3522, 16 specimens, lat. 57° 58′ N.; long. 170° 09′ W., 41 fathoms, crs. gy. s. g., August 4, 1893.

Albatross 3638, 1 specimen, lat. 57° 07′ 30″ N.; long. 170° 28′ 15″ W., 33 fathoms, g., July 18, 1896.

Albatross 3292, 1 specimen, lat. 57° 14′ N.; long. 159° 35′ W., 32 fathoms, bk. s. g., July 18, 1890.

Albatross 3317, 1 specimen, lat. 53° 57′ 40″ N.; long. 166° 59′ W., 165 fathoms, crs. s. g. r., August 16, 1890.

Albatross, "Summer 1890," dozen specimens (probably Bering Sea). 1 specimen, lat. 62° 15′ N.; long. 167° 48′ W., 20.5 fathoms, Lieut. George M. Stoney, U. S. Navy, June, 1884.

U. S. S. *Corwin*, "Explorations in Alaska, 1884," 6 specimens (from U. S. Museum records these explorations are known to have been "in the vicinity of Bering Strait").

"No label," 12 specimens.

All these stations so far as known, and probably all, are in Bering Sea.

In giving the number of individuals I have ignored a great many little ones sitting on the large ones.

Type.—Cat No. 5686, U.S.N.M.

STYELA HEMICÆSPITOSA, new species.

Plate 34, figs. 21–23.

Superficial characters.—Posterior half or less of body covered by a dense mat composed of short, filiform, more or less intertwined processes growing on the test, this carrying embedded among and clinging to the processes a quantity of fine greenish earth. Anterior half or more wholly devoid of the processes, the test here varying from nearly smooth in the flat form to pronouncedly tuberculate, particularly around the orifices in the pyramidal form; the tubercles generally somewhat soft and blister-like, often low and flat and separated from one another by considerable intervals. Form varying from flat-elliptical to high conical or cylindrical. Large specimens of the flat form 20 mm. in greatest transverse diameter and 12 mm. in height; large specimens of pyramidal form 12 mm. in greatest transverse diameter, and 15 mm. in height (figs. 21, 22). Siphons absent or very short, near together; orifices inconspicuously four-lobed. Test thin, rather stiff, opaque white where free from discoloration by the mud in which the animals lived. Mantle thin and delicate, the constituent muscle bundles being very fine and close together; musculature of nearly equal development over the whole body.

Respiratory system.—Branchial tentacles varying in number from 25 to 40, several sizes, the largest long and strong, laterally compressed, the smallest hardly more than short flattened stubs. Atrial tentacles present in great numbers, more than 100, very fine filiform, all of nearly equal length. Dorsal tubercle spherical, projecting prominently; hypophysis mouth broad U-shape, ends little or not at all curved, directed forward. Branchial sac with four folds on each side, all low, with wide intervals between them. (For the scheme of longitudinal vessels of sac see Table 11.) Transverse vessels of two sizes, regularly alternating, the smaller ones usually crossing the stigmata. Stigmata long and open with parallel borders, from 4 to 6 between two longitudinal vessels in the spaces between the branchial folds. Branchial network generally regular in its elements, as described. Dorsal lamina neither toothed on the edge nor ribbed on the side. Endostyle not prominent, tortuous at the anterior end.

TABLE 11.

No. of specimen.	*Albatross* Station.	Locality.	Depth in fathoms.	Size in mm.	Test.	Tentacles.	Folds on sac.	Longitudinal vessels in sac.	Total vessels.	Average vessels on folds.	Average vessels between folds.	Stigmata in mesh.	Ovaries on each side.	Stomach folds.	Anal lobes.
1	3227	Bering Sea	225	High form, 20 by 18.	Upper nearly smooth, lower rough.	35	4	L. 4–5–6–11–5–10–6–14–2. R. 4–10–9–17–2–19–3–15–9 D. L.	63 90	10 15+	4.6 5.4	4	1	22	Lobe.
2	2971	Off Southern California.	29	High form, 20 by 10.		36	4	?–14–6–12–7–6–2–15–5 D. L.	62	14+	5	4–6	(?)		
3	2838	Off Lower California.	44	do	Thin in middle, warty near siphons.	22+	4	L. 1–11–2–10–2–11–4–16–1 R. 1–12–1–15–2–12–2–17–2 D. L.	58 64	12 14	2.6 2	7	2	27	
4	2338?	do	44	High form, 20 by 13.	Anterior smooth, posterior furry.	30	4		....	120	4	5–8	1	30	
5	2972	Off Southern California.	61	Low form		37	4	L. 5–9–7–18–6–16–7–18–3 D. L.	89	15.25	5.6	4–6	1	(?)	6 lobes.
6	2972′	do	61	Low form 13 by 25.	Thick and cartilaginous.	40	4	L. 2–8–7–10–5–8–6–16–4 R. 4–9–6–11–6–11–7–13–6 D. L.	66 73	10.5 11	5 6	7	2	22	Regular like beads.

[1] Maximum.

Alimentary system.—On the left side of the body the intestinal canal as a whole forming a reversed S as seen from the outer surface, the ventral or gastric portion of the S being considerably broader than the dorsal or rectal portion. Esophagus short; stomach spindle-shaped, about a third longer than thick, wall closely and deeply folded, the folds about 30 in number; intestine of quite uniform diameter throughout; anal border with a series of distinct, somewhat bead-like lobes, in some specimens these extending all the way around, while in others they are restricted to scarcely more than one-half of the circumference, the other portion being occupied by a single projecting pointed lobe or lip (fig. 23).

Reproductive system.—On both sides of the body. Ovary consisting of a much elongated, evenly cylindrical mass, two or one on each side, on the left crossing the rectal part of the intestinal loop, and in some individuals reaching back across the gastric portion of the loop also. Testes consisting of fully separated bodies of unequal size and irregular shape arranged along both sides of each ovarian cylinder, but sharply separated from it. Both ovaries and testes adhering closely to the mantle, the testes seeming to be without common sperm ducts, each lobe discharging its sperm independently (fig. 23).

The great individual variation among the animals strongly suggests at first sight that we are dealing with two quite distinct specific groups. The difference in shape, for example, as shown by the photographs, and as indicated in the diagnosis by the terms "flat form," and "pyramidal form" is striking indeed, and when taken in conjunction with other external differences, particularly the tuberculation of the test in the pyramidal form and the evenness of the surface in the flat form, would lead one to say without hesitation that the two styles make two well-separated species.

Such an internal difference, too, as the presence of two ovaries on each side in some individuals and of only one in others would, according to our usual notions about species in the genus *Styela*, strongly incline one to believe we have to do here with two species. The several differences do not, however, correlate with one another in such way as to make a specific grouping possible at least within the limits of the specimens examined. For example, some of the pyramidal forms possess double ovarian cylinders on both sides of the body while others have single cylinders on both sides, and the same variation occurs among the "flat" animals. Again, the differences in the number of longitudinal vessels of the branchial sac between the branchial folds are sufficient to serve as specific marks, as these structures usually go; but here a correlation between either the maximum or the minimum number of the vessels with the extreme of variation in other particulars is not obvious. I conclude, therefore, that no other course is open than to assign the specimens all to one

species pending the time when dissections of a sufficiently large number can be made to test more thoroughly the question of correlation of the variations.

In the structure and disposition of the furriness of the test *S. hemicæspitosa* is, so far as I can determine, unique in the genus, it resembling more closely in this respect the *Polycarpa,* or *Pandocea fibrillata* of Alder and Hancock than any other ascidian.

The species considerably resembles, particularly in some of its variations, *S. milleri* Ritter and *S. sigma* Hartmeyer. From *milleri* it differs, not only in the extent and arrangement of the test fur, but in the smaller number of branchial tentacles, the smaller number of vessels on the branchial folds, and the smaller number of testis lobes. And *S. sigma* appears to be wholly devoid of the test fur, to be a much larger species, and to possess a greater number of vessels between the folds of the branchial sac. Furthermore, the gonads of *sigma,* seemingly two on each side in all cases, are, as I infer from Hartmeyer's description, hermaphroditic, and so lacking the separate testicular masses characteristic of *hemicæspitosa.* Hartmeyer does not mention the point in his text, but his figure shows only the two pairs of cylindrical bodies on each side; and in several other species which he says are rather similar to *sigma* the gonads are expressly stated to be hermaphroditic. But the species with which *hemicæspitosa* undoubtedly has most in common is *S. loveni* (Sars), some individuals of this species presenting an approach to the hairiness of the test so conspicuous in *S. hemicæspitosa.* And interestingly enough *loveni* runs through a range of shape variations, as shown by Hartmeyer and others, almost exactly parallel with that presented by our species. But the test hairiness is almost wholly wanting in most specimens of *loveni.* This difference between the two species may be correlated with their difference in habitat, *hemicæspitosa* being a dweller on muddy bottoms, while *loveni* is usually found closely adherent to stones, shells, etc. The two species seem to be well differentiated, too, in the character of the branchial sac, the folds in *loveni* being less prominent, and the whole membrane, both folds and interspaces, carrying fewer longitudinal vessels.

The distribution of the species is surprising. All the specimens except two are from the coast of southern and Lower California, and from depths not exceeding 61 fathoms. Two individuals are from Bering Sea, taken at a depth of 225 fathoms. The agreement between the northern and southern specimens is very close, the only difference, so far as I am able to see about which there may be a question, being in the testis lobes. These are somewhat more numerous and voluminous in the Alaskans.

Albatross 2838, lat. 28° 12′ N.; long. 115° 09′ W., off Lower California, 44 fathoms, bottom gn. m., May 5, 1888; about 20 specimens, all pyramidal form.

Albatross 2971, lat. 34° 20′ 30″ N.; long. 119° 37′ 50″ W., off southern California, 29 fathoms, bottom fne. gy. s. m., February 11, 1889; 1 specimen, pyramidal form.

Albatross 2972 (type-locality), practically same location as 2971; but 61 fathoms, bottom gn. m.; about 40 specimens, all but three or four of the "flat form."

Albatross 3227, lat. 54° 36′ 30″ N.; long 166° 54′ W., Bering Sea, 225 fathoms, bottom gn. m., May 23, 1890; 2 specimens, pyramidal form.

Type.—Cat. No. 5684, U. S. N. M.

STYELA SABULIFERA, new species.

Plate 34, figs. 24–26.

Superficial characters.—Very regular in outline and rigid in consistency, covered all over with a closely set layer of black sand grains. Orifices rather near together at the anterior end, without siphons and scarcely recognizable in the preserved specimens. Body distinctly longer than broad, antero-posteriorly, and considerably compressed or wedge-shaped, the posterior end being thinnest (pl. 34, fig. 24). Some specimens with a considerably elongated process near the posterior end. Surface of the rather thick test bearing many short processes longest along the posterior margin of the body. Mantle musculature strong, the outer layer of circular fibers stronger than the inner layer of radial fibers. Length of a full-sized individual 17 mm, width 14 mm, thickness about 10 mm.

Respiratory system.—Four lobes of the orifices clear cut, small, but rather distinct because of their whiteness. Branchial tentacles simple, 20 to 30, of different sizes (fig. 25 *b. t.*), the larger and smaller alternating more or less regularly. Hypophysis (*hy.*) with a simple circular or oval-shaped mouth. Branchial membrane with 4 folds on each side, longitudinal vessels (*i. l. v.*) on folds of two specimens as follows:

No. 1. Endostyle { 0–*5*–0–*4*–0–*6*–0–*5* L.
0–*3*–0–*5*–0–*3*–0–*13* R.

No. 2. Endostyle { 0–*4*–0–*5*–0–*4*–0–*7* L.
0–*5*–0–*6*–0–*4*–0–*13* R.

No vessels between the folds; stigmata straight, 12 to 20 in the meshes. Dorsal lamina entire (*d. l.*), that is, without marginal teeth or ribbings.

Alimentary system.—On the left side, first part of intestine doubling back into close contact with stomach, rectal portion extending forward parallel with and near to the dorsal edge of the body. Stomach long with about 22 distinct oblique folds; anus with many small marginal lobes.

Reproductive system.—Gonads very definitely sausage-shaped masses, about 6 on each side of the body, placed transversely, those of the left side situated in the dorsal intestinal loop. Testes and ovary closely associated in the same mass, but not hermaphroditically (fig. 26 *gon.*).

Many delicate endocarps projecting from the mantle in among the gonads.

This rather unique *Styela* seems to have more in common with *S. vestita* (Alder) than with any other member of the genus. The most striking feature is the gonads. Alder and Hancock (1907, p. 124) remark on the peculiarity of the gonads in *S. vestita*, which resemble considerably those of the present species, and state that "the only other species in which we have met with the same arrangement of these organs is in the *Glandula mollis* Stimpson." This statement of the uniqueness of this type of gonads written more than a quarter of a century ago, almost holds good to-day in spite of the great number of species of *Styela* and closely related genera that have since been described. The only other species that I have noticed in the literature (though I have not examined quite all of it with reference to the point) having a similar type of gonads is *S. floccata* Sluiter, 1904. Here there are also five gonadial cylinders on each side placed transversely. A particularly interesting fact is that the four species mentioned as having this unusual style of gonads are very distinct in various other particulars, and all belong to quite distinct geographical regions.

Another point deserving special attention is the double system of folds in the stomach, as shown in figure 24 *st.* It will be seen that in addition to the oblique folds on the outer surface and anterior half of the organ, there is a set of longitudinal folds on the posterior half. A fact concerning these last that is not very clearly brought out by the figure is that these longitudinal folds are a modification in direction of the set of oblique folds of the inner surface of the stomach. Finally, the rigidity of the animal, the regularity of its shape, and the heavy uniform coat of black sand, make the species very distinct, even in so large an assemblage of species as that constituting the genus *Styela*.

The collection contains about 90 specimens from *Albatross* station 3270, lat. 55° 26′ 30″ N.; long. 162° 52′ W., depth 16 fathoms (type locality); and about 15 specimens from station 3288, lat. 56° 26′ 30″ N.; long. 160° W., depth 15 fathoms. The first of these hauls was made on June 26, 1890, and the second on July 17 of the same year. Both stations are in Bering Sea, the first in the extreme eastern part in Bristol Bay, the second a little west of this.

The haul from station 3288 also contained *Agnesia beringia*.

Type.—Cat. No. 5687, U.S.N.M.

STYELA LOVENI (Sars).

Ascidia loveni SARS, 1851, p. 157, No. 101.
Cynthia loveni SARS, 1858, p. 65.
Styela loveni KIAER, 1893, No. 9, p. 48.—HARTMEYER, 1903, p. 209, text figs. 6–11; pl. 5, figs. 4–6; pl. 11, figs. 6–9.
Styela aggregata TRAUSTEDT, 1880, p. 410; 1883, p. 480, pl. 36, fig. 17; pl. 37, figs. 9–12.—HARTMEYER, 1899, p. 479, text fig. E.; pl. 22, fig. 8; pl. 23, fig. 5.
Tethyum loveni HARTMEYER, 1909*a*, p. 1359.
Goniocarpa loveni HUNTSMAN, 1911, p. 131.

(See Hartmeyer, 1903, for fuller synonymy and discussion of same, and variation of this species.)

There are only two specimens in the collection which I assign to this species. That they are specifically the same as the animals which Kiaer and Hartmeyer have treated as *S. loveni* there can be little doubt. On the question of whether the original *Ascidia loveni* was really of the same group I do not pretend to have a first hand opinion, since I have not seen Sars's description. I do not hesitate, however, to follow Kiaer and Hartmeyer, since both are not only acquainted with Sars's work, but also have had opportunity to study specimens from the locality from which his animals came. Both specimens are of the flat form and are attached to stones. One of them is so much flattened as to be hardly more than a thick disk closely and broadly adherent to the stone. Neither possesses any of the furriness which, according to Hartmeyer, is found on some individuals of the species, and is so characteristic of the closely related species *S. hemicæspitosa*. In his first paper dealing with *loveni*, Hartmeyer (1899) says, "jederseits zwei wurstartige Ovarien." However, this is probably a slip of the pen, since both the text and figures of his later work (1903) show but one ovary on each side.

Albatross 3331, lat. 54° 01′ 40″ N.; long. 166° 48′ 50″ W. Bering Sea, 350 fathoms, bottom m., August 21, 1890, 1 specimen.

Dall No. 1161, anchorage Big Koniuji Island, Shumagin group, Alaska, 6 to 20 fathoms, sand, rocks, 1 specimen.

STYELA GIBBSII Stimpson.

Styela gibbsii STIMPSON, 1864.—HERDMAN, 1898, p. 261, pl. 13, figs. 1–4.—RITTER, 1900, p. 604, pl. 18, figs. 13, 14; 1907, p. 23.—HUNTSMAN, 1911, p. 131.
Tethyum gibbsii HARTMEYER, 1909*a*, p. 1359.

There are 4 specimens of this common Puget Sound species from the Sound collected on rocks, between tides by O. B. Johnson in July, 1889. These need no remark, as they are perfectly typical.

In addition there are a dozen specimens from off Oregon which, while agreeing closely with Puget Sound animals in external characters, differ from them slightly in a few particulars of internal structure.

The following tabulation presents the results of the examination of two of the Oregon specimens:

No. 1. Endostyle { 4–*17*–9–*12*–6–*12*–6–*6*–4 L.
10–*11*–8–*8*–4–*10*–7–*7*–4 R.

No. 2. Endostyle { 5–*20*–8–*12*–4–*19*–5–*12*–3 L.
6–*23*–6–*14*–5–*16*–6–*11*–4 R.

Comparison of these figures with those given by Herdman (1898) for this species shows that in number of tentacles and vessels on the folds the present specimens are somewhat higher than those examined by Herdman from Puget Sound. I can not, however, regard the deviation from the type as anything more than a variation that would be without specific significance were a sufficiently long series of individuals to be examined.

Albatross 3088, off Oregon coast, lat. 44° 28′ N.; long. 125° 25′ 30″ W., 46 fathoms, c. p., September 3, 1889, 12 specimens.

On rocks, between tides, Puget Sound, July, 1889, O. B. Johnson, collector; 4 specimens.

Albatross 2945, "off southern California," lat. 34° N.; long. 119° 29′ 30″ W., 30 fathoms, p., February 6, 1889, 1 specimen.

STYELA YAKUTATENSIS Ritter.

Styela yakutatensis RITTER, 1901, p. 241, pl. 27, figs. 22, 23.
Tethyum yakutatense HARTMEYER, 1909*a*, p. 1360.
Katatropa yakutatensis HUNTSMAN, 1911, p. 129.

This species was founded for a lot of pedunculated Styelas collected in Yakutat Bay, Alaska, the peduncle of which was, however, much shorter, relatively, that that of *S. montereyensis* (Dall) and *S. greeleyi* Ritter. Since the peduncle of the single specimen now before me is even shorter proportionally than the average for the Yakutat animals, and since it comes from the same geographical region, I do not hesitate to assign it to the same specific group. The body of the individual is 13 mm. long, and the peduncle is 7 mm., while the average for the Yakutat specimens measured was 18.11 mm. for the body and 10.1 for the peduncle. Furthermore, the transition from body to peduncle is even more abrupt here than is usual in the Yakutat specimens.

Albatross 2877, lat. 48° 33′ N.; long. 124° 53′, 59 fathoms, bk. s. and m. (Strait of Juan de Fuca), September 25, 1888.

STYELA ?, sp.

A single individual of some member of the Styelidæ found adhering to the stalk of *Boltenia ovifera* taken at *Albatross* 3303 deserves mention even though its exact identification is impossible. A curious thing about the specimen is that in spite of the fact that it is in a good state of preservation, and seems to be fully grown, not a trace of

gonads can be found. This being the case, even its generic identity must remain in some doubt. After *Styela* the genus to which it is most likely to belong is *Pandocia* (or *Polycarpa*), and this is one of the points that makes it interesting, for with this possible exception this genus is not represented in the collection, nor is it known to occur in Alaskan waters. I have suspected that the seeming absence of gonads may be due to the fact that these may be present in the form of immature polycarps and so might be mistaken for endocarps, which are present in considerable numbers. However, such is not the case so far as I can make out; and since in all recognizable particulars it is a *Styela*, and since this genus is well represented in the region, I assign it provisionally to this group. In nearly all respects it agrees with *S. loveni*, but the internal longitudinal vessels are rather different, there being fewer on the folds and more between them. The formula is:

L. 5–3–3–9–4–5–2–12–2
R. 3–5–2–11–2–6–3–11–5 D. L.

STYELOPSIS GROSSULARIA (Beneden).

Ascidia grossularia P. J. VAN BENEDEN, 1846, p. 61, pl. 4, figs. 7–11.
Styela grossularia TRAUSTEDT, 1880, p. 416.
Styelopsis grossularia TRAUSTEDT, 1882, p. 115.—HARTMEYER, 1903, p. 252, pl. 5, figs. 12, 13.
Dendrodoa grossularia MICHAELSEN, 1904, p. 19.
Styelopsis grossularia BJERKAN, 1908, p. 9.—REDIKORZEW, 1907, pp. 12, 28.
Dendrodoa grossularia HARTMEYER, 1909, p. 1361.—VAN NAME, 1912, p. 588, pl. 64, figs. 118, 119.

I can find no differences between the animals before me and the descriptions of *Styelopsis grossularia* that would warrant the separation of them from this species. The single cluster of specimens is a very compact mass containing 35 or 40 individuals ranging in size from scarcely 1 mm. to 12 mm. in greatest diameter. Many of the small individuals are seated upon larger ones, the largest of all being completely covered over by the coating of smaller ones.

None of the individuals seem to approach the columnar form which characterizes many though by no means all individuals of the species.

The departure of these specimens from the *grossularia* type that may possibly be important is the almost complete absence of siphons. Although the orifices with their four lobes can readily be recognized, there are no projecting siphons. Possibly, however, the absence of siphons is more seeming than real. The specimen, from St. Paul Island, is almost certainly a pick-up on the beach and had been subject to considerable buffeting before it was preserved. This, together with the usual contraction which nearly all ascidian orifices undergo at death, may account for the absence of the structures.

It is quite impossible to separate the individuals from one another, the fusion being almost as complete as though the mass were one of compound ascidians.

The internal organs are typically grossularian, considering the range of variation of the species that has been pointed out, particularly by Herdman, 1882, Lacaze-Duthiers and Delage, 1893, and Hartmeyer, 1903. The only possible exceptions to this statement are these: The fold projecting into the intestine, or typhlosole, is very prominent in the specimens at hand, it extending nearly the whole length of the gut and in places nearly dividing the lumen into two; the pyloric pouch of the stomach is relatively short in the individuals examined and seems not to reach across the intestinal loop to the opposite limb of the intestine, as it is figured as doing in *grossularia;* and finally, the lobes of the testes in my specimens are more numerous and voluminous relative to the ovary than seems to be the case with individuals of *grossularia* heretofore described.

Taken all in all, I conclude that, while it is possible it is not probable that the study of more ample material will find it necessary to set off the Bering Sea members of the *Styelopsis* group from *grossularia*, and that, consequently, the already very wide range of this species must be extended by several thousand miles.

A single mass of specimens from St. Paul Island, Bering Sea, taken in July, 1897.

DENDRODOA TUBERCULATA Ritter.

Plate 34, fig. 27

Dendrodoa tuberculata RITTER, 1899, p. 512, figs. 1–5.—HARTMEYER, 1903, p. 243, pl.5, fig. 9; 1909*a*, p. 1362.

The genus *Dendrodoa* is one of those groups of organisms which the more it is studied (up to some limit not yet ascertained in this case) the more dubious become the boundary lines of the subgroups into which it may be divided. When I described the two species, *tuberculata* and *subpedunculata*, in 1899 it seemed that the delimitations, not only between these two species but also between these and any of the previously known species, was satisfactorily definite. Since then, however, the studies of Hartmeyer and now my own have brought out strikingly the great variability of the animals, and so demonstrated that the subgroup boundaries can be made out only by the most searching examination of a great quantity of carefully collected well-preserved material representing the whole geographic range of the genus.

TABLE 12.

No. of specimen.	Collector.	Locality.	Depth in fathoms.	Size in mm.	Color.	Test.	Tentacles.	Folds of sac.	Longitudinal vessels on sac.	Total vessels.	Average vessels in folds.	Average vessels between folds.	Stigmatas in mesh.	Gonad lobes.	Stomach folds.	Anal lobes.
1	*Albatross* ...	Otter Island, Bering Sea.	?	70 by 35...	Dark red.....	Strongly tuberculate.	27	4	.....	....	9–12	4–5	20	6	29	None.
2	*Albatross* 3216.	South of Alaska Peninsula.	61	40 by 20...	Whitish and reddish brown.	Wrinkled tuberculate.	24	4	L. 2-*13*-4-7-3-*11*-2-7-2 end. R. 2-*11*-3-*9*-5-*10*-2-7-2	51 49	95 9. +	2.6 2.4	6 to 8	5	35	30 rolled back.
3	*Albatross* 3505.	Bering Sea....	44	32 by 25...	Reddish brown.	Strongly tuberculate.	18	4	L. 0-*14*-1-*4*-?- *8*-1-*4*-1 end. R. 1-*13*-1-7-1-*11*-1-7-1	33 43	7.5 9.5	.6+ 1	20 max.	11	24	?
4	Dall, 1038...	.....	...	30 by 15...	Dark brown...	Finely wrinkled tuberculate.	29	4	L..... R.....	....	.....	.....	20 to 25	5	26	?
5	*Albatross* 2845.	Unalaska to Cook Inlet.	42	30 by 15...	Reddish brown.	Tuberculate...	14	4	.....	....	7–16	3–4	5 to 7	5 or more.	26	28 fine.
6	*Albatross* 2849.	....do.....	69	30 by 10...	Yellowish brown.	Wrinkled tuberculate.	19 all short.	4	.....	....	4–16	.....	6 or 7	5	22	Finely lobed.
7	*Albatross* 3262.	Bering Sea....	43	25 by 17...	Light brown..	Rough.....	22	4	L. 2-*13*-3-*9*-4-*12*-4-7-3..... R. 2-*14*-4-*10*-4-*10*-4-*8*-3....	57 59	10.25 10.5	3.2 3.4	9	7–8	30 about.	28
8	*Albatross* 3216.	South of Alaska Peninsula.	61	21 by 21...	Whitish reddish.	Wrinkled tuberculate.	30	4	L. 1-*16*-2-*10*-3-*11*-4-7-2..... R. 2-*13*-4-*11*-4-*11*-4-*8*-2....	56 59	11 11—	2.4 3.2	9 or 10 or 12	5	About 30	?
9	*Albatross* 3504.	Bering Sea....	34	17 by 19...	Gray.....	Finely wrinkled.	25	4	L. 1-*12*-0-4-2-7-1-5-? end. R. 1-*13*-0-5-1-8-1-6-1	32 36	7 8	.8 .8	26	5	Present.	One large no small.
10	Turner.....	Unalaska.....	...	15 by 20...	Light to dark brown.	....do.....	30	4	R. 1-*16*-2-*9*-3-7-3-*8*-2 end ..	46	8. 75	2. 2	12 or more in some.	5	24	Slightly notched.
11	Dall.....	Unalaska.....	...	10 by 20...	Dark.....	.....do.....	44	4	L. ?-*13*-1-6-1-8-1-5-1..... R. ?-*13*-1-7-1-9-1-6-1.....	32 35	8+ 9—	1 1	15	6	23	None.
12	*Albatross* ...	Nikolski, Bering Island....	...	12 by —...	Milk white, gray.	....do.....	31	4	L. 0-*10*-1-*8*-1-7-1-*4*-1 end. R. 0-*10*-1-6-1-8-1-*8*-1	28 31	6 6.75	.8 .8	16	4	23	Slightly notched.
13	.....do.....	.....do.....	...	10 by 10...	.....do.....	.....do.....	25?	4	L. 1-*13*-1-6-1-*10*-1-7-2 end R. 1-*13*-1-8-1-*10*-1-8-1	42 44	9 9.75	1. 2 1	16 in some.	5	23	3 indistinct.
14	*Albatross* 3536.	Bering Sea....	49	10 by 10...	.....	.....do.....	42	4	L. 0-*14*-1-*4*-1-*8*-1-5-1 end. R. ?-*12*-1-*4*-1-7-0-6-0	35 30	7. 75 7. 25	.8 .4	25 in some.	6	Present.	Slightly notched.
15	*Albatross* 3213.	South of Alaska Peninsula.	41	5 by 3.....	Light yellowish.	Tuberculate...	16	4	10 to 16 on folds.....	....	.....	.....	7 to 9	5	24	Many.
16	.....	Kamchatka...	?	8.....	Light gray....	Minutely wrinkled.	Lost..	4	L. ?-*10*-?-*8*-0-7-0-*5*-0 end. R. ?-*11*-?-*6*-1-*9*-0-7-0	25 34	6.25 8. 25	? ?	6 to 10 or more.	4	Numerous.	?

Hartmeyer, 1903, points out that most of the characters which I relied upon chiefly for distinguishing *tuberculata* from *subpedunculata*, and both these from *aggregata*, occur within the range of individual variation of *aggregata*. He, however, finally decides not to include my species in the older species, but considerately leaves to me to determine what weight in this direction should be attached to his observation. After deliberating long on the considerable evidence now before me I am strongly of the opinion that, in spite of the undoubted great range of variation of both *aggregata* and the Bering Sea animals, the latter are sufficiently distinct from the former to deserve being considered as specifically distinct. The points which I rely upon most in support of this conclusion are the greater degree of tuberculation and of hardness of the test of *tuberculata*, the darker coloration of *tuberculata*, and particularly the character of the stomach. This member is, judging from my examination of specimens of *aggregata* sent me by Hartmeyer, as well as by the figures and descriptions given by various authors, relatively longer, more sharply set off from the intestine, and, perhaps most important of all, more distinctly folded as viewed from the external surface than in any of the north Pacific animals. It is probable, furthermore, that the longer rectal portion of the intestine in *aggregata* and the absence there of anal lobes are constant differential marks. Although, as indicated by the tabulation, there is great variety in the lobulation of the anal rim in the specimens I have examined, it is doubtful if they are wholly absent in any case, as they seem to be regularly in *aggregata*.

The almost complete invisibility of the folds of the stomach wall as seen from the external surface, though very prominent inside in all the Bering Sea specimens examined, is in striking contrast with their distinctness in *aggregata*. The difference is due seemingly to the greater thickness and closer adherence of the peritoneal layer in the *tuberculata* group. I am quite confident, therefore, that future, more thoroughgoing study will increase rather than diminish the distinctness of a group that will fall under the designation *tuberculata*.

Concerning the specimens from *Albatross* 3262 I have more doubt than about any others which I am calling *tuberculata*. Externally they strongly resemble many individuals of *Styela rustica*. The tentacles, furthermore, in some of these are remarkably short and stubby. Also the great number, seven, of branches of the ovary in some individuals arouses suspicion when considered in connection with the other differences noted that we may be dealing here with representatives of a different group. In view, however, of the great variation to which the whole genus is obviously subject I have not deemed it best to describe these as a distinct species. For example, the large number of ovarian branches (fig. 27) would have been considered, according to the earlier practices in dealing with the Dendrodoas, in itself a sufficient characterization of a distinct species. But, as the

table shows, two specimens of the most typical *tuberculata* (Nos. 2 and 4) possess the one 11, the other 9 lobes; and in general the variation in number of these is so great as to deprive them of much classificatory value, at least so far as this species is concerned. The remarkable reduction in the size of the branchial tentacles would at first sight also seem sufficient to exclude these specimens from *tuberculata*. But this again is one of those seemingly freakish variations that occur in some organisms. The smallest individual of the lot, being 14 by 12 mm., had three tentacles situated about at the quadrants, of good length and thickness, and no other, unless one or two at the very earliest stage of development, for I have no doubt that in this group new tentacles are added until a comparatively late period in the lifetime of the individual animals.

Mention ought also to be made of the fact that the stomach in some, though not in all the specimens in this lot, resembles that of *D. aggregata* more than it does that of the typical *tuberculata*. This in conjunction with the lighter color and diminished tuberculation of the test, has somewhat inclined me at times to assign these specimens to *aggregata*. But the lobing of the anal rim and on the whole the character of the digestive canal and the branchial sac have prevailed in favor of considering them as representing a strongly marked race or form of *tuberculata*.

? *Albatross* station 3505 (3 specimens), lat. 57° 09′ N.; long. 168° 17′ W., 44 fathoms, fne. gy. s., July 28, 1893.

Albatross station 2845 (1 specimen), lat. 54° 05′ N.; long. 164° 09′ W., 42 fathoms, crs. bk. s., July 29, 1888.

Albatross station 2849 (5 specimens), lat. 55° 16′ N.; long. 160° 28′ W., 69 fathoms, gn. m., August 2, 1888.

Albatross station 3213 (8 specimens), lat. 54° 10′ N.; long. 162° 57′ 30″ W., 41 fathoms, bk. s.

Albatross, 2 specimens, Otter Island, Bering Sea.

Albatross station 3262 (a dozen specimens), lat. 54° 49′ 30″ N.; long. 165° 02′ W., 43 fathoms, bk. s. r., June 24, 1890.

Albatross station 3504 (2 specimens), lat 56° 57′ N.; long. 169° 27′ W., 34 fathoms, fne. gy. s. bk. sp., July 28, 1893.

Albatross station 3216 (5 specimens), lat. 54° 20′ 30″ N.; long. 163° 37′ W., 61 fathoms, bk. s. m., May 21, 1890.

Albatross station 3536, lat. 57° 05′ N.; long. 170° 35′ W., 40 fathoms, gn. m. fne. s., August 8, 1893.

Other than *Albatross* stations: About 75 specimens, mostly small and in a compact mass, Unalaska, Alaska, washed up by the waves, Turner collection; about 20 specimens, Constantine Bay, Amchitka Island, 8 fathoms, Dall collection 1038; 2 specimens, Unalaska, Dall collection; 3 clusters, Kyska Harbor, beach, Dall collection 1873; 2 specimens, no data.

DENDRODOA SUBPEDUNCULATA Ritter.

Dendrodoa subpedunculata RITTER, 1899, p. 514, figs. 6-8.—HARTMEYER, 1903, p. 245; 1909*a*, p. 1362.

While my later study of the Dendrodoas has strengthened my conviction of the distinctness of *D. tuberculata* as a species, such has hardly been the result with regard to *subpedunculata*. Indeed, I am dubious about retaining the species since I am now obliged to rely on superficial characters entirely for separating it from *tuberculata*. The characters drawn from the branchial sac, to which I formerly gave much weight for distinguishing the two species, now seem very doubtful, as do all others drawn from the internal organization. However, the external differences are on the whole so numerous and pronounced that I have resolved to continue to recognize *subpedunculata*. In most of the specimens now under examination the test is light gray, in some cases almost milk-white, and is soft as compared with that of *tuberculata*. Furthermore, some of the individuals incline to pedunculation quite pronouncedly.

The specimens are so closely fused together, little and big ones, that it is next to impossible to separate them or even to distinguish one from another in some places. For the purpose of more convenient comparison I have included this species with *tuberculata* in the tabulation, Table 12.

There are two dozen or more specimens secured by the *Albatross* at Nikolski Island, Bering Sea, on June 3, 1892, and 1 specimen from Kamchatka and 5 specimens from Commander Islands, collected by Leonhard Stejneger in 1882–83; also 1 specimen from Adakh Island, *Albatross*, July 2, 1893.

DENDRODOA ADOLPHI (Kupffer).

Cynthia adolphi KUPFFER, 1874, p. 245.
Dendrodoa adolphi HARTMEYER, 1903, p. 244, pl. 10, fig. 10; 1909*a*, p. 1361.

I have not seen the original description of this species. However, Hartmeyer's account of it is sufficient to leave little or no room for doubt that the specimens at hand belong here. But since Hartmeyer's study of the species was restricted to a few poorly preserved individuals, making it impossible for him to settle a number of points, it will be best to give a full diagnosis of the species here.

Superficial characters.—Body nearly spherical and quite regular when not distorted by crowding or by pressure from some other source. Orifices not far apart, both opposite the side of attachment; siphons distinct but not long. Color nearly uniform light brown. Surface of the test presenting a great number of shallow, close wrinkles, on the whole somewhat more distinct in the posterior hemisphere, and extending around the body; but irregular radial ones present also. Some of the individuals (older ones?) with surface much

more roughened, almost warty. Test thin and tough, of quite uniform thickness throughout. All individuals firmly attached, some to the peduncles of *Boltenia* and some to others of their own kind; the area of attachment not large. Largest individuals about 1 cm. in diameter; mostly smaller.

Respiratory system.—Orifices indistinctly four-lobed. Branchial tentacles about 55, simple, all in one circle, long, and of approximately uniform length. Atrial tentacles present, slender, about 20 in number. Hypophysis mouth an almost but not quite closed circle, the opening turned toward the left. Branchial sac with four folds on each side; formula of internal longitudinal vessels in two specimens as follows:

No. 1. Endostyle $\begin{cases} 0\text{–}14\text{–}0\text{–}4\text{–}1\text{–}10\text{–}0\text{–}5\text{–}0 \text{ L.} \\ 0\text{–}15\text{–}0\text{–}5\text{–}1\text{–}11\text{–}0\text{–}7\text{–}0 \text{ R.} \end{cases}$

No. 2. Endostyle $\begin{cases} 0\text{–}8\text{–}0\text{–}4\text{–}1\text{–}8\text{–}1\text{–}6\text{–}0 \text{ L.} \\ 0\text{–}11\text{–}0\text{–}5\text{–}1\text{–}9\text{–}1\text{–}7\text{–}0 \text{ R.} \end{cases}$

Stigmata straight, about 8 to 20 in a mesh. Dorsal lamina a plain broad membrane.

Alimentary system.—On left side of body; esophagus rather long, slender and curved; stomach well-defined, regular, spindle-shaped, wall closely and regularly longitudinally folded, the folds 25–27 in number; from the stomach the intestine forms an almost circular bend, coming back to form a contact with the esophageal end of the stomach, at which point it makes an abrupt turn forward and downward to terminate in a narrow hook; anus with a smooth lip.

Reproductive system.—On right side, a trident-shaped body, the three prongs springing from a common basal piece in general running clearly parallel with one another. *Endocarps* present and well developed.

Hartmeyer expresses the view that *D. adolphi* may not be a good species; that it may have to be united with *D. aggregata.*

The examination of these specimens puts beyond question the validity of the species. From *aggregata* it is distinguished by the greater number of tentacles and fewer number of gonadeal prongs. In four specimens the tentacle numbers were 51, 54, 55, and 58. This is more than double the number ascribed to *aggregata*, a difference too great to be due to fluctuating variation.

The three-parted state of the gonads appears constant, though in one of the individuals examined one of the prongs was connected with the others by a small isthmus only, suggesting that in other cases it might be wholly separated, and so leave the gonad in the two-branched state which Hartmeyer (1899) has found to prevail in some specimens of *D. kükenthali.* As a matter of fact, the last-mentioned species would seem to be very close to *D. adolphi*, though *kükenthali* has a larger number, 64, of tentacles.

From *D. tuberculata*, *adolphi* is sharply distinguished in external features first of all by the distinct, though short wart-like siphons of the latter species. Furthermore, the body of *adolphi* is more nearly spherical, more regular, the test is more delicate, and the color is lighter. Internally the small number of gonad branches in *adolphi* sharply distinguishes the species from *tuberculata*.

D. adolphi was originally described from Shannon Island, near the coast of Greenland, and has not been reported from any other locality until now. There are about 150 specimens, large and small, in the one lot, taken at Cape Etolin, Nunivak, Alaska, by Dr. W. H. Dall in 8 fathoms.

PELONAIA CORRUGATA Goodsir and Forbes.

Pelonaia corrugata GOODSIR and FORBES, 1841, p. 30, pl. 1, fig. 1.—ALDER and HANCOCK, 1907, vol. 2, p. 145, pl. 46, figs. 15, 16; pl. 47; pl. 48, fig. 18; text figs. 81 and 82.—HARTMEYER, 1903, p. 203, pl. 5, fig. 14.—HUNTSMAN, 1911, p. 132.—VAN NAME, 1912, p. 545, text fig. 29; pl. 58, figs. 84, 85.

The early synonymy of this species is given in detail by Alder and Hancock, by Hartmeyer, and by Van Name.

After working with specimens so equivocal in their characters as compared with their kindred as to drive one almost to madness to know what disposition to make of them, it is a great pleasure to come upon a lot of individuals like those now in hand, that are no more dubious as to their place in the scheme of classification than are recently minted pieces of money.

It is certainly worthy of note that in spite of the wide distribution of *Pelonaia corrugata*, it being circumpolar in the Arctic Ocean, and extending as far south in the Atlantic as the British Islands in Europe, and the New England coast in North America; and in spite of its having been so long known and collected and studied by so many zoologists, it has never seemingly been assigned to any other genus.

Albatross 3253, 36 fathoms, mud and sand bottom, lat. 57° 05′ 50″ N.; long. 164° 27′ 15″ W. (southeastern Bering Sea); June 14, 1890. A single specimen.

U. S. R. S. *Corwin* 1880, 2 specimens (no further data).

CHELYOSOMA COLUMBIANUM Huntsman.

Chelyosoma columbianum HUNTSMAN, 1911, p. 124.

The character upon which Huntsman has chiefly relied to distinguish this species from *C. productum* is the presence of short stout muscle fibers connecting the central plates. Such fibers are present in the specimens now under examination; and since they seem, from the extensive study of the musculature by Bancroft, 1898, to be wholly wanting in the typical Chelyosomas of Puget Sound and the regions southward, *columbianum* stands by this character alone as a well-marked species. But the specimens at hand bear out Huntsman's

statement that *columbianum* also differs somewhat from *productum* in size, shape, and position of orifices. On the whole, too, the number of tentacles seems to be greater in *productum*.

About two dozen specimens, *Albatross* 2876, lat. 48° 33′ N.; long. 124° 53′, off Cape Flattery, Washington, 59 fathoms, bk. s. September 25, 1888.

One specimen, *Albatross* 2866, lat. 48° 09′ N.; long. 125° 03′ W., 171 fathoms, gy.s., September 20, 1888.

These two stations are near the entrance to the Strait of Juan de Fuca.

Half dozen specimens, no label, probably from same locality.

CHELYOSOMA PRODUCTUM Stimpson

Chelyosoma producta STIMPSON, 1864, p. 161.

Chelyosoma productum v. DRASCHE, 1884, p. 381, pl. 7, figs. 5–9.—BANCROFT, 1898, pp. 309–332, pl. 18, figs. 1–14.—HARTMEYER, 1909*a*, p. 1392.—HUNTSMAN, 1911, p. 124.

A single specimen from Puget Sound of this common species is in the collection, with no data beyond the fact that it is from the Sound.

CORELLA WILLMERIANA Herdman.

Corella willmeriana HERDMAN, 1898, p. 252, pl. 11, figs. 1–4.—RITTER, 1900, p. 604, pl. 18, fig. 15.—HUNTSMAN, 1911, p. 122.

Corella rugosa HUNTSMAN, 1911, p. 122.

There is certainly considerable difficulty in the way of placing the specimens now under consideration in this species.

There are five specimens from Puget Sound and eight from Loring, Alaska. Taken altogether these differ in such ways from the typical *willmeriana* that, were they to be regarded as specifically distinct from *willmeriana*, there would be as much reason for making two as one new species, and the line of cleavage between them would not separate the Puget Sound from the Loring specimens.

The distinctive characters are as follows:

Puget Sound specimens: Larger, length as great as 4 cm.; test rather thick and semicartilaginous; orifices both 6-lobed (as seen on siphon dissected from test), clear though not conspicuous; tentacles 47; dorsal languets large, well apart; internal longitudinal vessels about 20 on each side of sac; the coils of branchial stigmata very regular; stomach rather large and globose, with 20 to 25 longitudinal folds.

First Loring collection, one specimen, size 3 by 1.5 cm., very transparent, test thin, but somewhat stiff; orifices rather uncertain, 6 or 7 for each; tentacles 47; dorsal languets large and far apart; internal longitudinal vessels of branchial sac 23 on right and 24 on left; stigmatic spirals very irregular in form and distribution; stomach globular, wall with 20 to 25 folds; anus distinctly lobed.

Second Loring collection, 5 specimens, size 2 by 1½ cm., test very thin, soft, and transparent; lobes of orifices uncertain, 6, 5, or 4, tentacles 43 to 45; dorsal languets large and well separated; internal longitudinal vessels of sac about 22, and small papillæ on them corresponding to the short vessels by which the longitudinal vessels are connected with the branchial membrane; stigmatic spirals very regular, as in Puget Sound specimens; stomach globular, wall with 20 to 25 folds.

All the Loring specimens were attached to *Halocynthia villosa*, and were elongate and narrowed toward the point of attachment.

Puget Sound specimens from O. B. Johnson, July, 1889.

Loring specimens, *Albatross*, Alaska salmon investigations, April 29, 1903.

NOTE.—Huntsman's *C. rugosa*, the description of which has come to hand since the above was written, does not do away with the variational difficulties noted by me. The roughened test and more anterior position of the atrial aperture which, according to Huntsman, distinguish *rugosa* from *willmeriana* are certainly inapplicable as distinctive marks for the specimens before me, both being so far as I can see strictly individually and quite independently variable. My largest Puget Sound individual is entirely smooth-surfaced, while a second, nearly as large, is unmistakably roughened and papillate. A smaller individual is smooth or nearly so on one side and conspicuously rough on the other. The Loring specimens present much the same range of variation in this particular.

The other point on which Huntsman relies for separating the species is the number of longitudinal vessels, *willmeriana* being assigned 24 right and 22 left; while *rugosa* is given 20 to 22 on each side. This difference is quite too small to be held as specifically significant unless based on averages of a large number of determinations. As a matter of fact I find 20 on each side in a large Puget Sound individual, and 22 to 23 in the Loring animals.

CORELLA JAPONICA Herdman.

Plate 35, figs. 28–30.

Corella japonica HERDMAN, 1882, p. 190, pl. 16, figs. 1–9.—SLUITER, 1900, p. 20 — HARTMEYER, 1906, p. 25; 1909*a*, p. 1393.

Discussing this species in his final report on the *Challenger* ascidians Herdman recognized its close resemblance to *C. eumyota* Traustedt (1882), but pointed out a number of characteristics which seemed sufficient to distinguish it from Traustedt's species. The results of my comparison of the specimens at hand with the descriptions of *japonica* and *eumyota* led me at first to the conclusion that my specimens, even though from the Japanese coast, agreed more closely with *eumyota* than with *japonica*. This was surprising because

eumyota comes from the eastern coast of South America. But since the beginning of my studies I have had the opportunity, thanks to Hartmeyer, to examine specimens from Yokohama and identified by him as *japonica,* and do not now hesitate to regard my specimens and his as being of the same species; nor do I seriously question that both sets of specimens are the same as the ones examined by Herdman; that is, that all are *japonica.* It appears from a late paper by Hartmeyer (1906) that he found no difficulty in the way of identifying his Japanese animals as Herdman's species. There are, however, a few points, two particularly, in which my observations do not quite agree with Herdman's description, and since it was just at these points that I formerly thought my specimens agreed more closely with *eumyota* than with *japonica* I have thought it desirable to present a few drawings and write explicitly of these matters. The first to be noticed is the mantle musculature. Herdman called special attention to the peculiarity of this but his statement and figure need modifying somewhat to make them apply to the specimens which I have examined. He says, "In *Corella japonica* the musculature is very strongly developed along the dorsal part of the left side, while in *Corella eumyota* there is no such disproportionate development"; and his figure 2, plate 26, illustrates this statement. In all the specimens examined by me as well as in those from Yokohama and identified by Hartmeyer as *japonica* and those belonging to the U. S. National Museum collections, while the muscle fibers are undoubtedly well developed along the dorsal ridge, they are not particularly more so there than all the way around an elliptical area corresponding to nearly the entire left side; in fact in the specimen from which figures 28 and 29 were drawn the fibers are distinctly more numerous and quite as strong all along the ventral edge of the area as along the dorsal. In the specimens which I have examined the area of relatively heavy mantle muscle fibers might be characterized as a distinct patch of elliptical shape corresponding in general to the left side of the animal; and one of the striking things about this patch is the sharpness of its boundary as determined by the abrupt ending of the muscle fibers along nearly the whole circumference. Figures 29 and 28, the first of the left, the second of the right side of the same individual, illustrate this. The abrupt termination of the more or less radially disposed fibers on the dorsal and posterior edges is clearly seen in the figures, while the ends along the ventral and anterior edges can only be inferred from the fact that the fibers are present on the left side and do not pass over on to the right side at all. In some specimens the circumference of the muscle "patch" is as distinctly visible all the way around on the left as it is in figure 29 along the posterior end.

The second point of divergence of my results from Herdman's description concerns the tentacles. These are said by Herdman to be all of one size in *japonica;* and in his schematic classification of the species of *Corella*, given on page 190, he makes this the final criterion for differentiating *japonica* from *eumyota*, the last being characterized by tentacles of two sizes. In all the specimens examined by me the tentacles are at least of two sizes, and although the difference, particularly in length, is not great, it is undoubted. And an interesting fact about the difference is that, particularly in some individuals, the larger tentacles are bent in toward the center of the circlet — that is, toward the branchial orifice—distinctly more than are the smaller ones. This difference in disposition of the tentacles of different sizes is especially observable in one of the individuals from Yokohama sent me by Hartmeyer.

Figure 30, showing the arrangement of the stigmata in one of my specimens, corresponds so well with Herdman's figure 5, plate 26, as to leave no doubt about the agreement in this regard; but the end-to-end and reversed dispositions of the openings as here seen is worthy of particular notice since this seems to afford one of the best distinctions between *C. japonica* and *C. æquabilis* Sluiter (Sluiter, 1904, p. 17), end-to-end arrangements of the stigmata in the same infundibulum not occurring in Sluiter's species.

Concerning *C. japonica* and *C. eumyota*, as our information now stands the best differentiating marks are the larger number of branchial tentacles and the greater irregularity and the different modes of coiling (Herdman, 1910) of the stigmata in *eumyota*. The difference in the mantle musculature and the size of the tentacles, especially appealed to by Herdman, do not seem to hold, at least on the ground on which he placed those differences. The statement by Traustedt, 1882, page 285, that *C. japonica* is distingished from *C. eumyota* by papillæ on the internal longitudinal vessels of the former and their absence in the latter is due to error on Traustedt's part, papillæ not being present in *japonica*.

Five specimens from *Albatross* 3656, Hakodate Bay, Japan, 11.5 fathoms, *gn. m. s.*

Three specimens from station 3659, Hakodate Bay, Japan, 15.5 fathoms, *fne. gy. s.*

Both lots taken September 19, 1896.

CORELLA, species.

At *Albatross* 3088, off the coast of Oregon, a single specimen of a Corella was taken which, though sufficient to enable one to determine with certainty the genus to which it belongs, is not sufficient to warrant a decision as to the species.

CORELLOPSIS PEDUNCULATA Hartmeyer.

Corellopsis pedunculata HARTMEYER, 1903, p. 273, pl. 5, fig. 15; pl. 12, figs. 1–5.

Although the single specimen at hand differs in some respects from Hartmeyer's description of this species, the differences are entirely too small to justify the making of another species on the strength of the evidence at hand. The lobing of the orifices in Hartmeyer's specimen was vague, so the author was unable to state positively the number of lobes present, six being given with a question for both orifices. The exact state of things is dubious here also, but this much is clear: There are on the atrial orifice four prominent bands on the inside of the orifice, each terminating in several irregular lobes or crenulations.

Seventeen branchial tentacles are present, of two or three sizes, the largest being long and strong.

The rudiments of internal longitudinal vessels of the branchial sac are much longer in our specimen than are those figured by Hartmeyer. It appears, too, that the secondary series of internal vessels shown by Hartmeyer as running radially and diagonally from the center of each stigmatic spiral are less regular in the present specimen.

One specimen, *Albatross* 2842, lat. 54° 15′ N.; long. 166° 03′ W., 72 fathoms, pebble bottom, July 23, 1888.

CORYNASCIDIA HERDMANI, new species.

Plate 35, figs. 31–36.

Superficial characters.—Strongly pedunculate, the peduncle being one and one-third, or more, longer than the elongate body and, in its thinnest part, from one-fifth to one-sixth the thickness of the body in its dorso-ventral diameter, thinnest in its middle portion and from here expanding gradually but distinctly to its foot; peduncle composed mostly of testicular material of the same general character as that of the body, hence transparent like the body. Body elongate (fig. 31) about twice as long as thick, quite regular, cylindrical, though soft, tapering abruptly to the peduncle, colorless and quite transparent, the relatively small, compact, dark visceral mass occupying the postero-dorsal angle showing distinctly through the external coverings. Siphons, both at the anterior end, separated by the diameter of the body, atrial long, tube-like, curved backward; branchial very short. Orifices rather large, the branchial with a wide thin lip or flange subtending nearly its dorsal semicircumference; atrial with five broad, thin, scallop-like lobes, with two or three irregular smaller ones in the intervals between some of the larger ones. Test rather thin except on peduncle, soft and gelatinous, very transparent. Mantle very

thin, musculature sparse, but the longitudinal fibers assembled into distinct though small and widely separated strands none of these extending farther back than the visceral mass; circular fibers very few and restricted almost entirely to the siphons. Length of body 4 cm., of peduncle 6 cm., diameter of peduncle in smallest part about 5 mm.

Respiratory system.—Tentacles disposed in a wide single circle (fig. 34 *b. t.*), the individuals simple, long and slender all nearly equally long and thick, about 100. Hypophysis very small, elliptical, long and narrow (fig. 36). Branchial sac capacious but the elements all very slender and fragile; internal longitudinal vessels present, numerous, very small (fig. 33, *i. l. v.*), borne at the summits of long thin posts, this making this system of vessels rather widely and loosely connected with the branchial membrane proper; transverse vessels (*t. v.*) in the form of narrow irregular strands between the serie of stigmata; stigmata very large and long, the prevailing direction of the long axes being lengthwise of the sac, but in places at right angles to this and in some areas the quadrangular arrangement of the vascular net-work characteristic of the genus may be seen (figs. 33 and 35.) Dorsal languets (fig. 35, *d. lu.*) long and slender in keeping with the other elements of the respiratory apparatus.

Alimentary system.—A rather small compact mass, situated far back and dorsalwards but apparently more to the left (specimen out of shape to such an extent as to make certainty impossible); intestinal loop narrow elongate, but simple (fig. 32); stomach, *st.*, not very distinct from intestine, with 25 or 30 indistinct folds on inner surface; anal rim smooth.

Reproductive system.—Ovary, one only, elliptical, rather compact, situated in the intestinal loop; testes diffuse, scattered over the ovary, in part, and extending on to the gastric limb of the intestinal loop (fig. 32, *ov.* and *tes.*)

Although clearly belonging to the genus *Corynascidia*, the species now described and named for Professor Herdman, the founder of the genus, is sharply distinguished from the other two species heretofore described.

The most unique feature about the animal is the branchial orifice. In its wide lip, or valve (fig. 31, *b. s.*), the species reminds one of *Pterygascidia mirabilis* Sluiter, 1904. Of the two previously known species of the genus, *herdmani* resembles *C. suhmi* Herdman much more closely than it does *C. sedans* Sluiter, Sluiter's species being non-pedunculate.

In general features, the siphons and orifices disregarded, *C. suhmi* and *C. herdmani* have much in common, but the character of the stigmata (fig. 33), as well as that of the orifices, sharply differentiates the species. Over large areas of the sac very little or no suggestion of the quadrate or spiral disposition of the stigmata occurs in *C. herdmani.*

I regret not being able to determine more exactly the relations and orientation of the visceral mass, especially with reference to the branchial sac; but in ascidians so soft as this and indeed in most of the deep-water species, more or less derangement of the parts in preserved specimens seems almost inevitable.

The question of the dorsal tubercle is also puzzling. On the evidence of a single specimen not in the best state of preservation I would not venture to declare it to be entirely wanting, but although the area where it should be is intact, I am unable to discover the organ.

Type-locality.—A single specimen, *Albatross* 3326, lat. 53° 40′ 25″ N.; long. 167° 41′ 40″ W. Bering Sea, 576 fathoms, muddy bottom, August 20, 1890. This location is a little north of Unalaska, where the bottom drops off quite abruptly to a considerable depth.

Type.—Cat. No. 5683, U.S.N.M.

AGNESIA BERINGIA, new species.

Plate 36, figs. 37–41.

Superficial characteristics.—Varying from elongate-laterally compressed to short-elliptical compressed, and from a soft and clean surface layer to one moderately firm with much adhering and embedded sand. Test proper colorless and semitransparent, but often entirely hidden by the coating of coarse, black sand. A long slender peduncle frequently, though not always, present. Siphons hardly visible. Largest individuals 3.7 cm. in greatest diameter, most of the lots considerably smaller. Mantle thin and delicate, its musculature being but little developed, and confined to the anterior end of the body; a series of distinctly separated nearly parallel muscle fibers surrounding each orifice, and a set of distant, short fibers radiating from each orifice.

Respiratory system.—Orifices rather near together, at the anterior end in the elongate individuals, the branchial being considerably in advance of the atrial usually (not so in the one shown in fig. 37). Lobing of the orifices obscure, six to eight lobes being indistinctly recognizable. Tentacles simple, of several sizes, disposed in several rather uncertain circles. Total number 50 or more, the smallest mere buds. The circlet of largest tentacles nearest, and very near the peripharyngeal band, the smallest nearest the branchial orifice (fig. 39 *b. t.*). All of the tentacles thick, particularly at base, in proportion to their length separated from one another by liberal spaces. Hypophysis a somewhat urn-shaped elliptical mass with the broader, open end forward; a peculiar prominent flap of epithelial membrane on the right side of the organ (fig. 39 *hy.*). The ganglion long and slender, in close contact with the hypophysis at its anterior end. Dorsal languets consisting of what seem to be a series of enlarged papillæ of the inner surface of the branchial sac, there being one for

each transverse vessel; the series a little to the right side of the median line. The median line itself marked by a narrow strip of the branchial membrane in which there are no stigmata (fig. 40 *d. l.*). Branchial membrane with neither longitudinal folds nor vessels, but with prominent transverse vessels or folds, the edges of which are armed with numerous long, strong processes each conical in shape with its free apex usually curved or hooked, about 10 or 12 of these vessels in each sac. Stigmata long and closely and definitely coiled, there being in general two rows of spirals in the interval between each two transverse vessels; about three or four turns in each spiral; usually four somewhat irregular vessels radiating quadrant-wise from the center of each spiral (figs. 40, 41).

Alimentary system.—On the left side, the stomach and first half of the intestine forming a close loop reaching across the posterior end of the body; the second or rectal half of the intestine forming nearly a right angle with the first part, and running forward along the dorsal side of the body (fig. 37). Stomach but little thicker than the intestine, and not definitely set off from it; wall smooth. Anus with a somewhat toothed border (fig. 38).

Reproductive system.—In the intestinal loop, the ovary a rather regular mass situated centrally (*ov.* fig. 38), with the testes disposed in the form of a fringe around this, the whole when fully developed spreading sometimes over the outer surface, sometimes over the inner surface, and sometimes over both surfaces of the intestinal loop. Gonoduct large, running parallel with the intestine and in close contact with it, *ov. d.*, in some individuals to the outside, in some to the inside of the rectum.

The genus *Agnesia* was founded by Michaelsen (1898) for an ascidian rather closely related to *Corella*, coming from Tierra del Fuego. A much fuller description of the animal was published by the same author in 1900. Up to the present time no other species of the genus has come to light, and it is an interesting circumstance that the second one should come from a latitude in the northern hemisphere almost the counterpart of that in the southern from which the first species comes (southern Tierra del Fuego, the home of *A. glaciata*, the original species, is in about 53° south, while the specimens of *A. beringia* come from 54° to 57° north in Bering Sea).

On the whole, too, it seems that the two are very much alike. It is true that *A. glaciata* is described as being without a peduncle, and since the present species is pedunculated this difference of itself would seem to separate the two generically almost, to say nothing about specifically. However, Michaelsen had only two specimens, one a small one, and the other, seemingly full-grown, was badly injured. This fact, along with the fact that many of the specimens at hand seem to be devoid of the peduncle makes me suspect that, were a large number of individuals of the South American

species to be examined, some of them would be found to possess the peduncle. Assuming this interpretation of the seeming difference between the two species as regards the peduncle to be correct, the other differences between them seem to be slight. Michaelsen says that there may be as many as nine coils in each stigmatic spiral in *A. glaciata.* Four, or at most five, appear to be the maximum number in *beringia.* But of more importance, perhaps, the spirals in *glaciata* are made up of a considerable number of stigmata placed end to end, while in *beringia* one or two stigmata constitute the entire spiral.

A wide range of individual variation occurs in our species. From some of the stations the specimens are all of the maximum size, or nearly so, given in the diagnosis, and the large ones are nearly devoid of sand on the test, and have rather thicker, more opaque tests. Some of the other gatherings, on the other hand, are very heavily coated with sand, and the test is very thin and transparent.

Again, the position and course of the genital ducts differ considerably, they being plainly visible in surface views in some specimens, and quite hidden by the rectum in others. I fail, however, to find any constancy and correlation of these variations that would warrant the institution of more than one species.

The collection contains several hundred specimens, all from the southeastern Bering Sea mingled with *Styela sabulifera* in some jars:

Albatross 3261, lat. 54° 42′ 15″ N.; long. 164° 49′ 15″ W., 27 fathoms, bk. g. p., June 24, 1890.

Albatross 3284, lat. 56° 16′ 30″ N.; long. 160° 53′ W., 25 fathoms, fne. g., June 29, 1890.

Albatross 3287, lat. 56° 33′ N.; long. 160° 14′ W., 30 fathoms, crs. bk. s., July 17, 1890.

Albatross 3288, lat. 56° 26′ 30″ N.; long. 160° W., 15 fathoms, bk. g., July 17, 1890.

Albatross 3525, lat. 57° 21′ N.; long. 170° 05′ W., 29 fathoms, bk. s. sh., August 4, 1893.

Albatross 3543, lat. 56° 41′ N.; long. 169° 39′ W., 43 fathoms, bk. s. sh., August 18, 1893, type locality.

Albatross 3560, lat. 56° 40′ N.; long. 169° 20′ W., 43 fathoms, fne, gy. s. bk. sp., September 3, 1893.

Albatross 3496, lat. 56° 32′ N.; long. 169° 45′ W., 41 fathoms, gy. s. st. gn. m., July 17, 1893.

Type.—Cat. No. 5689, U.S.N.M.

An interesting memorandum occurs on the reverse side of the label for station 3287 to the effect that one of the specimens was attached to the back of a shrimp of the genus *Crago.*

NOTE.—Since the above was written Huntsman (1911) has described a species, *A. septentrionalis,* from the west coast of Canada. This, too, appears to be nonpedunculate, and in other respects somewhat more like *glaciata* than *beringia.*

PHALLUSIA VERMIFORMIS, new species.

Plate 36, fig. 42.

Superficial characters.—Long and irregularly cylindrical, the general appearance being considerably that of the tubes of some of the tubicolous worms, particularly some of the chætoptera. Length of longest specimen 140 mm., width 30 mm.; surface uneven, bearing on and embedded in it various foreign bodies as sponges, hydroids, calcareous algæ, etc. Test rather thick, opaque white, semicartilaginous. Animal apparently attached along whole right side. Branchial orifice at anterior end, atrial nearly half way back on dorsal side; lobing of orifices obscure, apparently eight for each; scarcely siphonate, though atrial orifice at the summit of a prominence. Mantle very thin and delicate on the left side, but thick and strong on the right, forming on this whole side a distinct pad or "sole."

Respiratory system.—Tentacles 100 to 150, long and slender, several sizes. Hypophysis mouth horseshoe-shaped, the left limb nearly straight, the right strongly hooked inward but not coiled. Branchial sac drawn out behind the digestive tract into a straight appendage considerably longer than the portion in front of the intestine (pl. 36, fig. 42 *b. p.*), and about one-half as broad as the anterior part. Wall of sac slightly if at all plicate; internal longitudinal vessels bearing papillæ only at the points of crossing of the transverse vessels; that is, no intermediate papillæ present. Seemingly no exception to this. From 3 to 5 stigmata between the longitudinal vessels. Transverse vessels of nearly same size. Dorsal lamina a rather broad membrane, edge smooth throughout; sides of the membrane ribbed posteriorly but not anteriorly; extending considerably behind the esophageal opening but not to the end of the posterior pouch of the sac.

Alimentary system.—A very compact mass small in proportion to the size of the branchial sac, it being hardly longer than the portion of the sac in front of it, and considerably shorter than the posterior pouch of the sac. Esophagus narrow and sharply curved; stomach globose, inner wall longitudinally furrowed, somewhat irregularly, some furrows being bifurcate. Furrows about 14 in number. Loop of the intestine following the stomach long and close. Renal organ a finely ramifying network on intestinal wall and within the intestinal loop.

Reproductive system.—Lying in the intestinal loop, sperm duct and oviduct following closely the course of the rectal bend of the intestine, the oviduct only visible to surface view for the proximal two-thirds of the length of the two, the sperm duct lying deeper and appearing only toward the end of the course (fig. 42, *ov. d.* and *s. d.*). Male and female gonads not readily distinguishable in the specimens at hand.

This species belongs to the *mentula* section of the genus, that is, the section with the branchial sac extending well behind the intestinal viscera, and seemingly surpasses all other species in the length of the posterior pouch. So far as concerns size and proportions of the animal as a whole, it appears to resemble *Ascidia elongata* Roule more than any other species. However, in internal structure it appears to differ quite sharply from that species. Although the description of *elongata* (Roule, 1884) is not full enough to enable me to make comparison complete at every point, it is sufficient to warrant the inference that *vermiformis* differs from *elongata* in the greater relative length of the postvisceral sac pouch, in the greater number of tentacles, and in the absence of intermediate papillæ on the internal longitudinal vessels; also the intestinal mass of *vermiformis* seems to be more compact and more elongate, proportionally, than that of *elongata*. These inferences are drawn from Roule's statements concerning the similarities and differences between *elongata* and *mentula*.

Type-locality.—*Albatross* 2945, lat. 34° N.; long. 119° 29′ 30″ W., off southern California, 30 fathoms, pebbly bottom, February 6, 1889; 4 specimens.

Type.—Cat. No. 5792, U.S.N.M.

Worth noting is the fact that two crustaceans were found in the branchial sac of one of the specimens. These have been kindly identified by Miss Mary J. Rathbun of the United States National Museum. One was *Pontonia californiensis*, a shrimp; the other *Cryptophrys concharum*, a crab.

PHALLUSIA UNALASKENSIS, new species.

Plate 36, figs. 43–45.

Superficial characters.—Very soft and mobile to handling; elongate, subcylindric, length 6 cm. major, transverse diameter 2.5 cm. Firmly attached at posterior end to sand-encased worm tubes. Branchial orifice anterior, atrial distant from branchial about the diameter of the branchial siphon; both orifices 6-lobed, the lobes not conspicuous on surface, but clearly marked by radiating ridges on inner surface of test; orifices situated on summits of firm rounded mound-like siphons, the branchial larger (pl. 36, fig. 43). Test thin and transparent throughout except in the siphonal mounds. Mantle very thin and almost as transparent as glass excepting for the small scattered muscle fibers contained in it on the right side of the body and around the orifices; the abrupt thickening at the branchial orifice in the above-mentioned mound-like siphon forming a conspicuous object on the animal removed from the test.

Respiratory system.—Branchial tentacles about 24, of several sizes, but all very small in proportion to the size of the animal, situated on a low ridge running concentric with the peribranchial band, from which it is removed about one third the distance between the peri-

pharyngeal band and the branchial orifice; the individual tentacles separated from one another by a liberal interval (fig. 44, *b. t.*). Peripharyngeal band low and narrow, scarcely larger than the ridge carrying the tentacles; quite remote from the branchial orifice, making a large peribranchial area which is smooth and uninterrupted except by the tentacular circlet. Hypophysis mouth (*hy.*) rather small, horseshoe-shaped, somewhat broader than long, the horns approaching each other and directed toward the branchial orifice. Sub-neural gland and ganglion forming a single elongate mass removed from the hypophysis somewhat more than the length of the gland. Dorsal lamina (*d. l.*, fig. 44) low and broad anteriorly, changing gradually to a high, thin membrane near the esophageal opening, then tapering down rapidly to its termination some distance behind that point; sides ribbed throughout; edge remotely toothed posteriorly but not anteriorly. Branchial sac voluminous, not extending farther back than the visceral mass; the membrane corrugated, the corrugations very irregular, being neither continuous lengthwise nor of equal depth. Longitudinal vessels about 25 on each side, these large and membrane-like. Transverse vessels also somewhat higher than thick, but much smaller than longitudinal, rather narrow and of nearly the same size; distance between each two longitudinal vessels nearly equaling three spaces between transverse vessels. Papillæ restricted mostly to the crossings of the vessels, these being prominent and strongly curved, the concave side of the curve presenting a membrane-like expansion; intermediate papillæ few, irregularly scattered and small in comparison with the papillæ at the angles. Stigmata long and narrow, from 6 to 15 between the two longitudinal vessels (fig. 45).

Alimentary system.—Situated on left side, voluminous, occupying nearly two-thirds the length of the animal and the whole depth. Stomach situated at the extreme postero-dorsal angle of the body, somewhat longer than broad, distinctly set off from the intestine; wall with 14 or more folds showing prominently on inner surface but not at all on outer. Intestine proper forming a broad low reverse S as seen from the outer face, the proximal limb running along the ventral edge of the body from its issuance from the stomach; the distal or rectal limb along the dorsal edge and somewhat farther forward than the first loop of the intestine; anus obscurely 4-lobed. Renal vesicles and concretions thickly distributed in the wall of stomach and first part of intestine.

Reproductive system.—Testes ramified over outer surface of posterior end of stomach, and the portions of the intestine adjacent to stomach. Ovary a branched structure not visible on outer surface of the digestive viscera, but ramifying on the inner surface of the first intestinal loop. Gonoducts not recognized.

This species has considerable in common with *P. obliqua* (Alder), more seemingly than with any other. Indeed, in view of the fact that the collection contains but a single specimen—too small a number on which to base a satisfactory description of a species—I have tried to persuade myself that it might, provisionally at least, be considered as falling within the range of variation of *obliqua*, particularly as Hartmeyer has pointed out that *obliqua* is a highly variable species. However, the distinct 6 lobes of the branchial orifice, the remoteness of the ganglion and gland from the hypophysis, and the wide separation of the internal longitudinal vessels as compared with the transverse vessels, not to speak of several less important points, leaves no room for doubt about the distinctness of this Alaskan species from *obliqua*, its nearest of kin.

Type-locality.—A single specimen, *Albatross* 3315, lat. 54° 02′ 40″ N.; long. 166° 42′ W. (north of Unalaska Island), 277 fathoms, gn.m.s., August 15, 1890.

Type.—Cat. No. 5685, U.S.N.M.

PHALLUSIA ADHÆRENS (Ritter).

Ascidia adhærens RITTER, 1901, p. 227, pl. 27, figs. 1–5.
Ascidiella prunum HARTMEYER, 1909*a*, p. 1401.

Since Hartmeyer has considered *P. adhærens* a synonym for *P. prunum* (Müller), I have not only examined the specimens of the collection now in hand with special care, but have reexamined the original specimens from which *adhærens* was described and am forced to conclude that the Alaskan animals possess features of considerable and constant difference from *P. prunum*. Hartmeyer gives the tentacle number for *prunum* as 40–50, this being the average of a large number of specimens. The average number in *adhærens* is undoubtedly much fewer. I agree with Hartmeyer that the number of tentacles in this group is very difficult to determine with much accuracy, is subject to much individual variation, and hence is not of great value as a species character. Nevertheless, within wide limits and when averages are taken, it is of some value. The average for six specimens now before me I find to be 31, the maximum being 50 and the minimum 19.

But the two most decisive features are in the branchial sac and the alimentary tract. Van Name has recently published a drawing of the branchial membrane of *prunum*.[1] If this be compared with figure 5, plate 27 (Ritter, 1901), showing the sac of *adhærens*, it will be seen that, while the areas bounded by the intersecting longitudinal and transverse vessels in *prunum* are nearly square, in *adhærens* at least two areas between the transverse vessels are required to make one between the longitudinal vessels.

[1] Van Name, 1912, pl. 66, fig. 129.

Turning to the digestive tract, the descriptions and figures given by both Hartmeyer and Van Name make it apparent that the stomach of *prunum* graduates more insensibly into the intestine than it does in *adhærens*. By this difference what corresponds to the duodenal section of the intestine is broad at its proximal end and tapers distally in *prunum*, whereas in *adhærens* it is of nearly uniform diameter throughout. Again, the folding of the stomach wall is usually distinctly seen on the outer surface of the organ in *adhærens*, while this seems not to be so in *prunum*. There are probably other, smaller differences between the two species, but these are sufficient to indicate their distinctness.

It appears to me extremely doubtful if *P. columbiana* Huntsman is distinct from *adhærens*.

Three specimens, Kodiak Island, 16–25 fathoms, gravel bottom, W. H. Dall.

One specimen, New Harbor, Unga Island, 1872, W. H. Dall.

One specimen, Sitka, L. A. Beardslee, collector.

One specimen, *Albatross* 3558, lat. 56° 58′ N.; long. 170° 09′ W., Bering Sea, 25 fathoms, s. dk. sp. rky., September 3, 1893.

Ten specimens, Bering Sea, summer, 1900, Dr. H. Horn.

One specimen, *Albatross*, Loring, Alaska, April 29, 1903, Alaska salmon investigations.

The specimens collected by Doctor Horn are worthy of special mention in that, though from Bering Sea (it is unfortunate that the locality is not more definite), they are, in outward features at least, somewhat more typical than most of the other specimens coming from nearer the original localities, namely, the Shumagin Islands and Yakutat Bay.

CIONA INTESTINALIS (Linnæus).

The single specimen of *Ciona* in the collection is so badly out of shape and contracted that determination of all its characteristics is impossible. So far as can be ascertained, however, nothing would warrant separating it specifically from the old and widely distributed species. And in view of the fact that the species is definitely known to occur in the whole arctic region and also on the coast of Japan, western Canada, and California, it would be expected to be found in Alaskan waters.

The tentacles, branchial sac, and dorsal languets agree entirely with those of typical *intestinalis*. Uncertainty exists only as to the relation of the digestive tract and gonads, and here the uncertainty is entirely from the impossibility of determining the exact state of things, not from any recognized disagreement.

One specimen, *Albatross*, Alaska salmon investigations, Loring, Alaska, April 29, 1903.

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EXPLANATION OF PLATES.

PLATE 33.

Fig. 1. View of left side of *Eugyrioides dalli*, test removed. The first bend of the intestine is more open in the specimen figured than is typical. × 1. *b. s.*, branchial siphon; *int.*, intestine; *ov.*, ovary; *st.*, stomach; *tes.*, testis.

2. A tentacle of *E. dalli*. *b. t.*, branchial tentacle.

3. Branchial sac of *E. dalli*, inner surface. *i. l. v.*, internal longitudinal vessels; *s.*, stigmata; *t. v.*, transverse vessel.

4. *Halocynthia washingtonia*, surface view, left side. × 1. *a. s.*, atrial siphon.

5. Orifices of *H. washingtonia*. *a. s.*, atrial siphon; *b. s.*, branchial siphon.

6. Esophagus, stomach, and "liver" of *H. washingtonia*, showing wide separation of the parts of the liver. *es.*, esophagus; *l.*, liver; *l'.*, secondary liver; *st.*, stomach.

7. *Halocynthia haustor foliacea*. × *a. s.*, atrial siphon; *b. s.*, branchial siphon.

8. *Hartmeyeria triangularis*. × 2/3. *b. s.*, branchial siphon; *ped.*, peduncle.

9. *H. triangularis*, test removed to show particularly the arrangement of the muscle bands of the mantle. *b. s.*, branchial siphon; *int.*, intestine; *m. f.*, muscle fibers; *ov.*, ovary.

10. *H. triangularis*, left side, mantle with adhering alimentary and reproductive systems dissected and turned back to expose the inner face of these and the outer face of the branchial sac. *b. s.*, branchial siphon; *b. sc.*, branchial sac; *gon.*, gonad; *int.*, intestine; *l.*, liver.

11. *H. triangularis*. *b. t.* branchial tentacles; *ef*, *ef'* the unique epithelial folds; *gn.* ganglion; *hy*, the hypophysis; *pg–pg'*, peripharyngeal groove.

12. Atrial tentacles and periatrial fold, *H. triangularis*. *a. t.*, atrial tentacle; *p. a. f.*, periatrial fold.

13. Branchial membrane of *H. triangularis*. *b. f.*, branchial fold; *d. l.*, dorsal lamina; *t. v.*, transverse vessel.

PLATE 34.

Fig. 14. *Culeolus sluiteri*, surface view. × 1. *b. s.*, branchial siphon; *ped.*, peduncle.

15. Tentacle of *C. sluiteri*. *b. t.*, branchial tentacle.

16, 17. Gonads, right and left side respectively, of *C. sluiteri*. *int.*, intestine, *ov.*, ovary; *tes.*, testis.

18. *Styela macrenteron*. A small short individual, with a prominent intersiphonal horn. × 2/3. *b. s.*, branchial siphon.

19. *S. macrenteron*. An elongate individual, mantle of left side thrown back to expose the reproductive and alimentary systems. × 2/3. *ov.*, ovary; *r.*, rectum; *tes.*, testis.

20. The intestinal tract of *S. macrenteron* at its extreme of length and coiling. × 1. *an.*, anus; *int.*, intestine; *r.*, rectum; *st.*, stomach.

21, 22. *Styela hemicæspitosa*, "high" and "low" forms, respectively. × 1½.

23. Alimentary and reproductive systems of *S. hemicæspitosa* and their relation to each other. *ov.*, ovary; *tes.*, testis.

Fig. 24. *Styela sabulifera*, left side view, mantle removed to expose the parts. × 3. *gon.*, gonad; *st.*, stomach.

25. Hypophysis, branchial tentacles, dorsal lamina, and branchial sac of *Styela sabulifera*. *b. t.*, branchial tentacle; *d. l.*, dorsal lamina; *hy.*, hypophysis; *i. l. v.*, internal longitudinal vessels.

26. Gonad of right side of *S. sabulifera*. *ov.*, ovary; *tes.*, testis.

27. *Dendrodoa tuberculata*. A gonad of the most highly branched form. *gon.*, gonad.

PLATE 35.

Fig. 28, 29. *Corella japonica*, right and left side views respectively; test removed × 2. *b. s.*, branchial siphon; *int.*, intestine; *m. f.*, muscle fibers; *ov.*, ovary; *s. d.*, sperm duct; *st.*, stomach; *tes.*, testis.

30. Branchial sac of *C. japonica*. *d. l.*, dorsal lamina; *i. l. v.*, internal longitudinal vessels; *s.*, stigmata.

31. *Corynascidia herdmani*, right side, surface view. × 1. *b. s.*, branchial siphon; *ped.*, peduncle.

32. Alimentary and reproductive systems of *C. herdmani*. *ov.*, ovary; *ov. d.*, oviduct; *s. d.*, sperm duct; *st.*, stomach; *tes.*, testis.

33. Branchial membrane of *C. herdmani*. *i. l. v.*, internal longitudinal vessels; *s.*, stigmata; *t. v.*, transverse vessel.

34. Branchial tentacles and mantle muscle bands of *C. herdmani* *b. t.*, branchial tentacle; *m. f.*, muscle fibers.

35. Dorsal languets with adjacent parts of *C. herdmani*. *ant.*, anterior; *d. lu.*, dorsal languets; *i. l. v.*, internal longitudinal vessels; *rt.*, right; *s.*, stigmata; *t. v.*, transverse vessel.

36. Hypophysis and small piece of peripharyngeal groove of *C. herdmani*. *hy.*, hypophysis; *p. g.*, peripharyngeal groove.

PLATE 36.

Fig. 37. *Agnesia beringia*, left side, test removed. × 1. *b. s.*, branchial siphon; *int.*, intestine; *gon.*, gonad.

38. Alimentary and reproductive systems of *A. beringia*. *int.*, intestine; *ov.*, ovary; *ov. d.*, oviduct; *st.*, stomach; *tes.*, testis.

39. Branchial tentacles, peripharyngeal groove, and hypophysis of *A. beringia*. *b. s.*, branchial siphon; *b. t.*, branchial tentacle; *hy.*, hypophysis.

40. Whole dorsal area of branchial sac of *A. beringia* showing the processes on the transverse vessels with larger ones near the mid-dorsal line which seem to take the place of dorsal languets. *d. l.*, dorsal lamina; *p.*, papilla; *p. g.*, peripharyngeal groove; *t. v.*, transverse vessel.

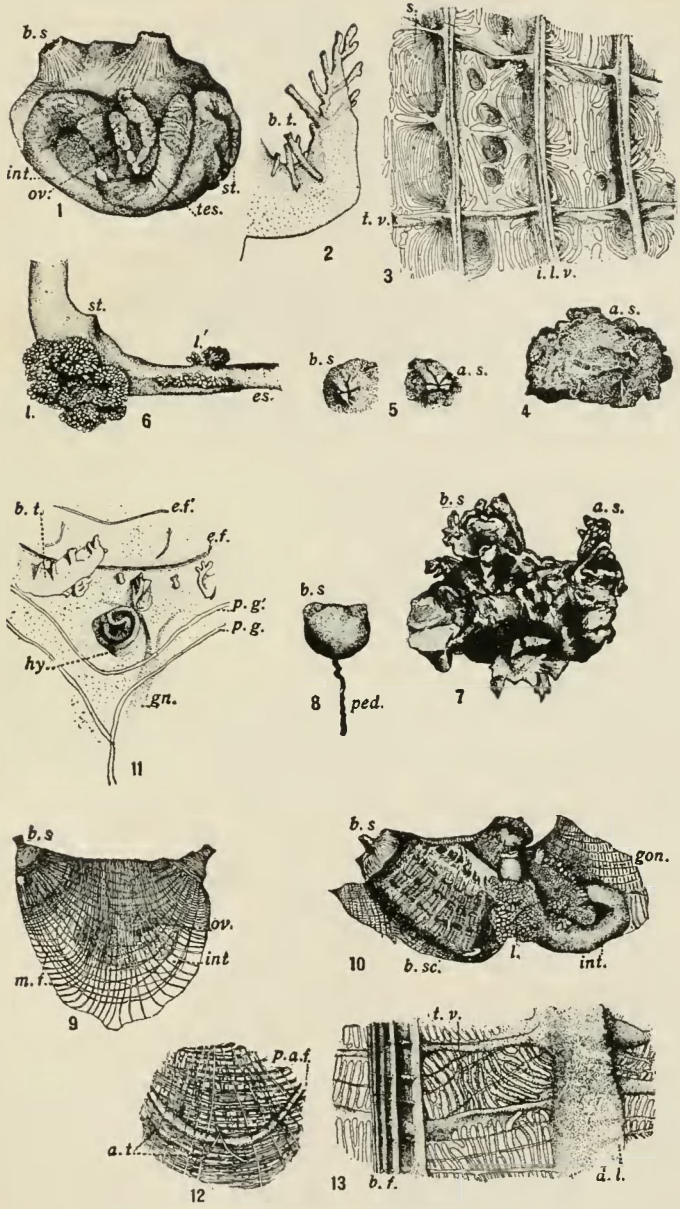
41. The branchial membrane of *A. beringia* in detail. *p.*, papilla; *t. v.*, transverse vessel.

42. *Phallusia vermiformis*, test removed, left side. × ½. *a. s.*, a trial siphon; *b. p.*, branchial pouch; *b. s.*, branchial siphon; *ov. d.*, oviduct; *s. d.*, sperm duct; *st.*, stomach.

43. *Phallusia unalaskensis*, anterior end, test removed. *b. s.*, branchial siphon.

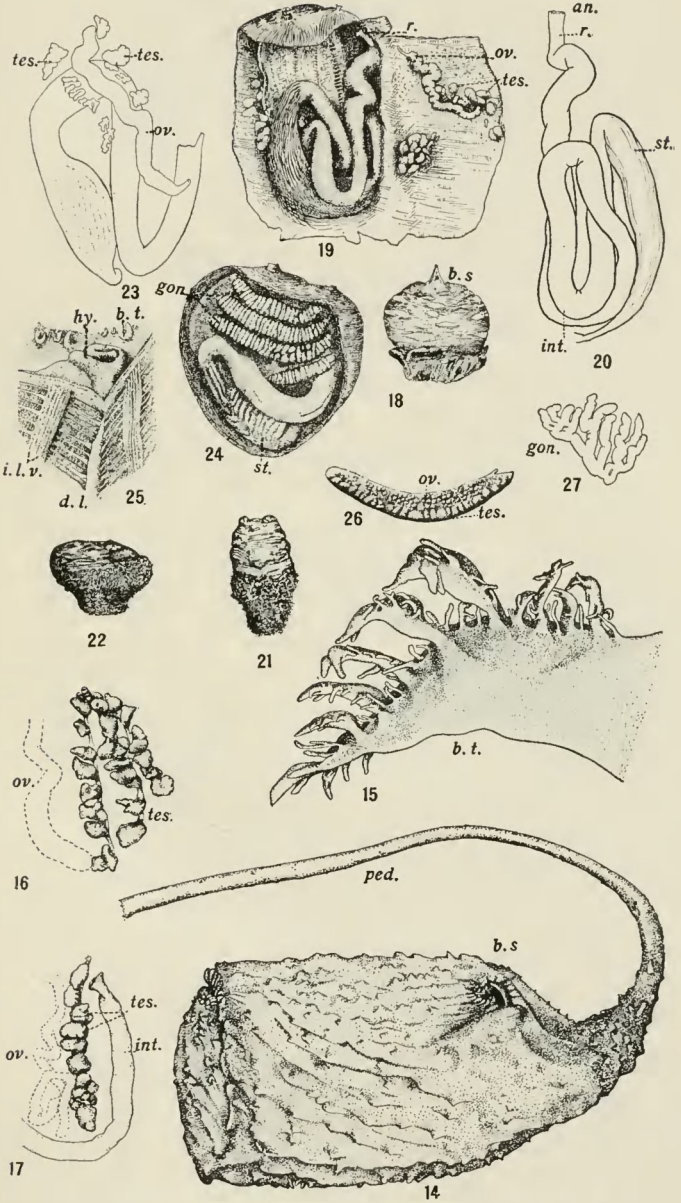
44. Hypophysis, branchial tentacles, and dorsal lamina of *P. unalaskensis*. *b. t.*, branchial tentacle; *d. l.*, dorsal lamina; *g.*, hypophyseal gland; *gn.*, ganglion; *hy.*, hypophysis; *p. g.*, peripharyngeal groove.

45. Branchial membrane of *P. unalaskensis*. *i. l. v.*, internal longitudinal vessels; *p.*, papilla; *t. v.*, transverse vessel.



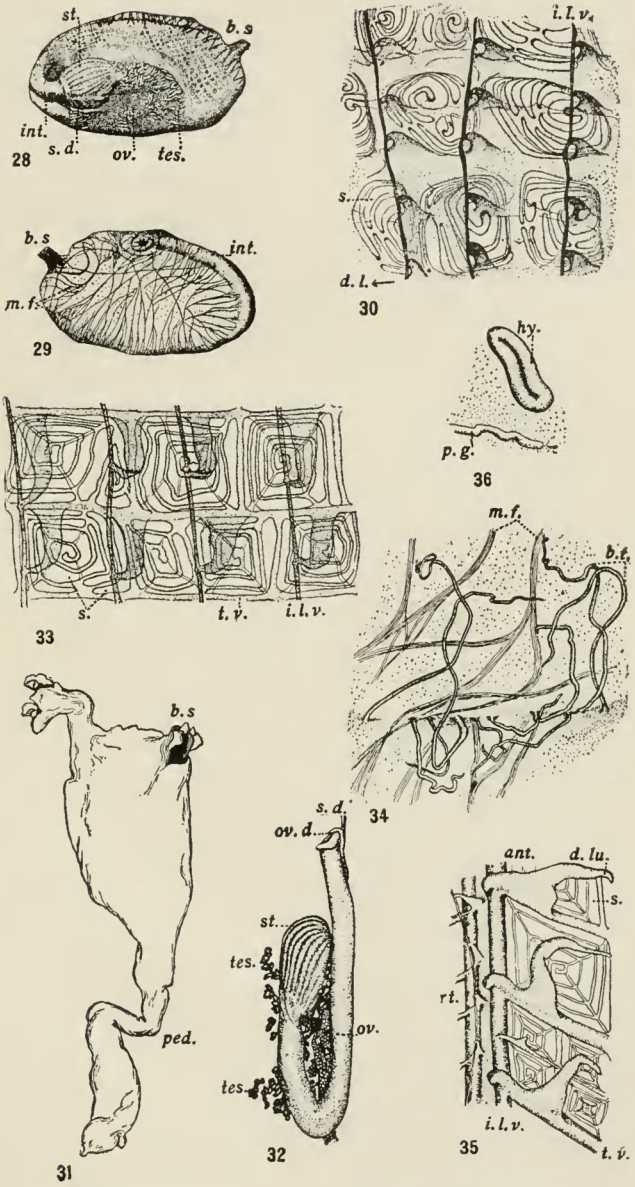
SIMPLE ASCIDIANS FROM THE NORTHEASTERN PACIFIC.

FOR EXPLANATION OF PLATE SEE PAGE 504.



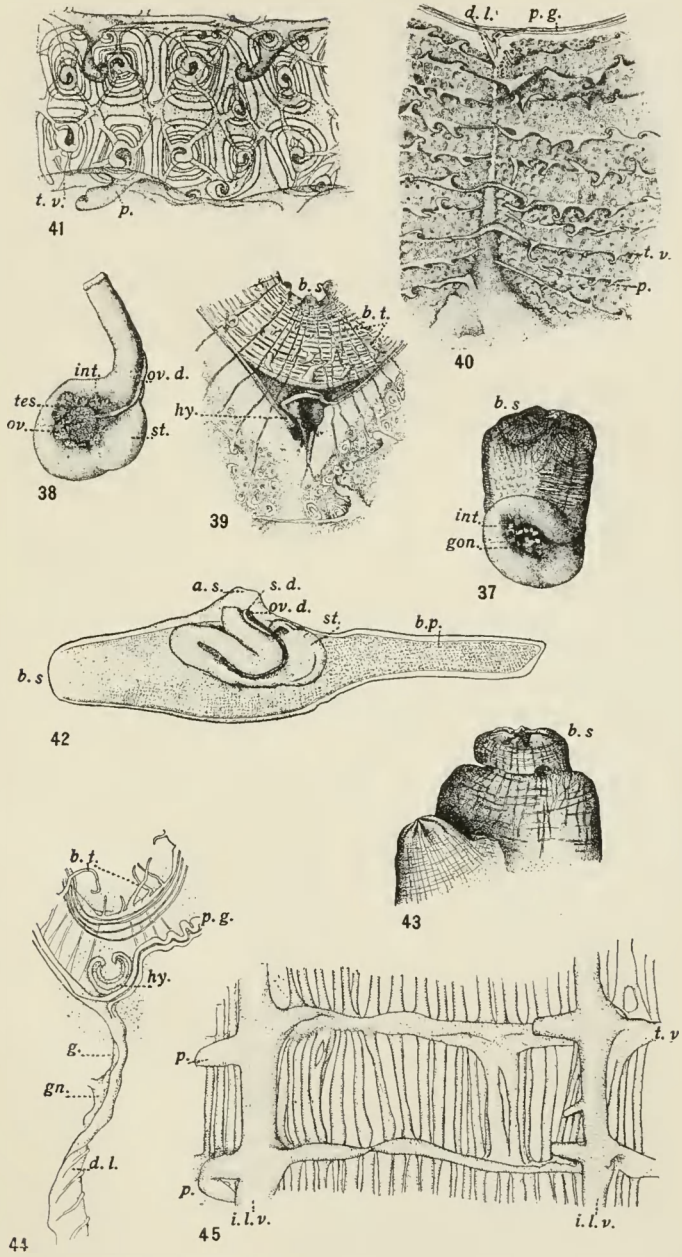
SIMPLE ASCIDIANS FROM THE NORTHEASTERN PACIFIC.

FOR EXPLANATION OF PLATE SEE PAGES 504-505.



SIMPLE ASCIDIANS FROM THE NORTHEASTERN PACIFIC

FOR EXPLANATION OF PLATE SEE PAGE 505.



SIMPLE ASCIDIANS FROM THE NORTHEASTERN PACIFIC.

FOR EXPLANATION OF PLATE SEE PAGE 505.

MAMMALS COLLECTED BY THE SMITHSONIAN-HARVARD EXPEDITION TO THE ALTAI MOUNTAINS, 1912.

By N. Hollister,

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INTRODUCTION.

The fauna of the Altai Mountains, Siberia and Mongolia, has been virtually unrepresented in American museums. The United States National Museum, therefore, gladly welcomed the generous invitation of Dr. Theodore Lyman to participate, with the Museum of Comparative Zoölogy at Harvard, in a zoological expedition to that part of Asia during the summer of 1912, and I was detailed as its representative for field work.

Doctor Lyman's plans were to follow the routes of the Demidoff [1] and the Swayne [2] sporting expeditions to the country of the famous Altai wild sheep, on the Mongolian side of the Little Altai, and, while securing good specimens of the sheep, ibex, and other large game of that region, to make the most of the opportunity afforded to collect the smaller vertebrate animals for the two museums. The resulting trip extended to nearly four months, but so much time was taken by the long journey to and from the scene of operations that only about thirty-five days of actual collecting were enjoyed. We were fortunate, however, in our selections of camp sites in three different physiographical regions, and by working at high pressure when the opportunity offered we were enabled to make much greater and more varied collections than we had anticipated. Doctor Lyman, whose time was chiefly devoted to the collecting of large game, had engaged as my assistant in the work of collecting the smaller vertebrates Conrad Kain, of Vienna. Without the assistance of this indefatigable mountaineer, whose resourcefulness, ability, and good companionship are known to Alpine Club people of many countries, the collection would be much smaller than it is. The collection of

[1] E. Demidoff, After Wild Sheep in the Altai and Mongolia, pp. i–xii; 1–324; numerous illustrations and map, London, 1900.

[2] H. G. C. Swayne, Through the Highlands of Siberia, pp. i–xiv; 1–259; 60 illustrations and map, London, 1904.

mammals, including about 350 specimens, has been turned over to the National Museum for determination. An account of the birds, with descriptions of three new forms, has been published by Mr. Outram Bangs.[1] The collections have now been divided between the two institutions.

ITINERARY.

Having been joined by Kain in London the latter part of May, 1912, we proceeded to St. Petersburg, completed the arrangements for permits with the Russian officials, engaged the services of an interpreter, and departed over the Siberian Railway, June 8, for the East. On the morning of June 12 we left the train at Novonikolævsk, on the Obi River, and before evening were embarked on a steamer for the upper river. Biisk, the head of navigation for steamers, was reached on the night of June 15. Arrangements for horses and tarantasses were made for the first stage of the trip over the post road to the southward and on the morning of June 18 we began the long trip by team to the last Russian outpost, Kosh-Agatch. At Ust-Inya, something over half the distance, we negotiated with Kalmuks for horses for our pack trip beyond Kosh-Agatch, and these reached Kosh-Agatch with us June 28. A delay of two days at Ust-Inya gave me the opportunity for setting a few traps, and the first mammals were collected there.

Kosh-Agatch, on the Chuisaya (or Tchouia) Steppe, is the end of the road, and from here on to the Mongolian border the trip was by pack and saddle horses. Our party now consisted of Doctor Lyman, Kain, and myself, and the Russian interpreter and four native Tartars and Kalmuks, with 15 horses. Two days' journey across the desert steppe and up the valley of the headwaters of the Chuya (or Tchouia) River brought us to the "last timber," a few larch trees (*Larix sibirica*) near Tschornia Creek, a branch of the Chuya near the Mongolian border, in Tchegan-Burgazi Pass. Here a suitable camp was pitched and I settled down, July 1, with Kain and one Tartar camp man, to make a collection of the mammals and birds of the Little Altai. Doctor Lyman, with the rest of the outfit, pushed on through the pass for a circle of the range in Mongolia after big game, particularly sheep and ibex.

Except for a few larches in some of the valleys on the Siberian side the region is without timber, though there is evidence that other sheltered slopes have been deforested within comparatively recent times. Trees were, however, never plenty, and the constant drain on the limited growth by Kirghiz, Kalmuk, and Tartar has almost cleaned up the remnant. The Mongolian side is absolutely without bush or tree, and as on the Chuisaya Steppe, "*tezek*," or dry horse-

[1] Bull. Mus. Comp. Zoöl., vol. 54, No. 16, pp. 463–474, January, 1913.

dung is the principal fuel for cooking. The country about the site of our Tchegan-Burgazi camp is steep rolling mountains, with rocky slides and beautiful alpine tops. Close by, to the southwest, is the snow-capped border range, and from the higher points the country as far as can be seen is rolling grassy alps, interspersed with rocky, desert areas, and snowy ranges. The altitude of our camp in the valley bottom was 8,300 feet, and the highest point near camp for a day's collecting, about 12,000 feet. The rolling alplands average about 9,000 to 10,000 feet.

While we were engaged in work in the Tchegan-Burgazi, Doctor Lyman had a most interesting and successful trip into Mongolia, by way of the Tchegan-Burgazi Pass, returning by the Tarkuta Pass and over the range to our camp. His hunting was chiefly in the Suok Plain and Taylüke Valley country, desert mountains and plateaux, and his notes on this trip will be found beyond with the text on the sheep, ibex, and other game animals.

The Tchegan-Burgazi camp was occupied, and active collecting carried on until July 27, when, Doctor Lyman having returned, we broke camp and moved northward to the center of the Chuisaya Steppe. One night's trapping and a day of shooting and preparing specimens gave us a small collection of steppe species and we reached Kosh-Agatch on the return trip July 29. Two days were occupied with packing and preparing for the homeward journey, the plans for which included a week's stay in the heavily forested mountains north of Ongudai, and on July 31 we departed over the post road to the north.

August 5 we reached the point we had selected as a good place to work in the forested mountains, and pitched camp at 6,875 feet, just in the edge of the forest, at the north end of Tapucha Pass, about 5 miles south of the village of Tapucha. This locality is about 125 miles southeast of Biisk. The camp was in a beautiful forest of nut pine (*Pinus cembra*), heavy with moisture and thick with underbrush and windfalls, with alps and rocky tops near by, and snow peaks in the distance. Here collecting was carried on until August 11, when, the weather having warned us of the severe mountain winter approaching, and our time being nearly up, we left on the last part of the tarantass trip, and reached Biisk late on the night of August 14.

The trip by steamer down the Obi was made without incident worthy of note, and on August 21 we took the westbound train at Novonikolævsk for St. Petersburg. We were fortunate in many ways, and though the weather throughout our stay in the Altais was unspeakably bad, and rain, sleet, hail, and snow the rule rather than the exception, yet the trip passed off without serious trouble. We were treated with great kindness and attention by the Russian officials at every point, and the settlers along the post roads always gave us the best to be had.

Thirteen new species and subspecies of mammals, collected on this expedition, have been described in preliminary papers. These are:

Sorex roboratus.
Myotis petax.
Mustela lymani.
Mustela lineiventer.
Phodopus crepidatus.
Myopus morulus.
Apodemus nigritalus.
Sicista napæa.
Allactaga grisescens.
Eutamias asiaticus altaicus.
Ochotona nitida.
Lepus quercerus.
Procapra altaica.

ANNOTATED LIST OF SPECIES.

SOREX ARANEUS BOREALIS Kastschenko.

1905. *Sorex araneus borealis* KASTSCHENKO, Обз. Млекопит. Зап. Сибири и Туркестана [Synopsis mammals western Siberia and Turkestan], I, Chiroptera and Insectivora, p. 85. Tomsk.

Six specimens from alpine meadows at 9,000 to 9,500 feet in Tchegan-Burgazi Pass, and three specimens from the forests near Tapucha at 6,400 feet. The series, collected in July and August, contains specimens in both the summer and winter pelages. This race averages somewhat smaller than any European form of *araneus*, except the Spanish *granarius*. It is otherwise very like true *araneus*. No definite type-locality is given in the original description, but the account is largely based on specimens collected by Middendorff in the "far north." The range, as given by Kastschenko, includes all of extreme northern Siberia, all the mountain ranges from the Altai eastward, and possibly all of eastern Siberia.

Measurements of Sorex araneus borealis from the Altai Mountains, Siberia.

Locality.	Number.	Sex.	Head and body.	Tail vertebræ.	Hind foot.	Condylobasal length of skull.	Zygomatic breadth.	Breadth of braincase.	Depth of braincase (median).	Mandible.	Maxillary tooth row (entire).	Mandibular tooth row (entire).	State of wear of teeth.
			mm.	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	
Tchegan-Burgazi Pass...	175429	Male....	66	32	11.5	17.1	5	9.1	4.5	9	7.5	6.7	Much worn.
Do.....	175431	...do.....	64	37	12.5	17.6	5	8.8	5.1	9.1	7.9	7.4	Not worn.
Do.....	175432	...do.....	63	38	12.5	17.5	4.9	8.7	5	9	7.9	7.4	Do.
Do.....	175433	...do.....	67	31	12.5	17.4	5	9.1	4.7	9.1	7.5	7	Slightly worn.
Do.....	175434	...do.....	61	37	12	.....	5	.....	.....	8.9	7.5	7.1	Not worn.
Do.....	175430	Female..	61	36	12	17.5	4.9	9	5.1	9	7.9	7.2	Slightly worn.
Tapucha.....	175437	Male....	64	37	12	17.6	5	9.1	4.6	9.5	7.9	7.4	Not worn.
Do.....	175435	Female .	67	40	12.5	.....	.....	9.5	5.4	9.7	8.1	7.5	Do.
Do.....	175438	...do.....	62	39	12	17.6	5	9.2	5.2	9.5	8	7.4	Slightly worn.

SOREX ROBORATUS Hollister.

1913. *Sorex roboratus* HOLLISTER, Smiths. Misc. Coll., vol. 60, No. 24, p. 2, March 13.

The unique type-specimen of this shrew was trapped in the heavy forests of *Pinus cembra* about 5 miles south of Tapucha, August 7. The species is readily distinguishable in the flesh from *Sorex araneus*

borealis, common in the same forest, by its large size, dark color, and large hind foot. In general size it approximates *Sorex araneus tetragonurus*, but seems not to be closely related to any known form.

MYOTIS PETAX Hollister.

1912. *Myotis petax* Hollister, Smiths. Misc. Coll., vol. 60, No. 14, p. 6, November 29.

No bats were seen in the desert mountains along the Mongolian frontier. The single specimen collected on the trip, the type of this new species, flew into the window of our room in the post station at Kosh-Agatch on the evening of July 30. Bats seem to be rare in the Altai region and only two or three were seen during the trips on the upper Obi and on the long drive from Biisk to the southward. Two bats recorded by Kastschenko[1] from Cherga, as *Vespertilio daubentonii*, are doubtless of this species.

CANIS ALTAICUS (Noack).

1910. *Lupus altaicus* Noack, Zool. Anz., vol. 35, p. 465.

There is reason to believe that wolves are fairly plentiful in the Altai; but, strange to say, only one was seen alive by members of our party. The perfect skull of a wolf, found dead near our Tchegan-Burgazi Pass camp, was preserved. Compared with skulls of *Canis lupus* from Sweden, this specimen has considerably smaller teeth, a longer, more slender rostrum, and higher, rounded audital bullæ. The differences seem great enough to warrant the separation of the form. Without specimens of the earlier named varieties from Tibet and China for comparison, I use the name *altaicus* of Noack as unquestionably referring to this animal. We saw a number of wolf skins, including some of small pups, in the trading post at Kosh-Agatch.

That the wolves destroy many wild sheep, especially during the winter season, is hardly to be doubted. The great numbers of sheep skulls and skeletons found in the mountains show that the game suffers considerably from some cause. Referring to conditions on the Mongolian side of the range, Lyman writes in his journal:

> The bottom of the valley is a perfect bone yard. On an average there must be a sheep head for every 200 yards over the 10-mile range of which I am writing. My hunter found a large ram freshly killed by a wolf. Wolves may be the destructive agency. I saw but one in the valley, at a considerable distance. Among the great number of sheep heads in the valley bottom I saw none of very large size.

Demidoff,[2] in 1897, while hunting in what seems to be the exact valley of which Lyman writes, had some of his ponies attacked one night by wolves.

The wolf skull from Tchegan-Burgazi Pass is fully adult, with basal suture closed, and is probably a male. It measures: Condylobasal

[1] Рез. Алтайской зоол. Экеп. 1898. [Results Altai Zool. Exped. 1898], Vertebrates, p. 12, Tomsk, 1899.

[2] After Wild Sheep in the Altai and Mongolia, 1900, p. 143.

length, 244 mm.; zygomatic breadth, 140; mastoid breadth, 82.5; post-orbital constriction, 41; interorbital constriction, 45.5; rostral breadth over canine, 47; depth of braincase, crest excluded, 64.5; palatal depth behind tooth row, 66; rostral depth behind canine, 36.1; mandible, 190; maxillary tooth row, 107.5; mandibular tooth row, 122.5; upper carnassial, 25 by 14.2; first upper molar, 16 by 20.5; lower carnassial, 27.9 by 10.7.

VULPES VULPES TARIMENSIS Matschie.

1908. *Vulpes tarimensis* MATSCHIE, Wiss. Exp. Filchner China und Tibet, vol. 10, 1 teil, p. 166.

The fox is said to be common in the desert mountains in the vicinity of Tchegan-Burgazi Pass. Lyman saw one on the Mongolian side, and we found two skeletons, from which the skulls were saved, on the Siberian slopes. In the trading post at Kosh-Agatch were a number of skins. We purchased a skin from Kalmuks which, from their account, must have been collected near the site of our Tschornia Creek camp, where we obtained the skulls

The form represented is separable from the European *Vulpes vulpes* by its peculiar color and the large, high audital bullæ. The general color of skins is a yellowish-buff; the face, top of head, and an irregular dorsal stripe tawny-ochraceous; ears black outside. The tail is quite grayish, in marked contrast to the color of the body. The throat, upper breast, and stripe the entire length of ventral side, slate color, mixed with white and buff. This fox is apparently the *Vulpes tarimensis* of Matschie, based on the *flavescens* of Blanford[1] (not? *flavescens* Gray). Noack has already referred the Altai fox[2] to *Vulpes flavescens* Gray. Owing to the general confusion regarding the foxes of central Asia, and to the uncertainty as to the origin of the type of *flavescens*, it seems best, at present, to follow Matschie and treat the northern fox of the *flavescens* type as distinct.

The Kalmuks call this fox "*dil-koo*."

Cranial and dental measurements of Vulpes vulpes tarimensis from the Tchegan-Burgazi Pass.

	175175. Male ? ad.	175176. Male ? ad.
	mm.	*mm.*
Condylobasal length	137	.....
Zygomatic breadth	73	.....
Mastoid breadth	47.1	47.7
Interorbital breadth	26.3	26
Rostral breadth over canines	22.9	24
Palatal depth behind tooth row	34.7	34.8
Rostral depth behind canine	16.7	16.8
Mandible	106	102.5
Maxillary tooth row	65	62.5
Mandibular tooth row	71.7	69.7
Upper carnassial	13.6 by 7.8	13.5 by 8.3
First upper molar	10 by 12.6	9.5 by 12.5
Lower carnassial	15 by 5.9	16.4 by 6.5

[1] Scientific Results of the Second Yarkand Mission, 1879, pp. 22-24.

[2] Zool. Anz., vol. 35, 1910, p. 457.

MUSTELA LYMANI Hollister.

1912. *Mustela lymani* HOLLISTER, Smiths. Misc. Coll., vol. 60, No. 14, p. 5, November 29.

A stoat was seen running over the rocks at our Tschornia Creek camp, early in the morning, July 1. At the camp in the timber 5 miles south of Tapucha we were fortunate enough to shoot the adult male which was afterwards made the type of this new species. No weasels of the *M. nivalis* group were seen; several skins in full winter pelage, noted in the trading post at Kosh-Agatch, were of the larger species and doubtless *lymani*. Kastschenko has, however, recorded *M. nivalis* from the River Komoorlu in his report on the collection made by the Tomsk University expedition of 1901.[1]

MUSTELA (PUTORIUS) LINEIVENTER Hollister.

1913. *Mustela lineiventer* HOLLISTER, Proc. Biol. Soc. Washington, vol. 26, p. 2, January 18.

Three specimens, all fully adult, from about 9,000 feet in the open alps at Tchegan-Burgazi Pass, July 8, 10, and 23. All were trapped at marmot burrows, and the habits of the animals seem to be much like those of the American black-footed ferret. We saw a number of skins of this polecat in the trading post at Kosh-Agatch, and our Kalmuck and Tartar camp men knew the animal well, using for it the Russian name "*kar-yoke'*," which doubtless includes the related *Mustela eversmanni*, an animal not obtained by us. The polecats were perhaps even more infested with fleas than were the ground squirrels and marmots.

MELES AMURENSIS ALTAICUS Kastschenko.

1901. *Meles amurensis altaicus* KASTSCHENKO, Ann. Mus. Zool. Acad. St.-Pétersbourg, vol. 6, p. 613.

We purchased a single skin of this badger. It was collected north of Kosh-Agatsh in the Baskkaous Valley country. No signs of badgers were noted in the border mountain range.

PHODOPUS CREPIDATUS Hollister.

1912. *Phodopus crepidatus* HOLLISTER, Smiths. Misc. Coll., vol. 60, No. 14, p. 3, November 29.

Our single night's trapping in the center of the Chuisaya Steppe, July 28, added 16 of these little hamsters to our collection, and several other specimens not preserved were caught. The burrows are closed by the animals during the day, and there is little evidence of the abundance of the species until the visit to the traps in the morning. A single specimen was caught by Kain, in his hands, on the mountain above Tschornia Creek, at 10,000 feet altitude, July 26. Our per-

[1] Ann. Mus. Zool. St.-Pétersbourg, vol. 7, 1902, p. 291.

sistent trapping on these higher alplands of the frontier range had failed to produce a specimen of this mouse. The mountain specimen agrees in all details with the series from the Chuisaya Steppe. The wonderfully developed cheek pouches of nearly all the specimens examined were well filled with tiny seeds.

MYOSPALAX MYOSPALAX (Laxmann).

1773. *Mus myospalax* LAXMANN, Kongl. vet. Acad. Handl., vol. 34, p. 134.

One specimen from the border of alps and forest in the mountains near Tapucha. It would seem from the great number of earth mounds in this vicinity that this species is an abundant one, but our traps were not suited for capturing it, and we had difficulty in obtaining even a single specimen.

MYOPUS MORULUS Hollister.

1912. *Myopus morulus* HOLLISTER, Smiths. Misc. Coll., vol. 60, No. 14, p. 1, November 29.

The unique type-specimen of this lemming was trapped, August 6, under a log in the thick nut pine forest 5 miles south of Tapucha, at 6,875 feet altitude. Only a single specimen of the genus has heretofore been recorded from Asia. Middendorff[1] mentions a skin and skull from the west coast of Okhotsk Sea, which he identified, by a comparison with Liljeborg's colored plate, as the Scandinavian species, *M. schisticolor*. At the same time Middendorff prophesied that these lemmings would eventually be found to range across the continent, and the capture of a specimen in the Altai goes far toward the fulfillment of his prediction. Middendorff's record is without doubt authentic, and is entitled to more consideration than has hitherto usually been shown it.

EVOTOMYS RUTILUS (Pallas).

1778. *Mus rutilus* PALLAS, Nov. Spec. Quad. Glir. Ord., p. 246.
1874. *Evotomys rutilus* COUES, Proc. Acad. Nat. Sci. Philadelphia, p. 187.

We found this species abundant in the damp mountain forests near Tapucha, at about 6,900 feet. Sixteen specimens were preserved, collected from August 6 to 11.

Pallas described his *Mus rutilus* from the wooded regions and alps east of the Obi River. From this, and the fact that in the same account he refers specimens from the mouth of the Obi to his species, but remarks upon a difference in color, it is reasonable to argue that the "type-locality" of *rutilus* is near the head of the Obi, close to the Altai, and not at a point near the Arctic coast. Our specimens may, then, be considered as fairly typical. Thomas has recently recorded *rutilus* from the Syansk Mountains, 100 miles west of Lake Baikal.[2]

[1] Sibirische Reise, vol. 2, 1853, p. 198.
[2] Ann. and Mag. Nat. Hist., ser. 8, vol. 9, p. 398, April, 1912.

In color our specimens from the Altai differ conspicuously from a series of *E. wosnessenskii*, from Kamchatka, in the decidedly darker tone of the red, and the much grayer sides. In all the 16 specimens (except one which has the teeth so worn that the enamel pattern is obliterated) the last upper molar has on the inside four salient angles and three re-entrant angles, the posterior loop being deeply cut by an inner re-entrant angle. Ten adults measure, averages and extremes: Head and body, 101 mm. (95–107); tail vertebræ, 34 (30–38); hind foot, without claw, 16.7 (16–17.5).

EVOTOMYS RUFOCANUS (Sundevall).

1846. *Hypudæus rufocanus* SUNDEVALL, Öfversigt af Köngl. Vet. Akad. Förhandl., vol. 3, p. 122.

1897. *Evotomys rufocanus* BAILEY, Proc. Biol. Soc. Washington, vol. 11, p. 122, May 13.

I can not distinguish the six specimens of this mouse collected in the Tapucha forests, August 6 to 11, from Scandinavian examples. A single immature specimen collected at Tchegan-Burgazi Pass is somewhat paler, and has grayer sides and a restricted dorsal stripe; but with the variation in both *rufocanus* and *latastei* in mind is seems best to refer this specimen to the same form as the small series from Tapucha. Thomas has recorded *Evotomys rufocanus latastei* from a point 100 miles west of Lake Baikal, and remarks that the specimens agree closely with examples from Kamchatka.[1] Dr. J. A. Allen has kindly lent me a series of seven specimens of his *latastei*, from Gichiga, northeast Siberia, but as his specimens are all immature my comparisons with *latastei* are of little consequence. My three immature specimens from Tapucha agree better, however, with immature examples from Norway than with the young of *latastei*.

The single Tchegan-Burgazi Pass specimen was trapped in open alps at about 9,000 feet elevation. As there are indications of timbered draws within comparatively recent times in the immediate vicinity, it is probable that before the almost complete deforestation of such places the species was more abundant in the frontier range than it is at the present time.

MICROTUS OBSCURUS (Eversmann).

1841. *Hypudacus obscurus* EVERSMANN, Учен. Записки, Казанскимъ унив., (VIII), I, p. 156. [Mém. sav. univ. Kasan.]

1899. [*Microtus arvalis*] var. *obscurus* TROUESSART, Cat. Mamm., I, p. 558.

Thirty specimens, from Tchegan-Burgazi Pass and the forests near Tapucha, seem to represent *M. obscurus*, described by Eversmann from the Altai. The species is allied to *Microtus arvalis*, but is larger, with a much larger skull, actually smaller teeth, and is much darker and richer colored. In the 30 specimens the true *arvalis*

[1] Ann. and Mag. Nat. Hist., ser. 8, vol. 9, p. 397, April, 1912.

enamel pattern is present in 28. Two have m^3 abnormal. In one, No. 175333, the last loop has an additional inner reentrant angle posteriorly; and another, No. 175325, has the second outer salient angle of m^3 so reduced, and the first inner triangle so lengthened transversely, that it has the appearance of a second loop, much like the anterior loop. It seems quite certain that this is an independent species, and not a race of *Microtus arvalis*. Poliakoff evidently confused other forms with it. It is uncertain from his account whether he considered the original example the Altai or the Kirghiz Steppe specimen, listed by him. Eversmann in his original description, however, mentions only the Altai and gives measurements of only one specimen.

Measurements of selected adult specimens of Microtus obscurus from the Altai Mountains, Siberia.

Locality.	Number.	Sex.	Head and body.	Tail vertebræ.	Hind foot.	Condylobasal length of skull.	Zygomatic breadth.	Interorbital constriction.	Occipital breadth.	Nasal.	Mandible.	Maxillary tooth row, alveoli.
			mm.	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*
Tchegan-Burgazi Pass	175326	Male	117	43	18	.....	15.4	3.5	.....	7.3	15.7	5.9
Do	175322	Female	118	44	17	.....	14	3.4	.....	7.2	16.3	6.1
Do	175325	...do	114	43	17.5	26.4	14.2	3.3	11.4	7.4	16.5	6
Do	175237	...do	117	42	17	26	14.4	3.5	11.5	7	15.7	6.3
Tapucha	175339	Male	134	50	18.5	27	14.6	3.5	12.4	7.7	16.1	6.1
Do	175340	...do	126	40	18	26.7	14.1	3.4	11.7	6.9	15.2	5
Do	175341	...do	124	47	19	27	14.5	3.5	12	7.2	15.2	5.7
Do	175342	...do	119	40	18	25.5	14	3.4	12.2	6.9	15.5	6.1
Do	175343	...do	127	52	18	26.3	14.2	3.2	11.6	7.5	15.6	5.1
Do	175336	Female	120	45	16.5	25.2	14.1	3.1	11.6	7	14.9	6
Do	175337	...do	116	41	18.5	25.6	14.4	3.5	11.5	7	15.2	5.8
Do	175344	...do	131	43	18	.....	14.8	3.2	12.1	8	16.2	6
Do	175345	...do	127	50	17.5	26.2	15	3.1	11.9	7.1	16.2	6
Do	175346	...do	124	47	17	25.5	14.6	3.4	11.9	7.1	15.9	5.8
Do	175347	...do	118	38	17	25.4	14	3.5	11.5	7.4	15.5	5.9
Do	175348	...do	124	47	18	26	14	3.5	11.5	7	15.5	6.1
Do	175349	...do	125	47	17	26.5	14.9	3.3	12	7	16.1	6
Do	175350	...do	127	44	17	26.6	14.5	3.5	12	7.6	16.2	6.4

MICROTUS (STENOCRANIUS) EVERSMANNII (Poliakoff).

1881. *Arvicola eversmannii* POLIAKOFF, Annex. Mem. Acad. St.-Pétersbourg, vol. 39, p. 285.

1901. *Microtus* (*Stenocranius*) *eversmanni* KASTSCHENKO, Ann. Mus. Zool. Acad. St.-Pétersbourg, vol. 6, p. 186.

Eight specimens from the heavy pine forests near Tapucha are referred to this species, described from the Altai. The skins in this series are readily distinguishable from specimens of *tianschanicus* from the desert ranges to the southward by their richer, darker color, above and below. There seem to be no differences in external measurements nor in the skulls and teeth of the two forms and they probably intergrade. There is a great variation in the size of skull in both forms. Skulls of adults in the Tapucha series range from 25 to 27.5 mm. in condylobasal length. There is a strong tendency

toward distinctly grooved incisors in several specimens. The name *eversmannii* of Poliakoff has been misapplied by Büchner to an *arvalis*-like *Microtus* from further south. This has caused considerable confusion and Mr. Thomas has recently remarked that "judging from Büchner's figure of the skull, *M. eversmanni* Poliakoff, would seem to be either this [*M. arvalis*] or a related form, and not a *Stenocranius.*" [1] I believe that Professor Kastschenko, in his paper on the forms of *Stenocranius* [2] fixes the true status of *eversmannii*, as a mountain form of the wide ranging *Stenocranius* type. In this paper Professor Kastschenko quite properly raises the question if the forms of the subgenus *Stenocranius* known to him are not possibly all races of one wide ranging species. These forms include *M. gregalis* (Pallas) not Radde,[3] not Poliakoff, of eastern Siberia; *M. eversmannii* (Poliakoff), in the mountains of south-central Siberia; *M. slowzowii* (Poliakoff), of the west Siberian steppes; and *M. raddei* (Poliakoff), of the Transbaikal country. To these Kastschenko adds, in the same paper, three new forms of *M. slowzowii; lutea* from Tomsk, *brevicauda* from the Yakootsk District, and *tridenticulata;* the last described as a "variety," not a race, with abnormal enamel pattern, and coming from no special territory.

The *Microtus eversmanni* of Trouessart,[4] is likewise not the *M. eversmannii* of Poliakoff, but apparently that of Büchner, and therefore relates to some form of *arvalis.*

MICROTUS (STENOCRANIUS) TIANSCHANICUS Büchner.

1889. *Microtus tianschanicus* BÜCHNER, Wiss. Res. Przewalski Central-Asien Reis. Zool. theil, vol. 1, p. 107.

Thirty-one specimens from the desert mountains near the Mongolian frontier in Tchegan-Burgazi Pass. The skins in this excellent series are uniformly much lighter colored than the lot from the forested mountains near Tapucha, which I have referred to *M. eversmannii.* Aside from the color differences I can detect no characters to separate them. The enormous difference in size of adult skulls of this species is most exceptional but it seems to represent true individual variation. Examination of fresh specimens showed seven plantar tubercles and, in old males, large side glands well forward of the hips. Of two pregnant females examined July 18, one contained 7 embryos, 4 right, 3 left, 12 mm. in diameter; and one 8 large fetuses, 4 right and 4 left. These mice seemed most abundant in the open alplands at from 9,000 to 10,000 feet altitude.

[1] Ann. and Mag. Nat. Hist., ser. 8, vol. 9, p. 398, April, 1912.

[2] Ann. Mus. Zool. Acad. St.-Pétersbourg, vol. 6, 1901, pp. 165–206.

[3] The *Microtus gregalis* of Radde and of Poliakoff (not of Pallas), from Transbaikalia, is renamed *Microtus poljakowi* by Kastschenko in his paper in the Ann. Mus. Acad. St.-Pétersbourg.

[4] Cat. Mamm., vol. 1, p. 599.

Measurements of selected adult specimens of Microtus (Stenocranius) from the Altai Mountains.

Locality.	Number.	Sex.	Head and body.	Tail vertebræ.	Hind foot.	Condylobasal length of skull.	Zygomatic breadth.	Interorbital constriction.	Occipital breadth.	Nasal.	Mandible.	Maxillary tooth row.
M. eversmanii.												
			mm.	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*
Tapucha	175382	Male	130	34	17.5	27.5	13.7	2.2	11.4	7.4	16.5	5.5
Do	175384	...do	122	30	16.5	26.5	13.5	2.1	10.4	7.4	16.1	5.6
Do	175388	...do	120	29	16	24.9	13.2	2.1	10.5	6.7	15.1	5.5
Do	175385	Female	121	25	15.5	25.5	13	2.4	10	7	15	6
Do	175389	...do	118	26	15	25	13	2.4	10.3	6.7	16	5.7
M. tianschanicus.												
Tchegan-Burgazi Pass	175351	Male	116	33	17	.....	14	2.4	11.2	.....	16.1	6
Do	175352	...do	114	30	17.5	25.2	12.6	2.6	11	7.1	15.1	5.7
Do	175357	...do	123	28	17.5	.....	.....	.....	10.5	7	16.2	6
Do	175359	...do	123	26	16	27	13.6	2.4	11.2	7	16.1	6.1
Do	175360	...do	115	35	16	27	13.4	2.4	11.5	6.5	16	6
Do	175369	...do	127	33	16	.....	13.5	2.5	.....	7.3	16	6
Do	175356	Female	112	25	14	23.8	12.9	2.5	10	6.5	15.1	5.5
Do	175363	...do	119	23	16	25	12	2.4	10.2	6.4	15.4	5.9
Do	175367	...do	113	25	16	24.5	11.6	2.3	10	6.4	15.1	5.1
Do	175372	...do	120	27	15.5	25	13	2.4	10	6.6	15.3	6
Do	175376	...do	115	29	15.5	25	12.9	2.5	10.1	6.8	15.6	5.5

ALTICOLA (PLATYCRANIUS) STRELZOVI (Kastschenko).

1899. *Microtus strelzovi* KASTSCHENKO, Рез. Алтайской Зоол. Эксп. 1898. [Results Altai Zool. Exp.] Tomsk, p. 50, pl. 2, figs. 2, 3.

1901. *Microtus (Platycranius) strelzowi* KASTSCHENKO, Ann. Mus. Zool. Acad. Sci. St.-Pétersbourg, vol. 6, p. 201.

Seventy-two specimens from the frontier range in the Tchegan-Burgazi Pass, July 1–26. This mouse is by far the most abundant mammal in the rocky parts of the desert mountains. At least a hundred specimens were caught in addition to the number preserved. Our experience with the species exactly agrees with Kastschenko's account of its local habitat, and we caught the animal only among the loose rocks. So closely is it confined to rocky cliff sides that, although exceedingly abundant in such places, traps set only a few feet out in the grassy creek bottoms, or in the alps above the rocks, almost invariably failed to catch specimens. The fully adult examples, when freshly caught and in full coat, are strikingly handsome mammals. Most of our specimens were taken at about 8,500 feet elevation, and although a few were captured up to a thousand feet higher, the lower cliffs near the stream beds seemed to be the normal home. At Tapucha we did not catch this mouse, doubtless because we trapped almost entirely in the forest and alps. The type-locality is Lake Tenga, only about 25 versts south of Tapucha, but at a much lower elevation and in a much more open country.

The subgenus *Platycranius*, described by Kastschenko as a subgenus of Microtus, is clearly an aberrant *Alticola*, as surmised by Miller.[1] The palate, enamel pattern, mammary and plantar tubercle

[1] Ann. and Mag. Nat. Hist., ser. 8, vol. 1, p. 97, January, 1908.

formulas are as in *Alticola*, and the two distinguishing characters, the large ears and peculiarly flattened skull, seem best considered as subgeneric.

Measurements of selected adult specimens of Alticola (Platycranius) strelzovi from the Tchegan-Burgazi Pass, Altai Mountains, Siberia.

Number.	Sex.	Head and body.	Tail vertebræ.	Hind foot.	Condylobasal length of skull.	Zygomatic breadth.	Interorbital constriction.	Occipital breadth.	Occipital depth.	Nasals.	Mandible.	Maxillary tooth row.	Mandibular tooth row.	Observations.
		mm.	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	
175208	Male....	119	43	19.5	27.5	15.7	3.8	13.4	6	7.8	16.6	6.1	5.7	
175210	...do.....	118	42	19.5	26.5	16	4	13	6.1	8	16.6	5.5	5.7	
175216	...do.....	119	41	22	27.5	16.2	4	13.1	6.1	8	16.9	5.5	5.4	
175218	...do.....	127	47	20	28.1	16.5	4.2	13.5	6	8.4	17.3	6	5.9	Old.
175222	...do.....	127	45	20.5	27.5	16.2	4	13.4	6.5	8.1	16.9	6	6	
175229	...do.....	118	45	20.5	28	16.5	4.2	13.1	6.2	8.4	17	6	5.7	
175240	...do.....	104	33	20	25.2	14.5	4.1	13	6.1	7.4	15	5.5	5.4	Young adult.
175241	...do.....	122	46	20.5	27.4	16	3.9	13.4	5.7	8.1	17	5.5	5.5	Old.
175257	...do.....	105	39	20	25.5	14.5	4	12	6	7.5	15.5	5.1	5.3	Young adult.
175259	...do.....	110	38	20	26.1	14.9	4.7	13	6.5	7.6	16.1	5.5	5.5	Do.
175261	...do.....	105	36	21.5	25.5	14.6	3.9	12.5	6.4	6.8	16	5.2	5.5	Do.
175266	...do.....	109	36	20	25	.....	4.2	12.4	6.7	7	15.5	5.5	5.5	Do.
175269	...do.....	105	33	20	25	14.6	4.2	13	7	7	15.4	5.5	5.4	Do.
175199	Female.	119	43	21.5	27.6	16.5	4.2	13.1	6	8	16.7	6.2	5.7	
175200	...do.....	118	44	21	28	16.5	4.2	14.1	6.3	8.1	17	5.7	6	
175214	...do.....	108	38	21.5	24.1	14.2	4.1	12.2	6.1	7	15	5.5	5.2	Do.
175211	...do.....	105	37	20.5	25.5	14.7	4.1	.....	6.5	7.1	15.5	6	5.5	Do.
175212	...do.....	109	42	20	25.5	14.9	4	12.8	6.2	8	16	5.7	5.3	
175213	...do.....	110	38	20.5	26	15	4.3	12.5	6.5	7.9	16.2	5.5	5	
175219	...do.....	133	47	20	30	17	4	14.2	6.5	8.7	17.2	6.8	6.4	Old.
175220	...do.....	133	47	20	28.2	16.5	4.5	14	6.4	8.4	17	6	5.9	
175223	...do.....	104	36	21	26	15	4.2	12.5	6.5	7.2	16	5.3	5.7	
175230	...do.....	123	48	21	27.5	16.2	4	13.2	6.2	8.1	17	6.1	6	
175242	...do.....	128	44	20	29	16.5	4.3	14	6.5	8.1	17.1	6	5.9	
175243	...do.....	119	43	20	27.5	16	4.1	13	6.5	8	17.1	6.5	5.7	
175249	...do.....	107	39	20	26	14.7	4.2	12.1	6.5	7.2	16.2	5.7	5.9	Young adult.
175256	...do.....	122	44	20	27.5	16	4.2	12.9	6.2	7.8	17	5.9	6	
175260	...do.....	101	38	20	25.2	14.5	4.1	12.5	6.5	7.2	15.5	6	5.9	Do.
175263	...do.....	105	34	20	24.5	14.1	4	11.9	6.1	7	15.5	5.3	5.4	Do.
175264	...do.....	135	43	21	29	16.5	4.2	14.3	6.5	9	17.5	6.5	6	Old.
175265	...do.....	124	37	20	28.9	16.3	4.2	14.1	6.5	8.8	17.5	6	5.8	
175267	...do.....	109	37	20	26.1	15	4.1	13	6.4	7.1	15.1	5.5	5.5	

APODEMUS NIGRITALUS Hollister.

1913. *Apodemus nigritalus* HOLLISTER, Smiths. Misc. Coll., vol. 60, No. 24, p. 1, March 13.

Ten specimens from the heavy forests of *Pinus cembra* near Tapucha, August 6–11. These were trapped in small grassy openings in the woods, usually under logs or bushes. This species is a member of the *speciosus* group, and is rather nearly related to *Apodemus peninsulæ* of Korea and northern China. It is readily distinguishable from the smaller *Apodemus sylvaticus tscherga*, which occurs in the same forests, by its much larger size, more reddish coloration, the heavy supraorbital beads on the skull, and the presence in females of eight mammæ instead of six.

APODEMUS SYLVATICUS TSCHERGA (Kastschenko).

1899. *Mus tscherga* KASTSCHENKO, Рез. Алтайской Зоол. Эксп. 1898. [Results Altai Zool. Exp.], Tomsk, p. 46.

1910. *Mus sylvaticus tscherga* KASTSCHENKO, Ann. Mus. Zool. Acad. St.-Pétersbourg, vol. 15, No. 3, p. 283.

1912. *Apodemus tscherga* THOMAS, Ann. and Mag. Nat. Hist., ser. 8, vol. 9, p. 397, April.

Three specimens. Two of these were trapped under thorn bushes on the dry, semi-desert hills near Ust-Inya, at 3,850 feet, June 24, and one was captured at the Tapucha camp in heavy forest bordering open alps at 6,875 feet, August 8. The species was evidently a common one at Ust-Inya, as several examples, either ruined by the trap or very immature, were caught in the one night's trapping, in addition to those saved. At Tapucha this little mouse occurs with the much larger and differently colored *Apodemus nigritalus*, but it seemed by no means as abundant as the latter species. With these specimens, and a good series of the larger species from the Altai before me, it is plain that Kastschenko's original description of *Mus tscherga* relates wholly to this, the smaller, species. Later[1] Kastschenko received an additional collection from the Altai which contained specimens of the larger species, and assuming that these were the adults of the species previously named *tscherga*, he proceeded to rediagnose his form. The young of the larger species, of a size about equal to the adults of the smaller *tscherga*, have the hind foot always 22 mm. or more, or about as in the fully grown (hind foot of adults of *A. nigritalus* measures 22 to 25 mm.), while the adults and immature of *tscherga* have a hind foot measurement of 19 or 20 mm. The form described by Miller from Russian Turkestan[2] as *Apodemus microtis* seems indistinguishable from *Apodemus sylvaticus tscherga*.

Measurements of Apodemus from the Altai Mountains, Siberia.

Species and locality.	Number.	Sex.	Head and body.	Tail vertebræ.	Hind foot.	Condylobasallength of skull.	Zygomatic breadth.	Interorbital constriction.	Breadth of braincase.	Nasal.	Mandible.	Maxillary tooth row.	Mandibular tooth row.	Observations.
A. sylvaticus tscherga.			mm.	mm.	mm.	mm.	mm.	mm.	mm.	mm.	mm.	mm.	mm.	
Ust-Inya.....	175172	Male...	94	77	20	22.8	11.5	3.8	11.2	9	13.1	3.5	3.9	Teeth moderately worn.
Do.....	175173	Female	97	72	19	22.4	12.5	3.6	10.9	10	14	3.6	3.6	Teeth much worn.
Tapucha.....	175174	Male...	83	75	19	21.2	11.9	3.9	11.2	8.6	13	3.6	3.8	Teeth slightly worn.
A. nigritalus.														
Tapucha.....	175162	...do....	102	96	23	25	13.2	4.1	12.4	10.2	15.5	3.7	3.7	Do.
Do.....	175164	...do....	122	102	25	27.5	14.8	4.3	12.5	11.5	17	4.1	4	Type.
Do.....	175167	...do....	109	.....	23	25.6	14	4.5	12.3	10.6	16.1	3.9	3.9	Teeth much worn.
Do.....	175169	...do....	100	84	22	25.1	13	4.2	12.1	10	15.4	3.7	3.9	Teeth slightly worn.
Do.....	175170	...do....	108	87	25	25	13	4.1	12.1	9.5	16.5	4	4	Do.
Do.....	175163	Female	106	88	23	24.5	13.4	4.1	12	9.7	15.5	4	3.9	Do.
Do.....	175165	...do....	102	92	22	24.1	13.1	4.2	12	9.3	15.7	3.6	3.7	Do.
Do.....	175166	...do....	97	87	23	23.6	13	4	12	9.5	15	4	4	Teeth unworn.
Do.....	175168	...do....	87	74	23	22	12.6	3.9	12	8.6	14.2	4	4	Do.
Do.....	175171	...do....	113	101	23	26.1	13.5	4.1	12.1	11.1	17	4.1	3.9	Teeth much worn.

[1] See Ann. Mus. Zool. St.-Pétersbourg, vol. 7, 1902 p. 301.

[2] Proc. Biol. Soc. Washington, vol. 25, p. 60, April 13, 1912.

SICISTA NAPÆA Hollister.

1912. *Sicista napaea* HOLLISTER, Smiths. Misc. Coll., vol. 60, No. 14, p. 2, November 29.

A single specimen of this jumping mouse was trapped in the damp pine forest 5 miles south of Tapucha, August 6. It was caught in a densely grown part of the woods near the border of extensive open alplands, at 6,875 feet elevation.

ALLACTAGA GRISESCENS Hollister.

1912. *Allactaga grisescens* HOLLISTER, Smiths. Misc. Coll., vol. 60, No. 14, p. 2, November 29.

Two specimens from the center of the Chuisaya Steppe, near the banks of the upper Chuya River, 8 miles south of Kosh-Agatch, July 28. One of these was trapped; the other was shot by Kain on the open steppe just before dark. A few burrows, too large for *Phodopus*, which were seen on the steppe were doubtless the dens of these jerboas. As stated in the original description, this new species seems related only to *Allactaga mongolica* and its subspecies *longior*. It is possibly confined to the Chuisaya Steppe, the fauna of which is decidedly Mongolian, as might be expected from its isolation from the great Siberian plains and its connection with the northern extensions of the Gobi, the Kobdo and Suok Plains, by the Tarkuta, Tchegan-Burgazi, and Bain-Chagan Passes.

The Kalmuks call this jerboa "*yel'-mahn.*"

MARMOTA CENTRALIS (Thomas).

1909. *Arctomys centralis* THOMAS, Ann. and Mag. Nat. Hist., ser. 8, vol. 3, p. 260, March.

Four skins and skulls and four odd skulls from the Tchegan-Burgazi Pass. The skin of this marmot is one of the chief articles of trade from the natives. We saw great bales, containing hundreds of skins each, in the trading post at Kosh-Agatch, and the trader informed us that he had only a short time before sent a large shipment to Biisk. The animal is known to all the natives by the Russian name "*su-rock'.*"

The Altai marmot was first separated by Brandt, but his name for the animal appears to be a *nomen nudum*, in every instance of its use, down to Kastschenko's paper on the Results of the Tomsk Altai Expedition in 1899. In the meantime the name has become valid as a synonym of *Marmota bobak* in Trouessart's Catalogue of Mammals, 1897. The *Marmota centralis* of Thomas, from the northern Tian-Schan seems to be identical with the Altai form, however, so the species is provided with a name. The relationships seem close with the Transbaikal *Marmota sibirica*, of which *centralis* will doubtless prove to be a subspecies.

CITELLUS EVERSMANNI (Brandt).

1841. *Spermophilus eversmanni* BRANDT, Bull. Sci. Acad. St.-Pétersbourg, vol. 9, p. 43.

1903. *Citellus eversmannii* ALLEN, Bull. Amer. Mus. Nat. Hist., vol. 19, p. 142, March 31.

We first saw this spermophile at Cherga, two days' journey south from Biisk. Two young specimens were killed in the house where we spent the night at that place. The people called them rats and seemed little surprised to find them in the buildings. The next day, June 20, we noted many of the animals between Shebalina and Tapucha. Every grassy flat was inhabited by them, and though a cold rain was falling the spermophiles paid no attention to it and were apparently all out feeding. Ground squirrels were abundant in the Alpine flats between Tapucha and Ongudai, but only a few were seen beyond Ongudai until we reached the desert frontier range. The animals were exceedingly abundant about our Tchegan-Burgazi camp, and during our stay in this neighborhood we collected a series of 50 specimens. During the early part of July most of the animals, and especially the nursing females, were in a faded and ragged state of pelage, but before the end of the month we secured many specimens in the bright, fresh coat. The great difference in age between numerous young examples indicates a long breeding season. We found spermophiles in all sorts of places, and the burrows were placed both in rocky cliffs and far out in the open alplands. In addition to innumerable fleas, the spermophiles are terribly infested with botts (*Cuterebra*, sp.) and it is rare to obtain an example without half a dozen or more in some part of the skin.

Our Tartar and Kalmuk camp men called this species "*you-mah-rŭnk'*."

EUTAMIAS ASIATICUS ALTAICUS Hollister.

1912. *Eutamias asiaticus altaicus* HOLLISTER, Proc. Biol. Soc. Washington, vol. 25, p. 183, December 24.

A single chipmunk was seen at Chibit, June 26. Later, in the heavier forested region south of Tapucha, we found the species abundant and collected a series of 12 specimens. Not one was seen beyond a point about 15 miles south of Tapucha. The animal is remarkably quiet for a chipmunk and might readily be passed many times unobserved. Only rarely did we hear a low "chip" note.

OCHOTONA NITIDA Hollister.

1912. *Ochotona nitida* HOLLISTER, Smiths. Misc. Coll., vol. 60, No. 14, p. 4, November 29.

Thirty-one specimens; 17 from near the Mongolian border in Tchegan-Burgazi Pass, and 14 from the Tapucha camp. Along the upper Chuya River, in Tchegan-Burgazi Pass, we found pikas chiefly in the lower rocky cliffs along the main river and its tributary, Tschornia Creek, at about 8,500 feet elevation. The call note is decidedly different from that of the American pikas, and was not at first recog-

nized. It is much more like the high pitched note of some small bird and lacks all the nasal tone so characteristic of our species. The old animals, from July 1 to 25, were chiefly in the left-over winter pelage, or in a ragged state of molt. The young were already nearly grown, some of them molting the post-juvenal pelage and renewing into the brown fall coat of the adult. Numbers were caught in rat traps baited with rolled oats, a method I have never found at all successful with various American species.

In the heavily forested mountains near Tapucha we found pikas on the rocky tops, and even in dry rocky creek beds far below timberline. In these latter localities they seemed entirely out of place to us, but were nevertheless fully at home. The specimens taken here from August 7 to 10 are in full fresh fall coat. Our Tartar and Kalmuk camp men called the pika "*seen-ă-stăft'*."

I believe that true *O. alpina*, from which I have separated this species, will be found to inhabit the Bia-Altai, the region north of Lake Teletzkoi, and between the Bia and the Katun Rivers. There is a specimen of *alpina* in the United States National Museum labeled "Barnaul."

Measurements of Ochotona nitida from the Altai Mountains, Siberia.

Locality.	Number.	Sex.	Head and body.	Hind foot.	Occipitonasal length.	Condylobasal length.	Zygomatic breadth.	Breadth of braincase.	Mandible.	Maxillary tooth row.	Observations.
			mm.	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	
Tchegan-Burgazi Pass.	175391	Male	207	30.5	47.2	44.7	23.5	20	31.1	8.9	
Do	175393	do	190	29	43.8	41.6	22.4	18.6	30.2	8.5	Young adult.
Do	175397	do	195	29.5	45.5	42.9	22.1	19	30	8.1	
Do	175400	do	188	29	44	41	23	18.1	29	8.2	Do.
Do	175403	do	197	30	46.5	44.1	22.5	19	30.5	8.5	
Do	175390	Female	208	30	47.6	43.6	22.5	20.5	30.5	8.5	Type.
Do	175392	do	206	30	44.5	43.5	22.7	19	30	8	
Do	175394	do	182	30	44	41	21.5	19.1	29.1	8.1	
Do	175405	do	220	28	44.2	42.5	22.6	19.5	30.5	8.5	
Tapucha	175406	Male	185	30	45.6	42.4	23	19	30.4	8	
Do	175407	do	200	30.5	48.5	45	23	19.4	31	8	Old.
Do	175408	do	189	30	47.9	44.5	22	19.4	30	8.5	
Do	175412	do	202	30	44.6	42.6	22.1	18	30.4	8	
Do	175413	do	180	28	42	39.5	21.1	17.1	27.5	7.8	Young adult.
Do	175415	do	218	32	46.5	45	24.5	19.7	31.1	8.7	Old.
Do	175418	do	185	28	45	42.5	23.5	19.7	28.8	8.2	
Do	175419	do	180	29	44.1	41	22	19	29	8.1	
Do	175409	Female	189	29	43	41.1	21.9	18.7	29.4	8	Young adult.
Do	175410	do	202	30.5	47.8	44.4	24.5	19.5	31.2	8.1	
Do	175411	do	191	28	44.5	41.2	22	18	28.2	8.1	
Do	175414	do	205	30	41.8	42.7	23	19.2	30	8	
Do	175416	do	191	29	46	42	23	19	30	8.1	
Do	175417	do	191	28	43	40.8	21.1	18.5	29	7.9	Do.

LEPUS LUGUBRIS Kastschenko.

1899. *Lepus lugubris* KASTSCHENKO, Рез. Алтайской Зоол. Экск. 1898 [Results Altai Zool. Exp.], Tomsk, p. 57, pl. 2, fig. 4.

1900. *Lepus timidus altaicus* BARRETT-HAMILTON, Proc. Zool. Soc. London, p. 90, February 6. (Not *Lepus altaicus* WATERHOUSE, Mammalia, II, p. 45, 1848, in synonymy of *Lepus hybridus* DESMAREST.)

We met with this hare only in the Tapucha forests where, with difficulty, we secured three specimens; a skin and skull of a male in

juvenal pelage, head and skull of a male in post-juvenal pelage, and an odd skull of an adult. These specimens are nearly topotypes of *lugubris*, which was described primarily from a specimen taken at Ongudai. Neither of the skins has the outer side of the ear entirely black, as described of the species by Kastschenko and by Barrett-Hamilton; this may possibly be due to their immaturity. The adult skull, compared with skulls of *timidus*, agrees perfectly with the account given by Kastschenko. It is evident from the differences in the age of the two young animals secured that this hare breeds at least twice during the season.

LEPUS ZAISANICUS Satunin.

1907. *Lepus zaisanicus* SATUNIN, Ann. Mus. Zool. St.-Pétersbourg, vol. 11 (1906), p. 161.

Four hares from Tchegan-Burgazi Pass, near the Mongolian border, differ from all other Asiatic species, and agree very well with the color description and measurements of *Lepus zaisanicus*, and are therefore provisionally referred to that species. The upper incisors of these specimens, both juvenal and adult, present a remarkable appearance in being projected far forward. The skull of *zaisanicus* was not described by Satunin, and it is impossible without direct comparison to judge if these specimens actually represent his species, but from the external characters and on geographical grounds it seems most probable. The specimens were collected from July 9 to 25, on the high open alplands above Tschornia Creek, at from 8,700 to 10,000 feet elevation. Hares were by no means abundant in these mountains and comparatively few were seen. Lyman reported seeing a considerable number while sheep hunting on the Mongolian side of the range.

LEPUS QUERCERUS Hollister.

1912. *Lepus quercerus* HOLLISTER, Proc. Biol. Soc. Washington, vol. 25, p. 182; December 24.

The hares of the "*tolai* group" collected on the Chuisaya Steppe, near Kosh-Agatch, differ conspicuously from all the previously described species from northern Mongolia and Siberia, and are specifically distinct from the hares of the border mountains to the southward, which I have referred to *Lepus zaisanicus* Satunin. Hares are much more numerous on the desert steppe than in the higher mountains, and six were killed by members of our party during the 24 hours collecting in the center of the plain. Four specimens were preserved. It is not at all unlikely that this species is confined to the Chuisaya Steppe, as we failed to find it in the desert mountains to the southward, and the heavy forest on the north must prove an effective barrier to such a desert species. The Kalmuks call this hare "*ko-yun'*."

CAPREOLUS PYGARGUS (Pallas).

1771. *Cervus pygargus* PALLAS, Reise prov. Russ. Reichs, vol. 1, p. 453.
1843. *Capreolus pygargus* GRAY, List mamm. British Mus., p. 176.

Roedeer are fairly abundant in the timbered parts of the Altai. We saw many horns, attached to small parts of the frontals, in the trading posts, and at Kosh-Agatch the trader had a great many pairs. He told us that the animal is very abundant at times north of Kosh-Agatch, and in the winter many come down in the low foothills near town. It is then that most of these heads are taken. We obtained five representative sets of antlers from this place. In the Tapucha forest in August, in the early morning or late evening, we frequently heard roebucks barking. Lyman's journal, written at this place, contains the following notes:

The roedeer near the pass to the south of Tapucha appear to spend the day in the thick cover in the valleys. Here they are protected by the rank grass and the bushes. In the late evening they come up on the high rocky outcrops which rise on both sides of the valley bottom. I saw two in the timber, probably females, and one on the hillside. The calling of the males, which I heard several times, is much like the barking of an angry dog. At first I thought there were very few roedeer in this region, but later I came to believe they were fairly plenty. If the weather be fine, it should not be difficult to get a shot if one concealed oneself in these outcrops in the evening.

Two varieties of the Siberian roedeer have been described by Méhely.[1] A slender horned lowland form from Tomsk, Ekaterinburg, and other plains localities he calls *Capreolus pygargus leptocerus*, and a heavy horned upland form from Minusinsk he calls *C. p. pachycerus*. These subspecies are based on hunters' frontals and antlers, such as are collected and traded by natives throughout the southern Siberian mountains in great numbers. Kastschenko [2] states that no roedeer are known on the Siberian plains, and he believes that Méhely's horns are from unknown localities. He states further:

There are no roedeer near Tomsk, which Méhely repeatedly indicated as one source of his material; but by sportsmen and by commerce many horns are brought to Tomsk from the Altai. Probably the horns were obtained by Count Zichy in Tomsk.

In an earlier paper, Kastschenko [3] has shown the immense variation exhibited by roedeer antlers from the Altai. Our observations in the trading posts, and the series of antlers brought back by us, agree well with his remarks; and these names for races of roedeer, based on antlers of unknown origin, may both be placed in the synonymy of *pygargus*.

OVIS AMMON (Linnæus).

1758. *Capra ammon* LINNÆUS, Syst. Nat., ed. 10, vol. 1, p. 70.
1777. *Ovis ammon* ERXLEBEN, Syst. Regn. Anim., vol. 1, p. 250.

After crossing the Chuisaya Steppe, the second day south from Kosh-Agatch, we saw weathered horns, and an occasional skull, of

[1] Dritte asiatische Forschungsreise des Grafen Eugen Zichy, vol. 2, Zoolog. Ergeb. I, Säugethiere, 1901, p. 18, pl. 4.
[2] Ann. Mus. Zool. Acad. St.-Pétersbourg, vol. 7, 1902, pp. 294–296.
[3] Results Altai Zool. Exp., 1898, Tomsk, 1899, pp. 25–49, pls. 3, 4.

the wild sheep in the valley of the upper Chuya; and as we neared the Mongolian line these relics of the former occurrence of sheep, to the north of their present distribution, became more common. In the bed of Tschornia Creek were numbers of old weathered horns and parts of skulls, and though sheep do not range in these hills at the present time, in summer at least, they must have commonly grazed here not many years ago. In the border range, at the head of Tschornia Creek, Kain found signs of sheep which he believed had been made that same spring, and also much evidence that bands winter on those slopes. Several heads and parts of carcasses, probably of animals destroyed by wolves, were comparatively recent kills. During the summer, of late years, most of the sheep range on Mongolian territory. We were assured by all the natives that no sheep are known in the country north of Kosh-Agatch. We saw numbers of skins in the trading post, all of which were said to come from the neighborhood of Tchegan-Burgazi Pass.

Lyman collected four fine rams on the Mongolian slopes, in the Taylüke Valley, not far from Tarkuta Pass, July 6 to 20. Thomas[1] has fixed the type-locality of *Ovis ammon* as the upper Irtisch River, Siberia, so our specimens may be assumed to be fairly typical. These four summer skins are almost free of the old pelage and are renewing the coat. The hair is very short, mixed white and brown, and the general color varies greatly, from quite white to brown with the rump patch not at all conspicuous. Among the winter skins seen in Kosh-Agatch, all said to come from Tchegan-Burgazi Pass, the range of color was equally great, and we purchased examples of the extremes. One is rather light brown with grayish neck and shoulders, and the underside of body pure white. The other is very dark blackish-brown, almost black, with whitish dorsal stripe, broadly pure white on withers and mixed with brown hairs on neck and lower back. All the winter skins show the large white rump patch in sharp contrast to the color of back and hips. The horns of our four rams are good average size, by no means "record heads," and exhibit the normal circumference and spread. The skulls and horns measure as follows:

Skulls of *Ovis ammon*.	175180	175181	175182	175183
ADULT MALES.	*mm.*	*mm.*	*mm.*	*mm.*
Greatest length	367	371	375	389
Condylobasal length	357	362	347	359
Greatest breadth	193	195	194	207
Length upper tooth row, alveoli	98	99	98	100
Length lower tooth row, alveoli	102	105	104	103
Length right horn around curves	1,205	1,096	1,146	1,278
Length left horn around curves	1,155	1,185	1,153	1,204
Circumference horn at base	470	453	475	485
Distance between horn tips	875	673	740	780

[1] Proc. Zool. Soc. London, 1911, p. 152, 1911.

Heads of greater size may be had if one is eager for extreme measurements. Two sportsmen, besides our party, visited the range of this sheep earlier in the season of 1912, and obtained large heads. The horns of one of these heads, which I afterwards examined in the establishment of Rowland Ward, London, measured over 60 inches (1524 mm.) around the curve, and is, I was told, the largest sheep head received at Ward's in several years.

The following extract, taken from Lyman's manuscript journal of his sheep hunt across the Mongolian border, begins with July 1, the day he left our camp in Tchegan-Burgazi Pass. It is interesting, not only as an account of this wonderful sheep, but as a description of its local habitat and the methods of hunting.

Having left the Black River [Tschornia Creek] and with it the last timber, we followed up the main stream [headwaters of the Chuya] to a point where it forks, and continued up the left or east branch. At or near these forks I began to observe a good number of sheep heads. It was difficult to guess their age, for even on a live animal the horns often have a cracked and weathered look. I remember but one head in this district where the lower jaw was with the skull. At no very great distance from the forks we turned up a smaller stream to the left and made camp; 3½ hours' march, which at 2½ miles per hour would be about 8¾ miles. From this camp, which must be near Demidoff's "Happy Valley," I hunted the afternoon of this day and the whole of the next. The method of hunting is as follows: The guide, Yam-bai, the assistant guide, Mattai, and I, all ride. The country being generally rolling and without sharp ridges it is necessary to keep one's eyes fixed on slopes at a great distance, but it is not necessary to dismount often. When something is sighted, then it is necessary to examine with a good telescope, or when ridges occur one must go up on foot lest he should come suddenly on game. It is extremely uncommon to sight game very close, and when this does occur the country is so open that a successful stalk is almost impossible. The result is that one rides nearly all the time, a method which seemed strange to me at first, but which is the correct thing I am persuaded if one has a far-sighted hunter. The whole matter rests with the keen sight of the hunter. If left to himself the average good American sportsman would loose at least half his chances because he could not see the game before the game saw him.

The country on which sheep are found is of much the same character on both the Russian and Mongolian side of the frontier. It is everywhere absolutely devoid of trees and bushes and covered only with short grass. This grass gives place to shale slopes from time to time, and often one side of the mountain will be washed and weathered, leaving an expanse of broken rocks exposed. Near the tops of many of the hills are often found rocky outcrops of fantastic shapes. The higher mountains which seem to mark the boundary are completely washed, free from grass, their sides covered with rock slides, and extremely rugged.

The sheep are generally found on the open grass-covered slopes, pretty well toward the tops. When in such a position it is obvious that they are very difficult to approach. It is first necessary to get into a position where one can get a good view with a telescope; field glasses are of but little use, the distances are too great. It is then generally possible, by making a sufficient détour, to ride to the foot of the particular hill on which the band of sheep were seen. Sometimes it is even possible to ride a good way toward the desired position on the hill itself. The final stalk itself is always very difficult because of lack of cover, except in those cases where the sheep are found among rocks or near a rock outcrop. The result of the stalk is either a long shot, 300 yards or more, at animals at rest or undisturbed; or a short shot, 100 to 150 yards, at

animals on the point of flight. If the sheep are on a smooth slope near the top one gets a shot of the second type by coming up hill from the other side. The moment one's head appears above the sky line the sheep are off. The fact that the hills are round topped and without a ridge makes the last moments of the stalk very uncomfortable. To compare this kind of sheep hunting with the pursuit of the bighorn in North America one may say that the physical effort is far less in Mongolia than in North America, but as a rule the final stalk is more difficult. The contrast between the nature of the ground in the two countries may be brought out by the fact that it is nearly always possible to bring horses directly up to the kill in Mongolia.

To return to the narrative of the journey. On the first afternoon as we returned to camp two rams came out on the sky line, but seeing us, departed. On the second day going to the southwest saw a wolf at a great distance but nothing else. Weather very cold with snow. The next day we broke camp and continued up the small valley and over a low and inconspicuous pass, direction east of south. The Mongolian line is probably near this pass; there is a great pile of stones but no stake. The country ahead is high and rolling; to the west are a range of rugged peaks. After crossing a height of land, which I take to be the Bain-Chagan Pass, we proceeded down a valley east of south, and camped on a stream coming in from right, or west, side. March 4½ hours, say 11 miles. Saw two or three small sheep on hilltops after we had crossed the pass. Our camp ground here had been much used by Kirghiz with their flocks. The next day I tried for sheep both on the west and east sides of camp, but saw none. There are a good number of heads in the valleys, on both sides, showing that rams have been here, and recently.

We continued the journey on July 5, and turned sharp to right around hills on which I saw a gazelle. The view from these hills to the south and west is striking. The country rapidly flattens out to the south and descends into a valley in which seems to flow a stream. This is perhaps part of the Suok River system. On the other, south, side of this valley high hills, or mountains, rise and extend as far as the eye can see. To the west and south the valley is filled with large buttes of very characteristic and pronounced shapes. Looking down on this part of the valley, the view reminded me of a model of a great mountain system done on a small scale, or of a picture in a school geography. Farther to the west and south, and a good way off, rose a range of high mountains, some completely covered with snow. Later in the morning we came to some water, apparently a branch of the Suok system, and there saw at least 100 ewes and lambs, which came down off a hill and ran over the valley bottom. Saw too a small ram. Having crossed a ridge, we turned due west, into what I am told is the Taylüke Valley. We proceeded west up this valley about 3 miles and camped. Total distance since morning say 15 miles.

The Taylüke Valley, in which we spent 16 days, runs at this point nearly east and west. The valley bottom is perhaps 8,000 to 9,000 feet above sea. On the south side it is bordered by grass-covered hills, which roll with lessening height into a broad valley of a part of the Suok system. The hills on the north side of the Taylüke Valley roll back with increasing height to the boundary range. They are often broken on one side and have a good deal of rock outcrop in places. Sheep were found on both sides of the valley. They showed a preference, however, for the north side. They were not plenty to the east of the place of our first camp, the hills being stony and without much grass; and beyond a point 10 miles to the west they also became scarce. Their range to the north is limited by the barrier mountains and to the south by the Suok Plain. The extent of the range is thus very limited, for the distance from the Taylüke to the high barrier mountains is not more than 2 or 3 miles at the place where the sheep abound. On this range, however, rams are very numerous. Not a day passed that we did not see some. They go in bands of from 6 or 8 to 30 or 40. I counted one band of 40 rams. The ewes and lambs seem to be in the lower country to the east. Besides one band seen on the march and already mentioned, I saw but one lot of perhaps 30 on the east of the range.

An average adult ram will carry horns about 19 to 19½ inches at the butt, and 46 to 48 inches round the curl. Sheep of this size are very common. A few larger heads are to be found in nearly every band; very large heads are of course rarer. I regret that I took no body measurements of sheep. It is safe to say that the animal has a larger body than the average bighorn ram; but it is also certain that the increase in body is not in proportion to the increase in head. In the *Ovis ammon* the head is out of all proportion to the body. At a distance at this season (July) the rams appear to be of two rather distinct colors—yellowish and black. Near to, the color difference is not so noticeable. It is a characteristic perhaps due to the limited extent of the range that the rams will return time after time to a particular mountain top after they have been driven from it. When alarmed they never hesitate, but dash away until out of rifle shot. Their sight is keener than that of any animal I know. A black servant who accompanied an English sportsman into this region this summer told our men that he had been with the original Demidoff party in 1897, and that then the sheep were tame and comparatively easy to kill. An idea of the number of sheep may be got from the fact that in 15 days' hunting I shot four rams, wounded two, and missed three shots. The number of shots in proportion to the sheep seen was due to the great skill of my head hunter, Yambai, in stalking. It is to be noted that these rams are extremely tough. In my experience they will go farther when mortally hurt than almost any animal I ever saw.

The weather in the valley was bad. About July 8 there were three days when it was unpleasantly warm at noontime; for the rest of the time it was unpleasantly cold. There were few days of continual storm, but there was hardly a day that it did not hail, rain, or snow. The very sudden changes from hot to cold were very trying. If the altitude of the valley is taken at 8,500 feet, that of the hills on which the sheep are found may vary from 9,000 to 11,000 feet. On the hills, often near the tops, I found maral horns, but never a skull. The horns seemed very old. It is to be remembered that there is not a trace of timber in this whole region. Throughout the valley there are signs that it is visited by natives with considerable flocks at some season, but we saw only one party of Kirghiz or Kalmuks, who had got lost trying to cross the frontier, and another party of horsemen, seen at a distance. The number of sheepskins on sale at Kosh-Agatch makes it probable that the natives kill a good many in winter, perhaps in this valley bottom.

I made only two camps in the valley, the last some 6 miles west of the first. On July 22 moved west of north. Three hours' march took us over a steep pass, the Tarkuta, and down into the valley on the other side. On the north side of the pass sheep heads suddenly ceased. It seems pretty certain that the animals in the Taylüke Valley do not cross this divide. The hills in the valley where we camped are more broken than those on the Mongolian side, being covered with rock slides on many of their faces, but their tops are grassy and suitable for sheep. In fact, there is nothing to account for the absence of sheep.

CAPRA SIBIRICA FASCIATA Noack.

1902. *Capra fasciata* NOACK, Zool. Anz., vol. 25, p. 623.
1905. *Capra sibirica fasciata* TROUESSART, Cat. Mamm., Suppl., vol. 3, p. 738.

The type-locality of this ibex is on the Bia River, near Lake Teletzkoi, about 70 miles north of Kosh-Agatch. The animal is reported as common throughout the mountains in that vicinity, and numbers of heads and hides are traded at Kosh-Agatch. We were told of the presence of ibex in the mountains near Chibit, on the post road between Kosh-Agatch and Ust-Inya; and one of our men reported seeing one in the mountains near our Tapucha camp, August 7. A

fine male was said to have been brought into Tapucha during the time of our stay in the vicinity, but we failed to secure the specimen. I believe ibex are much more common and generally distributed in the mountains between Altaiskoe and Kosh-Agatch than is generally known to the sportsmen who have visited the Altai. This form is probably confined to the wooded country north of the Chuisaya Steppe, on the Siberian side of the ranges, where it inhabits the numerous timberline mountains. Kastschenko reports several specimens of the ibex from the Katoun Mountains and Buchtarme River, southwest of Ongudai and Ust-Inya. In Kosh-Agatch we purchased the skull and horns of a fine old male, killed on the Baskkaous River, which empties into Lake Teletzkoi. This specimen is virtually a topotype of *fasciata*. The horns are long, gracefully curved, and wide spreading, and the knobs are small and low. This skull, No. 175188, U.S.N.M., measures: Condylobasal length, 270 mm.; greatest breadth, 149; upper tooth row, alveoli, 66; length of horns over curve, 1013 and 1045; circumference at basal knob, 240; distance between horn tips, 810.

A pet ibex, a young male, which, in company with a young domestic goat of about the same age, enjoyed the entire freedom of Kosh-Agatch, made friends with us at once on our arrival in town. It followed us into the building given us as camp quarters, and was with considerable difficulty induced to leave, and then only after it had inspected the whole apartments and bounced from the bunk to the table, window sills, and on to the cement stove, or oven.

CAPRA SIBIRICA HAGENBECKI Noack.

1903. *Capra sibirica* var. *hagenbecki* NOACK, Zool. Anz., vol. 26, p. 381.
1907. *Capra sibirica hagenbecki* LORENZ, Denkschr. Kais. Acad. Wiss., vol. 80, p. 89.

This ibex, originally described from some point near Kobdo, Mongolia, is common in favorable places on both the Siberian and Mongolian slopes of the border ranges. Our two specimens, killed by Lyman on the Siberian side of Tarkuta Pass (about 35 miles west of Tchegan-Burgazi Pass), July 23 and 24, are both adult males, and agree in every particular with the description of *hagenbecki*. It is, indeed, likely that the original specimens, on which the form was based, came from much nearer our locality than the town of Kobdo, and the specimens may be assumed to be typical. The headwaters of the Suok River, one of the chief sources of the Kobdo, are not far from Tarkuta Pass.

This is one of the forms without the light-colored "saddle." Our skins, in the short summer coat, have the upper parts of uniform fawn color, blending to almost pure white on the belly. There is a faint narrow dorsal stripe from head to tail. Both specimens have the well-developed callosities on the knee joints, as described of this race,

and the horns are very heavily knobbed. The two skulls measure: Condylobasal length, 251, 250 mm.; greatest breadth, 145, 146; upper tooth row, alveoli, 71, 72; lower tooth row, 70, 73.5; length of horns over curve, 558, 563; 506, 475; circumference of horn over first basal knob, 260, 251; distance between horn tips, 310, 204.

Lyman's notes contain only one reference to ibex in Mongolia. In the Taylüke Valley, not far from Tarkuta Pass, he "frequently saw ibex on the north side of the valley, among the rocks. They were all females and young, of a rather light yellowish color. They did not confine themselves to broken ground, but often fed on the grassy hill tops." Later on, July 22, after crossing back into Siberia by the Tarkuta Pass, he wrote:

I hunted the mountains to the east and west for ibex. Saw no females, but on the mountain to the west saw two bands of male ibex on two succeeding days, one each day. The first lot consisted of 5 or 6, from which I shot one. Two or three of these carried horns much larger than the one shot. The second lot I could not count accurately; there were 12 to 18, perhaps, and of these 6 were very large, with horns as large as the head afterwards purchased in Kosh-Agatch. Shot one from this lot. I had a very good look at the large ones as they ran off, and there is no doubt as to the size of their horns. Both bands were feeding on grassy tops, not among rocks. These ibex were not so farsighted as the sheep, and when shot into the bands ran a little way and then stopped to look back before making off. In this they resemble our mountain goat, though not stupid to the same degree. They carry shot remarkably; the second one I killed was hit clean through the body, yet ran more than a mile. The meat of the first ibex was very good eating.

PROCAPRA ALTAICA Hollister.

1913. *Procapra altaica* HOLLISTER, Smiths. Misc. Coll., vol. 60, No. 19, p. 1, February 8.

We sighted four gazelles the first day south from Kosh-Agatch, while crossing the Chuisaya Steppe. They started at a good distance and ran directly into a low sweeping cloud of wind, rain, and sand, disappearing as if by magic. The many skins seen in the trading post at Kosh-Agatch were said to come chiefly from the Mongolian side; and though formerly abundant on the Chuisaya Steppe, gazelles are by no means common there at the present day. We had one day in the center of the steppe on our return journey, and I find the following in Lyman's journal regarding the gazelles:

Gazelles on the Kosh-Agatch steppe are scarce and wild. They keep to the open plain and do not get into the foothills, or at least I could find none in that type of country. I saw one band at a great distance on our way southward. On the return journey I devoted five or six hours to hunting and saw but one lot of four males. On the plains it is impossible to get near them. I missed a shot at about 300 yards. Saw also two lots of three or four females and young. My skillful hunter Yam-bai went out by himself for the whole afternoon, but could not get one. This is excellent proof that they are rare and shy in this region. The character of the feed on the Kosh-Agatch steppe is much the same as that in the foothills near the Suok Plain, Mongolia, thin grass growing on stony, desert-like ground.

The type-specimen of this gazelle, which is nearly related only to *Procapra gutturosa*, was shot by Lyman at the point where the trail south from the Bain-Chagan Pass turns westerly, on the edge of the Suok Plain, Mongolia, July 5. In his notes on the game of the trip over the Mongolian border I find a few references to gazelles. He mentions seeing a female soon after crossing the frontier, south of Tchegan-Burgazi Pass; four on the Suok Plain, July 5; and later in the same day, well up among foothills, three or four bunches of five or six each. Later notes mention a few in the Taylüke Valley.

EXPLANATION OF PLATES.

PLATE 37.

Collecting stations in the Altai Mountains.

Upper. Camp on the Chuisaya Steppe.
Middle. Camp on the Tchegan-Burgazi River.
Lower. Camp in the forests of *Pinus cembra* near Tapucha.

PLATE 38.

Natives of the Altai and Habitat of *Platycranius*.

Fig. 1. Kirghiz marmot hunter and horse.
2. Camp on Tschornia Creek, showing rock slide inhabited by *Alticola* (*Platycranius*) *strelzovi*.
3. Kalmuk horse owner.

PLATE 39.

Scenes in the Altai Mountains.

Upper. Yaks (*Pœphagus grunniens*) in Alpine meadow.
Middle. Young male ibex (*Capra sibirica fasciata*) at Kosh-Agatch.
Lower. The "last timber" to the south, on the border of the desert Altais. Larches (*Larix sibirica*) in valley of Tschornia Creek.

PLATE 40.

Skull of *Ovis ammon*, U.S.N.M. Cat. No. 175180, male, from Altai Mountains, Mongolia. (Greatly reduced).

Fig. 1. Dorsal view.
2. Ventral view.

PLATE 41.

Skull of type-specimen of *Procapra altaica*, U.S.N.M. Cat. No. 175179, Suok Plains, Mongolia (one-fourth natural size).

Fig. 1. Lateral view.
2. Dorsal view.

PLATE 42.

Skull and teeth of type-specimen of *Procapra altaica*, U.S.N.M. Cat. No. 175179, Suok Plains, Mongolia.

Fig. 1. Left upper tooth row, natural size.
2. Left lower tooth row, natural size.
3. Skull, ventral view (one-fourth natural size).





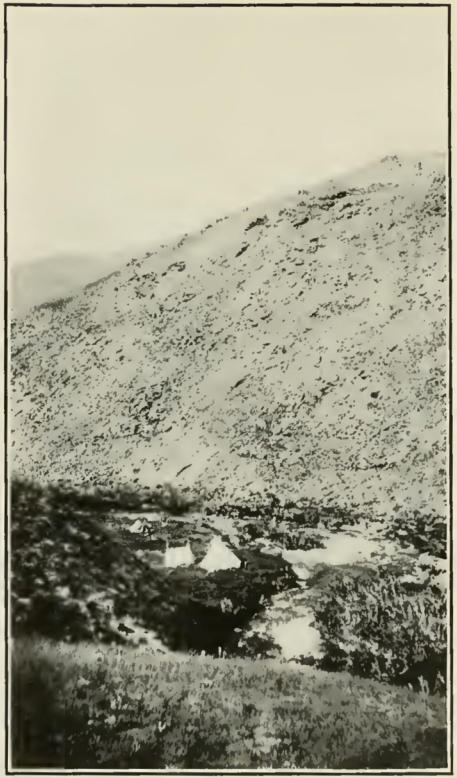


COLLECTING STATIONS IN THE ALTAI MOUNTAINS.

FOR EXPLANATION OF PLATE SEE PAGE 532.



1.



2.

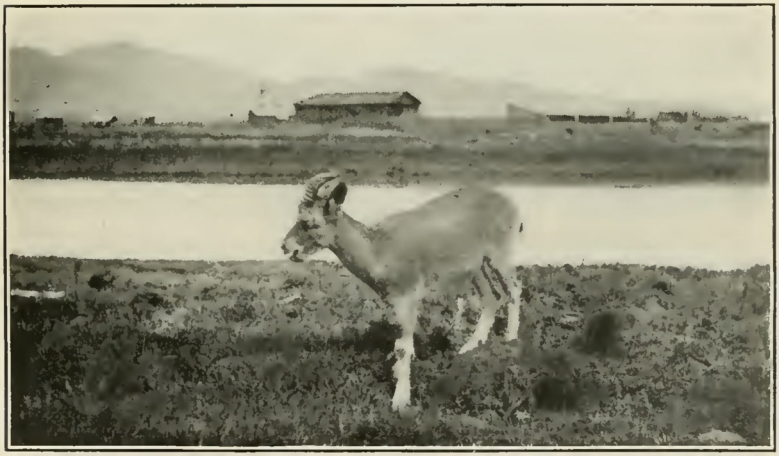


3.

NATIVES OF THE ALTAI AND HABITAT OF PLATYCRANIUS.

FOR EXPLANATION OF PLATE SEE PAGE 532.

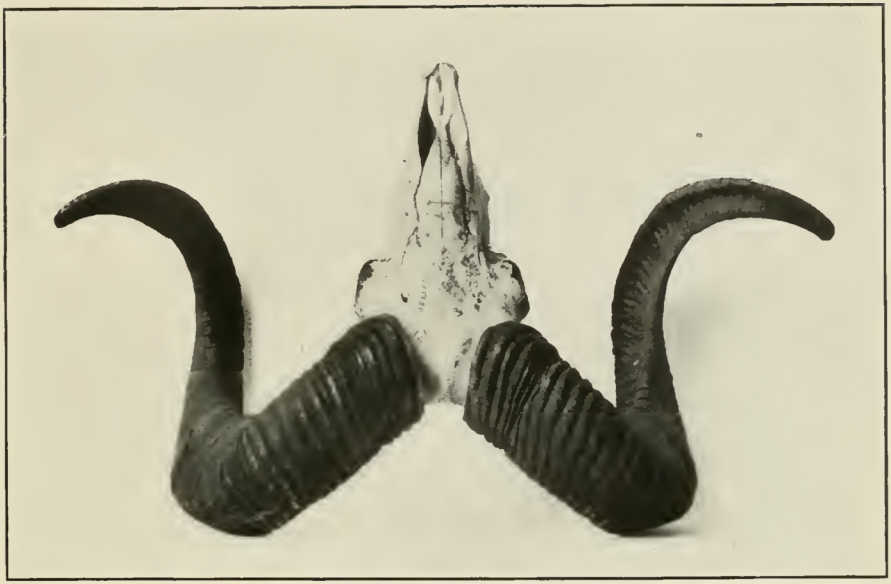


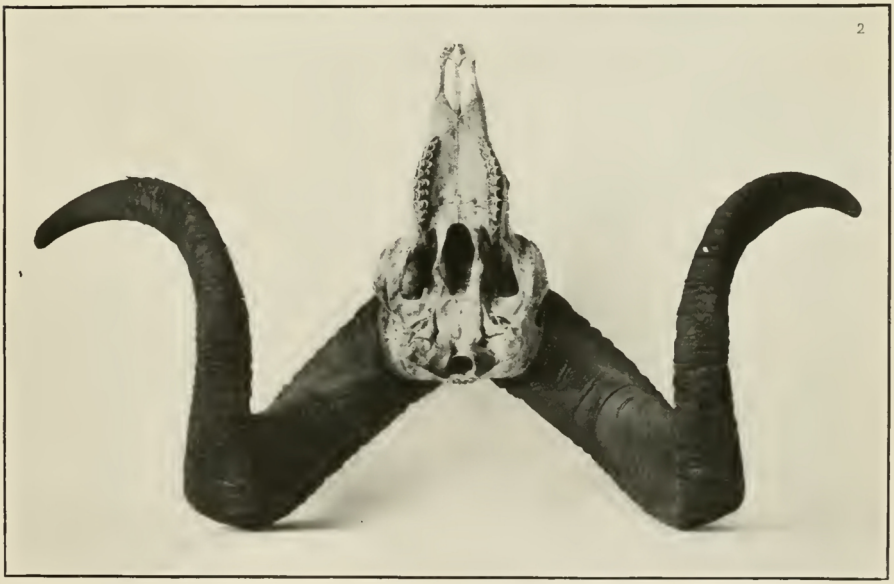




SCENES IN THE ALTAI MOUNTAINS.

FOR EXPLANATION OF PLATE SEE PAGE 532.

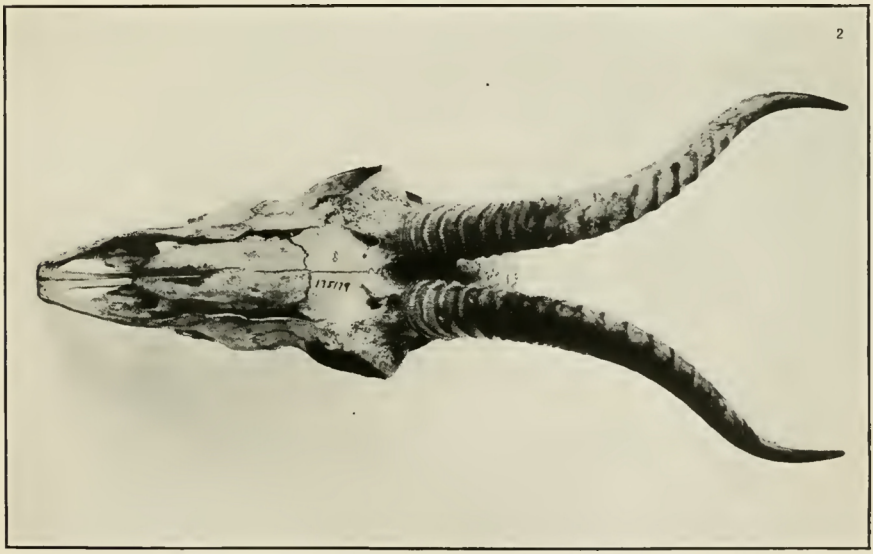




SKULL OF OVIS AMMON FROM ALTAI MOUNTAINS.

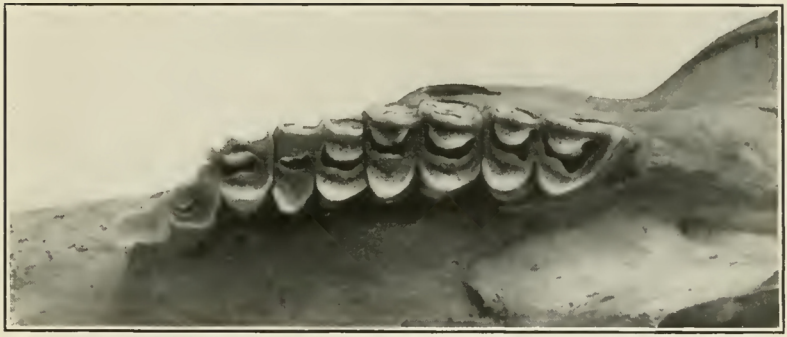
FOR EXPLANATION OF PLATE SEE PAGE 532.

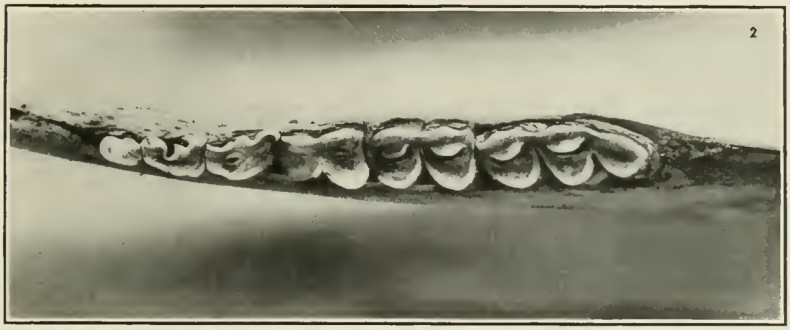


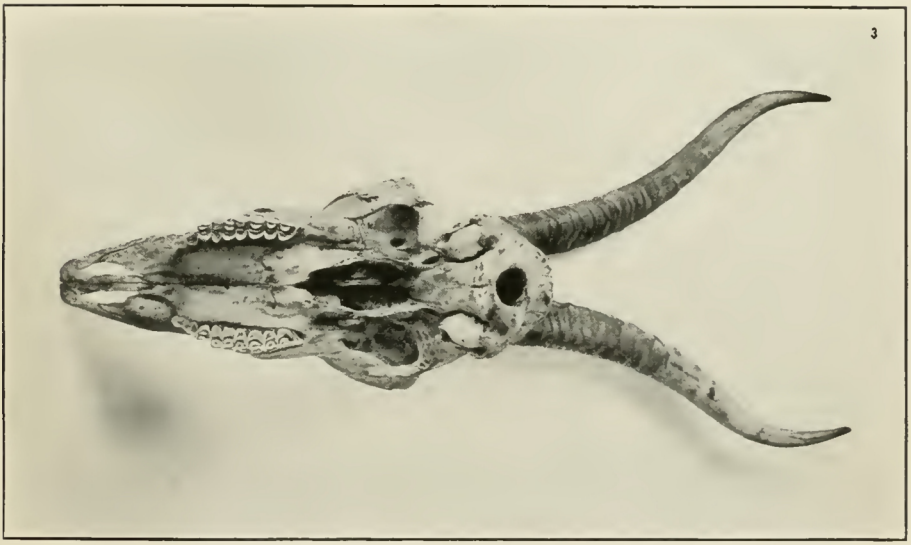


SKULL OF PROCAPRA ALTAICA FROM SUOK PLAINS.

FOR EXPLANATION OF PLATE SEE PAGE 532.







SKULL AND TEETH OF PROCAPRA ALTAICA FROM SUOK PLAINS.

FOR EXPLANATION OF PLATE SEE PAGE 532.

DESCRIPTIONS OF THIRTEEN NEW SPECIES OF PARASITIC HYMENOPTERA AND A TABLE TO CERTAIN SPECIES OF THE GENUS ECPHYLUS.

By S. A. Rohwer,

Of the Bureau of Entomology, United States Department of Agriculture.

The following paper, which is a contribution from the Branch of Forest Insect Investigations, Bureau of Entomology, deals with the descriptions of certain parasites on forest insects. Some of these parasites appear to be of importance, and it is necessary that names should be made available in the near future. A table to most of the Nearctic species of *Ecphylus* is also included.

One of the species, namely, *Caenopachys scolytivora*, was labeled as a new species by Mr. H. L. Viereck, and has been described by the author, so should be credited to Viereck and Rohwer.

ATANYCOLIDEA APICALIS, new species.

This species differs from *rugosiventris* Ashmead in its smaller size, in having the fifth tergite coarsely sculptured (in *rugosiventris* the fifth tergite is practically impunctate and smooth), in having the embossed area of the second tergite very short (in *rugosiventris* the embossed area of the second tergite is at least two-thirds of the length of the segment), and in having the sixth tergite yellowish.

Female.—Length 4 mm. Front with a strong median furrow which divides at the anterior ocellus forming a Y; thorax smooth and shining; transverse median of the fore wings nearly squarely interstitial with the basal vein; embossed area of the first tergite rounded anteriorly and with a few longitudinal striæ, not smooth, sharply defined as in *rugosiventris;* the lateral areas of the first tergite with short, irregular, poorly defined striæ, and with short longitudinal furrow; the apical lateral sides of the first tergite sharply angled and curved basally; second to fifth, tergites inclusive, longitudinally striate; the embossed area of the second tergite Y-shaped but not one-third the length of the tergite; no defined embossed area laterally on second tergite; sixth and seventh tergites smooth, shining, impunctate. Black; apical joint of the palpi piceous; abdomen dark red except a yellow-

ish spot on the sixth tergite; legs rather densely clothed with gray hair; wings dusky hyaline; costa and stigma brown, the rest of the venation pale brown.

Male.—Length 3.5 mm. The above description of the female will apply well to this sex, but the tarsi are pale brown and the yellow spot covers the base of the seventh tergite; the fifth tergite is smooth, impunctate.

Tryon, North Carolina. Described from one female and one male recorded under Bureau of Entomology Number Hopk.U.S.3070b. Material collected by W. F. Fiske.

Type.—Cat. No. 15507, U.S.N.M.

XYLONOMUS (XYLONOMUS) LEPTURÆ, new species.

Female.—Length to the apex of the abdomen 14 mm.; length of the ovipositor 11 mm. This species agrees with *Xylonomus ruficoxis* Rohwer in having the basal area poorly defined. It is closely related to *ruficoxis*, but may be separated from that species by its smaller size, black posterior coxæ, bases of the tibiæ banded with white, and in having the prescutum margined with rufous.

Cherrydale, Virginia. Described from one female recorded under Bureau of Entomology Number Hopk.U.S.7522c, material collected by R. W. Van Horn. This note states that this species is parasitic on the larvæ of *Leptura nitens*. The adult female (type) was bred May 20, 1908.

Type.—Cat. No. 15489, U.S.N.M.

PRISTAULACUS FLORIDANA, new species.

This species belongs to the genus *Pristaulacus* in the strict sense and is related to *flavicrurus* Bradley, but may be separated from this species by the dark spot occurring along the median vein of the fore wings; by having the head shining and below the ocellus with only setigerous punctures; by punctiform foveæ behind each lateral ocellus; by having the postocellar line distinctly longer than the ocellocular line and the intraocellar line distinctly greater than the greatest diameter of the anterior ocellus. These differences are taken from the metatype of Bradley's species in the collection of the United States National Museum. According to the metatype of *flavicrurus* the postocellar line is subequal with the ocellocular line, and the intraocellar line is distinctly shorter than the greatest diameter of the anterior ocellus.

Female.—Length, 14 mm.; length, of the antennæ, 11.5 mm.; length of the ovipositor, 20 mm. Head shining; the clypeus and the area immediately around the antennæ opaque, with fine granulations; no depression in front of the anterior ocellus; third antennal joint about one-third shorter than the fourth; prescutum not gibbose, faintly emarginate; metepisternum striato-reticulate, posteriorly the striæ predominating; posterior coxæ without a tooth; the tooth of the

anterior margin of the pronotum small; abdomen with a rather long petiole. Black; sides of the first and most of the basal portion of the second segment red; legs below the coxæ red; wings hyaline, a strong cloud along the median vein and entering the basal portion of the second discoidal cell; a large cloud below the stigma; wings beyond the stigma wanting; venation black; face, posterior orbits (sparsely), anterior margin of the pronotum, and posterior aspect of the propodeum with gray hairs.

Bartow, Florida. Described from one female collected September 19, 1911, by T. E. Snyder. Specimen taken on green foliage

Type.—Cat. No. 15487, U.S.N.M.

TRIASPIS FISKEI, new species.

This species may be readily separated from most of the American species by the very short, almost truncate, third tergite, and by the black hind tibiæ and tarsi.

Female.—Length, 4.5 mm. Clypeus with large punctures; laterally these punctures may become confluent; front shining, with a number of large setigerous punctures; vertex shining, practically impunctate; antennæ 32-jointed; third and fourth joints subequal; beyond the fourth joint the joints gradually decrease in length; prescutum anteriorly with shallow, poorly defined punctures, posteriorly more sparsely punctured and the punctures well defined; scutum punctured only along the notauli; notauli foveolate posteriorly where they form a U; suture between the scutum and scutellum with fine foveæ; scutellum shining, impunctate; dorsal aspect of the propodeum shining with a few poorly defined, shallow punctures divided by a strong longitudinal median carina; posterior aspect of the propodeum coarsely reticulate, without any defined areas; first tergite strongly striato-reticulate, laterally the striæ predominating, medianly the reticulations predominating; second tergite striato-reticulate, laterally the striæ predominating and curved toward the middle so the apical margin in the middle is transversely striato-reticulate, medianly reticulations predominating; third tergite about one-fourth shorter than the second, the lateral angles rounded, in the middle truncate, covered with fine longitudinal striæ. Black; clypeus, mandibles except apices, scape, lower margin of the pronotum and malar space rufo-piceous; palpi pallid; tegulæ yellowish brown; legs except apical two-thirds of the hind tibiæ and all of their tarsi which are brownish, reddish yellow; wings hyaline; costa and stigma rather dark brown; venation pale brown.

Tryon, North Carolina. Described from one female recorded under Bureau of Entomology Number Hopk.U.S.3103j. Specimen bred by W. F. Fiske, for whom the species is named.

Type.—Cat. No. 15519, U.S.N.M.

HETEROSPILUS LEPTOSTYLI, new species.

This species is related to *Heterospilus anthaxiæ* Ashmead, but may be separated from that species by the absence of striæ at the extreme base of the fourth tergite, by having the notauli complete and not subfoveolate, in having the mesoscutum more shining, in the shining propodeum and the yellow pronotum.

Female.—Length 2.5 mm. Head shining, polished, impunctate; third and fourth antennal joints subequal in length; mesoscutum shining, very finely granular; notauli complete, sharply defined, not foveolate; scutellum shining; propodeum shining, with strong median carina which joins the anterior apex of the diamond-shaped areola; ovipositor slightly more than half the length of the abdomen. Black; mandibles except apices, antennæ, pronotum, legs, second and extreme base of the third tergites yellowish; wings hyaline, iridescent; venation pale brown.

Male.—Length 2.5 mm. Besides the usual sexual characters the male is like the female.

According to the paratypes this species may vary to the extent of having the flagellum dusky.

Tryon, North Carolina. Described from three females and two males recorded under the Bureau of Entomology Number Hopk. U. S. 3045c, which refers to a note stating that this species is parasitic on the larvæ of *Leptostylus collaris* in chestnut. Insects bred by W. F. Fiske.

Type.—Cat. No. 15510, U.S.N.M.

CÆNOPACHYS SCOLYTIVORA, Viereck and Rohwer, new species.

Apparently similar to the genotype of this formerly monotypic and monobasic genus, but distinguished, however, by the thickened portion of the cubitus beyond the second transverse cubitus being only half or less than half the length of the corresponding part of the radius, and in the 20-jointed antennæ.

Male.—Length 3 mm. Front with the excavation finely, transversely striate; the raised portion of the front with large, sometimes confluent punctures; vertex and posterior orbits very finely reticulate; third antennal joint much shorter than the fourth, fourth and fifth subequal; scutum and prescutum opaque, finely granular, prescutum finely reticulate; notauli well defined, V-d posteriorly and finely foveolate; scutellum finely granular; propodeum opaque, finely granular with lateral regions well defined; a complete median carina well defined and joining at apex of the elongate, diamond-shaped area; the lateral areas defined posteriorly by oblique carinæ; first abdominal segment about one-fifth longer than its apical width with strong irregular striations; second and following abdominal

segments shining, impunctate. Rufo-piceous; frontal depression, scutum and prescutum, posterior part of the mesopleura blackish; basal joints of the antennæ ferruginous, apical joints, piceous; the lateral part of the front and the legs paler than the body; wings strongly dusky with a hyaline band across them at the base of the stigma and with the bases clear.

Paratype does not differ essentially from the type.

Elmore, South Dakota. Described from two males recorded under Bureau of Entomology Number Hopk. U. S. 730, material collected by J. L. Webb.

Type.—Cat. No. 15520, U.S.N.M.

Genus ECPHYLUS Förster.

Table to certain Nearctic species of Ecphylus.

The species described as *texanus* by Brues is the only Nearctic species known to be omitted from the following table, which is based on females only:

First tergite much longer than its apical width; prescutum with strong lateral tubercles 1

First tergite with the apical width greater than or subequal with its length 2

1. Ferruginous; prescutum without a median furrow; ovipositor longer than the body ..... *pallidus* Ashmead.

Black; prescutum with a foveolate median line; ovipositor about the same length as the body ..... *hubbardi* Rohwer, p. 538.

2. First tergite with all the striæ of equal size so there is no median area 3

First tergite with two striæ predominating or with two furrows so there is a well-defined median area 4

3. Notauli foveolate; piceous; ovipositor as long as abdomen ..... *lycti* Rohwer, p. 538.

Notauli not foveolate; head black, thorax and abdomen rufo-ferruginous; ovipositor shorter than the abdomen ..... *nigriceps* Ashmead.

4. Prescutum with an impressed median line (dark piceous; middle area of the first tergite narrowed posteriorly and not as coarsely sculptured as sides). *hypothenemi* Ashmead.

Prescutum without an impressed median line 5

5. Notauli foveolate (rufo-ferruginous; ovipositor shorter than the body). *schwarzi* Rohwer, p. 538.

Notauli not foveolate 6

6. Notauli obsolete posteriorly (ovipositor much shorter than the abdomen). *johnsoni* Rohwer, p. 539.

Notauli complete 7

7. Ovipositor much shorter than the abdomen; head black, thorax and abdomen ferruginous ..... *californicus* Rohwer, p. 539.

Ovipositor longer than or subequal with length of the abdomen; head, thorax, and abdomen (in part) piceous 8

8. Mesonotum shining, impunctate; first tergite bright yellow, the following segments piceous; ovipositor longer than abdomen ..... *lepturgi* Rohwer, p. 540.

Mesonotum finely granular; first tergite and base of second ferruginous; rest of abdomen piceous; ovipositor subequal in length with the abdomen. *bicolor* Rohwer, p. 540.

ECPHYLUS HUBBARDI, new species.

Female.—Length to the apex of the abdomen 2 mm.; length of the ovipositor 2 mm. Head smooth, shining, impunctate; prescutum subopaque, finely granular, laterally strongly angulate; notauli complete, foveolate; scutum shining; suture between the scutum and scutellum strongly foveolate; propodeum reticulate without a median carina or defined lateral areas; first abdominal segment much longer than its apical width, sharply defined laterally by carinæ and with two nearly parallel longitudinal carinæ near the middle which divide the segment into three areas, the rest of the surface longitudinally striate but in the middle area the striæ are broken; the rest of the abdomen shining, impunctate; ovipositor nearly as long as the insect. Piceous; antennæ basally yellowish; the head, the first and second tergites reddish piceous; legs rufo-piceous; trochanters pallid, anterior legs slightly paler; wings hyaline, slightly dusky; venation very pale brown.

Chi-Ri-Cahua Mountains, Arizona. Described from one female collected by H. C. Hubbard.

Type.—Cat. No. 15511, U.S.N.M.

This species is given the name *hubbardi* after the collector, and is the manuscript name proposed by Dr. W. H. Ashmead.

ECPHYLUS LYCTI, new species.

Female.—Length to the apex of the abdomen 2.25 mm.; length of the ovipositor 1.5 mm. Head shining; the area immediately behind the lateral ocelli with rather strong transverse carinæ; prescutum finely granular, distinctly tuberculate laterally; notauli complete, foveolate; scutum finely granular; the suture between the scutum and scutellum strongly foveolate; propodeum rather coarsely granular with defined lateral areas and short longitudinal median carina which joins the apex of a poorly defined, diamond-shaped areola; first tergite with its length and apical width subequal, with uniform, strong longitudinal carinæ; abdomen beyond the first tergite shining, impunctate. Piceous; head black; legs yellowish brown; wings hyaline, slightly dusky; venation pale brown.

Lake City, Florida. Described from one female labelled "ex *Lyctus* species in bamboo." Bred by H. G. Hubbard.

Type.—Cat. No. 15513, U.S.N.M.

ECPHYLUS SCHWARZI, new species.

Female.—Length to the apex of the abdomen 1.5 mm.; length of the ovipositor about 0.5 mm. Head shining, impunctate; prescutum finely granular; notauli complete, foveolate; scutum shining, practically impunctate, tuberculate laterally; the suture between

the scutum and scutellum strongly foveolate; propodeum finely granular without well-defined carinæ; first tergite with its apical width subequal with its length, sharply defined laterally by carinæ; two of the carinæ predominating, so it is divided into three areas which are finely, longitudinally striate; abdomen beyond the first tergite impunctate. Ferruginous; antennæ beyond the fourth joint piceous; wings hyaline, strongly iridescent; venation ferruginous.

Santa Rita Mountains, Arizona. Described from two females collected June 10 by Hubbard and Schwarz. It is named in honor of E. A. Schwarz.

Type.—Cat. No. 15515, U.S.N.M.

ECPHYLUS JOHNSONI, new species.

Female.—Length to the apex of the abdomen 1.25 mm.; length of the ovipositor 0.75 mm. Head smooth, practically impunctate; prescutum very finely granular and not dentate laterally; scutum shining, impunctate; notauli not defined posteriorly; suture between the scutum and scutellum faintly foveolate; propodeum finely granular with strong median carina which connects with the apex of a nearly diamond-shaped areola; basal tergite almost twice as wide apically as its length, not defined laterally by carinæ but with two longitudinal carinæ forming a median area; median area more strongly striate than the lateral areas; abdomen beyond the first tergite shining, impunctate. Piceous; abdomen, propodeum slightly paler; wings hyaline, iridescent; venation very pale brown.

North Mountain, Pennsylvania. Described from one female collected September 3, 1897. Species was probably collected by C. W. Johnson, as the manuscript name, *johnsoni*, of Ashmead, indicates.

Type.—Cat. No. 15512, U.S.N.M.

ECPHYLUS CALIFORNICUS, new species.

Female.—Length to the apex of the abdomen 2 mm.; length of the ovipositor 0.75 mm. Head shining, impunctate; prescutum shining, practically impunctate, laterally distinctly tuberculate; notauli not foveolate; scutum posteriorly finely granular; the suture between the scutum and scutellum distinctly but finely foveolate; propodeum granular, without carinæ; first tergite slightly wider apically than long, without well-defined lateral carinæ but with two sublateral strong carinæ which divide the segment into three areas which are rather finely but distinctly striate; segments beyond the first tergite shining, impunctate. Rufo-ferruginous; head black; first five joints of the antennæ pallid, apically strongly dusky; legs slightly paler than the body; wings hyaline; venation pale brown.

Siskiyou County, California. Described from one female.

Type.—Cat. No. 15514, U.S.N.M.

ECPHYLUS LEPTURGI, new species.

Female.—Length to the apex of the abdomen about 1.5 mm.; length of the ovipositor 1.25 mm. Head shining, impunctate; scutum and prescutum shining, impunctate, the latter not dentate laterally; notauli completely defined not foveolate; suture between the scutum and the scutellum not foveolate; propodeum granular with a faintly defined, median, longitudinal carina which joins the apex of an elongate, diamond-shaped areola, laterally with carinæ; first tergite a little wider apically than its length; sharply defined laterally with longitudinal carinæ, divided into three areas the middle area narrows apically and is irregularly striate, the lateral areas with well-defined longitudinal carinæ; beyond the first tergite the abdomen is shining, impunctate. Rufo-piceous; first tergite, legs except the piceous posterior femora bright yellow; wings hyaline; venation pale brown.

Tryon, North Carolina. Described from two females, the type recorded under Bureau of Entomology Number Hopk.U.S.3012o, which refers to a note stating that this species is bred from a cocoon found in the larval mine on *Lepturges facetus* in chestnut. A paratype is recorded under Bureau of Entomology Number Hopk.U.S.3012h3. Material collected and bred by W. F. Fiske.

Type.—Cat. No. 15517, U.S.N.M.

ECPHYLUS BICOLOR, new species.

Female.—Length to the apex of the abdomen 2 mm.; length of the ovipositor about 1 mm. Head shining, impunctate; prescutum finely granular, subtuberculate laterally; notauli complete, sharply defined; scutum shining, practically impunctate; suture between the scutum and scutellum faintly foveolate; propodeum finely granular with a short median carina which joins the apex of a long, diamond-shaped area, with two lateral carinæ; first tergite much wider apically than long, sharply defined laterally by carinæ, two of the striæ predominating so it is divided into three areas which are themselves finely, longitudinally striate to the apex of the first tergite; tergum polished, impunctate. Black; propodeum very dark piceous; the first and the base of the second tergite ferruginous; legs piceous; wings hyaline, iridescent; venation pale brown.

Easton, Washington. Described from one female collected by A. Koebele.

Type.—Cat. No. 15516, U.S.N.M.

RESULTS OF THE YALE PERUVIAN EXPEDITION OF 1911.—BATRACHIANS AND REPTILES.

By LEONHARD STEJNEGER,
Curator of Reptiles and Batrachians, United States National Museum.

Thanks to the efforts of Prof. H. W. Foote, the Yale-Peruvian expedition of 1911, under the direction of Prof. Hiram Bingham, brought home a small, but highly interesting collection of batrachians and reptiles which have been placed in my hands for report. The first set of specimens has been generously donated to the United States National Museum.

Class AMPHIBIA.

BUFO MARINUS (Linnæus).

Whatever may be the status of Tschudi's *Bufo molitor*,[1] the half-grown toad, collected at Santa Ana, altitude 3,000 feet above sea level, on August 3, unquestionably belongs to the present species. I have compared it both with full-grown and with younger specimens from La Guaira, Venezuela, and find it to agree perfectly with them. The tympanum equals one-half the diameter of the eye; the outline of the snout is exactly like that of the young Venezuelan specimens; and the parotoids are proportionally as large as in the adults.

BUFO SPINULOSUS Wiegmann.

One young and two minute specimens, just transformed, from Cuzco, July 9, 1911.

BUFO INCA, new species.

Diagnosis.—Head with bony ridges, the supraorbital and postorbital ridges forming together a flat curve and with the parietal curve a Y-shaped figure; tympanum very distinct, oval, erect, its longest (vertical) diameter about two-thirds the horizontal diameter of the eye; no horn-like appendage on upper eyelid; snout projecting; no tarsal fold; interorbital space much broader than upper eyelid; parotoids large, descending on side of neck.

Habitat.—Peru.

Type-specimen.—Cat. No. 49557, U.S.N.M.; Huadquinia, Peru, about 5,000 feet altitude; August, 1911.

[1] See Roux. Rev. Suisse Zool., vol. 15, pt. 2, 1907, p. 303.

Description of the type-specimen.—Cranial ridges sharply defined but not high, consisting of canthal, preocular, supraocular, postocular, parietal, and supratympanic ridges, the supraocular ridge flatly curved and forming a Y with the parietal ridges which converge backwards; snout prominent, overhanging the lip; nostrils anterior to edge of lip; interorbital space nearly flat, much wider than the upper eyelid; tympanum very distinct, much higher than wide, its greatest diameter about two-thirds that of the eye; first finger not extending beyond second; toes about half webbed; three outer joints of fourth toe free; subarticular tubercles single; two metatarsal tubercles, inner one large, well developed; tarsal fold only indicated by a series of close-set spines; heels do not overlap; heel extending to anterior border of eye; upper surfaces, including top of head, evenly covered with small, subequal, spinose warts; underside covered with small, densely set, high tubercles; parotoids large, about two-thirds the length of the head, descending on the sides.

Dimensions.

	mm.
Tip of snout to vent	39
Tip of snout to posterior edge of tympanum	13
Width of head	14
Width of interorbital space	5
Length of tibia	20

Remarks.—This species, of which the expedition brought home only one specimen, resembles *Bufo coniferus* Cope, but has larger parotoids and shorter legs, especially fore legs; the upper surface of the body including head is evenly covered with small spinose warts, and there are no cone-shaped spines on sides of neck and body; the cranial crests are lower, those of the canthus rostralis more straight and distant; profile of snout much more projecting, the nostrils being situated anterior to the lip.

From *Bufo ockendoni* Boulenger [1] (type-locality Marcapata Valley, eastern Peru) the present species differs in the more projecting snout, the very distinct tympanum, the large inner metatarsal tubercle, the densely and uniformly spinose upper parts, and the larger parotoids.

ELEUTHERODACTYLUS BINGHAMI, new species.

Diagnosis.—Toes nearly free; belly granular; upper surface smooth; head moderate, without bony ridges; vomerine teeth in two small transverse series between or slightly behind the choanæ; tympanum distinct, about two-fifths or one-third the diameter of the eye.

Habitat.—Peru.

Type-specimen.—Cat. No. 49559, U.S.N.M.; Cuzco, Peru, about 11,500 feet altitude; July 9, 1911.

Description of type-specimen.—Tongue large, rounded, entire behind; vomerine teeth in two small transverse series between, or

[1] Ann. Mag. Nat. Hist. (7), vol. 10, 1902, p. 396.

slightly behind choanæ; snout longer than orbital diameter; canthus rostralis distinct, rounded; nostril nearer the tip of the snout than the eye; interorbital space very slightly convex, somewhat wider than eyelid; tympanum distinct, about one-third the diameter of the eye; fingers moderate, first shorter than second; toes moderate, nearly free; disks medium, rounded; large inner metatarsal tubercle, no outer; tibiotarsal articulation of extended hind limb reaches center of eye; skin of upper surfaces smooth, with no tubercles; underside, including throat, granular; a strong pectoral fold; a slightly raised smooth dermal ridge from eye over tympanum. Color (in alcohol) above olive gray; a blackish brown hammer-shaped spot on top of head between eyes; a blackish brown loreal band edged above with a very distinct whitish line from tip of snout through eye, the whitish line occupying the edge of the upper eyelid, and over ear to shoulder; an indistinct whitish line on upper lip; back with three longitudinal series of blackish brown spots, the outer ones fused into more or less continuous bands; legs cross-barred; underside pale, posterior aspect of femur with indications of small whitish spots.

Dimensions.

	mm.
Tip of snout to vent	22
Width of head	8
Diameter of eye	3
Diameter of tympanum	1
Fore leg from axilla	12
Hind leg from vent	32
Vent to heel	18

Remarks.—In the younger specimens the tympanum appears smallest. In the youngest it is rather indistinct, the vomerine teeth are absent and the color pattern, including the light canthal line, more obscure.

Named in honor of Prof. Hiram Bingham, the leader of the Yale Peruvian Expedition.

ELEUTHERODACTYLUS FOOTEI, new species.

Diagnosis.—Toes free; upper and lower surfaces strongly tubercular; head moderate without bony ridges; vomerine teeth in two small patches inside of and on a level with posterior border of choanæ; tympanum indistinct, less than one-third the diameter of the eye.

Habitat.—Peru.

Type-specimen.—Cat. No. 49562, U.S.N.M.; Tincochchaca, Peru, 7,000 feet altitude; August 8, 1911.

Description of type-specimen.—Tongue rather large, somewhat heart-shaped behind; vomerine teeth in two small patches inside of and on a level with the posterior border of the choanæ; snout short, not longer than the orbital diameter; canthus rostralis angular; interorbital space flat, very wide, one and one-half times as wide as upper

eyelid; tympanum rather obscure, small, less than one-fourth the diameter of eye; fingers moderate, first shorter than second; toes moderate, free; disks rather large, rounded; large inner metatarsal tubercle, no outer; tibio-tarsal articulation of extended hind limb reaches center of eye; skin of entire animal above and below, including soles of feet, strongly granular, the granules or rounded tubercles of the upper surface about the same size as those of the lower, but not so close together; a weak pectoral fold; a strong, tubercular supratympanic fold from eye backward to above shoulder. Color (in alcohol) above dark drab, sprinkled with minute dark dots; a large irregular, X-shaped dark brown mark beginning on the eyelids and extending to the sacrum, the lines crossing behind the head; a dark band, light-edged above, from nostrils through eye and ear to sides of body where it dissolves into numerous minute dark spots; limbs cross-barred; hind aspect of femur marbled with dusky and with the indication of a pale longitudinal whitish line, more or less interrupted.

Dimensions.

	mm.
Tip of snout to vent	19
Width of head	8.5
Diameter of eye	2.5
Diameter of tympanum	0.5
Fore leg from axilla	12
Hind leg from vent	29
Vent to heel	17

Remarks.—In a second specimen, about the same size as the type, the ground color is paler and the dark color pattern consequently better contrasted. A slightly younger specimen, from the same locality, has this pattern less conspicuous, the X mark not being solid dark, but only its edges outlined by dusky lines.

Named in honor of Prof. H. W. Foote, the naturalist of the expedition.

LEPTODACTYLUS RUBIDO (Cope)?

A single specimen was collected at San Miguel, at an altitude of 6,000 feet. It is very much hardened and shrunken, hence there is some uncertainty as to the characters of the toes and the glandular ridges. The toes do not seem to be provided with a dermal margin and the upper surface appears to be smooth without folds on back or sides. The tongue is entire behind; the vomerine teeth are arranged in two straight series behind and not extending outward beyond the center of the large choanæ. The color (in alcohol) above is a kind of bluish gray; on each side of the back as far as the sacrum is a narrow blackish dorso-lateral line, and on the sacrum numerous small rounded blackish spots; there is a broken blackish line on the upper lip; the underside of the body is dark brown with numerous whitish dots, that of the hind legs whitish marbled with small dark brown spots.

Class REPTILIA.

Suborder SAURIA.

STENOCERCUS ERVINGI, new species.

Diagnosis.—Posterior dorsal scales considerably smaller than ventrals; caudal scales much longer than ventrals, not spinose; anterior border of ear without spines or lobules.

Habitat.—Peru.

Type-specimen.—Cat. No. 49550 U.S.N.M.; Huadquinia, Peru, 5,000 feet altitude; wet season, 1911.

Description of type-specimen.—No pterygoid teeth; scales on top of head small, flat, pitted; two rows of scales on interorbital space; two rows of large, supraocular scales, those of the inner row broader than long; occipital smaller than those surrounding it; anterior border of ear smooth, without projecting spines, the scales forming the margin not differentiated in any way; sides of neck longitudinally folded; underside of neck smooth; a strong vertical fold in front of the humerus; body rather depressed; dorsal scales small, obtusely keeled, not mucronate, those on median line slightly larger but forming no denticulation, the lateral ones anteriorly granular, increasing in size toward the median line and posteriorly, the largest ones considerably smaller than the ventrals and much smaller than the caudals; sides of neck and body finely granular; gular scales small, but much larger than lateral granules; ventrals considerably larger than largest dorsals, rounded, imbricate, smooth; adpressed hind leg reaches the eye; fifth toe nearly as long as second; legs above with keeled scales larger than largest dorsals; tail about one-third longer than head and body, cylindrical, covered with distinct rings of strongly keeled, blunt scales almost twice as large as ventrals. Color (in alcohol) above greenish gray, marbled with dusky and speckled with whitish rounded dots; a narrow, blackish, transverse band, edged behind with larger nearly continuous whitish spots from one humeral fold to the other, barely interrupted on the dorsomedian line; legs and tail above cross barred with dusky; throat greenish white with darker bluish-green marblings on the side of neck; underside whitish.

Dimensions.

	mm.
Total length	84
Tip of snout to vent	35
Vent to tip of tail	49
Tip of snout to ear	10
Width of head	7
Fore leg	17
Hind leg	26

Remarks.—This species is easily distinguished from the other Peruvian species of this genus by the smallness of its dorsal scales. In many respects it resembles *Stenocercus humeralis* from Ecuador, but differs materially in the absence of a trace of denticulation in front of the ear and in the much larger caudal scales.

Named for Dr. William G. Erving, the surgeon of the Yale Peruvian expedition of 1911.

LIOLÆMUS ANNECTENS Boulenger.

Eleven specimens collected between Cotuhuasi and Chuquibamba, at an altitude of 15,500 feet above the sea, agree substantially with Doctor Boulenger's description.[1] He indicates "two longitudinal series of scales on the frontal region," but the specimens before me show considerable variation in this respect, six having one row and five, two rows. The scale rows around the middle of the body vary between 56 and 70, two having 56, one 58, three 60, two 62, two 68, and one 70. The anal pores of the males vary between 4 and 7, one having 4, two 6, and three 7.

OREOSAURUS LACERTUS, new species.

Diagnosis.—No loreal; three supraoculars; two submental pairs in contact; twelve longitudinal series of ventrals; anterior row of preanals two, posterior four to six.

Habitat.—Peru.

Type-specimen.—Cat. No. 49551, U.S.N.M.; Tincochchaca, 7,000 feet altitude; August 10, 1911.

Description of type-specimen.—Adult male. Fronto-nasal quadrangular, as broad as long; frontal pentagonal, narrower behind; frontoparietals as long as frontal, but narrower; parietals and interparietal subequal, the latter seven-sided; three occipitals, the lateral ones as large as the large supraoculars, the median one smaller pentagonal; three supraoculars, the anterior smaller, descending in front of eye; no loreal; a row of scales between eye and supralabials; temporals large, especially upper row; six upper and six lower labials; one anterior unpaired chin-shield followed by two pairs in contact; eleven transverse rows of scales between chin-shields and collar, a series of granules between fourth and fifth rows, collar-shields ten; dorsal scales elongate quadrangular in transverse rows weakly keeled, the median row often consisting of subdivided or incomplete shields, twenty-one in a row across the back, and separated on each side from the ventrals by about two rows of coarse granules; forty scale rows from occiput to base of tail; ventrals large, quadrangular in twelve longitudinal and twenty-one transverse series; six large preanal scales, two in the anterior row, four in the posterior; six femoral pores on each side; tail about one-fourth longer than head and body, the scales

[1] Ann. Mag. Nat. Hist. (7), vol. 7, 1901, p. 546.

like those of the body, except the median pair on the underside which are relatively broader, being nearly square. Color (in alcohol) above dark brownish gray with three blackish stripes continued on the tail, one median and one on each side of the back, five scales from the median stripe; underside uniform dark plumbeous, paler on throat and chin.

Dimensions.

	mm.
Total length	113
Tip of snout to vent	50
Vent to tip of tail	63
Tip of snout to ear	11
Width of head	7
Fore leg	14
Hind leg	19

Remarks.—This species is most nearly related to Boettger's *Oreosaurus petersi*, but it has more longitudinal rows of ventral scales and fewer femoral pores. It also resembles *Oreosaurus ocellifer* Boulenger, but the latter has eight ventral rows and three pairs of submentals in contact. Boettger's species is said to have come from Para, but in view of its close relationship to the two Peruvian species, and the further fact that the other species of the genus are confined to Colombia, Ecuador, Peru, and Bogota, there is good reason for doubting its occurrence in Brazil, the more so since the unique type-specimen in Museum Senckenbergianum was obtained in 1849 from the museum in Mailand.

The Yale Peruvian expedition of 1911 obtained six specimens of this species, five from the type-locality and one from Ollantaytambo on July 20, 2,000 feet higher up.

There is considerable variation both in coloration and in number of scale rows. Thus the number of scales from occiput to base of tail varies between 38 and 46; that of scales across the back between 21 and 23; and that of the ventrals from collar to vent from 21 to 26. The preanals of the posterior row vary between 4 and 6. In the younger specimens the lateral dorsals diminish in size toward the lateral granules, the outermost ones being scarcely distinguishable from them. Variation in color consists chiefly in the lighter or darker ground color and the presence or absence of the median dorsal dark stripe; one specimen has the dorsal region irregularly sprinkled with dusky dots and in most of the specimens is there trace of a light upper edge to the dorso-lateral dusky stripe.

Suborder SERPENTES.

CLELIA CLOELIA (Daudin).

A single snake was collected by the expedition. It was taken at Huadquinia, altitude about 5,000 feet. Its scale-formula is as follows: *sc.* 19; *ventr.* 206; *an.* 1; *caud.* 91; *supralab.* 7; *oc.* 1+2; *temp.* 2+3.

NEW LAND SHELLS FROM THE PHILIPPINE ISLANDS.

By Paul Bartsch,
Assistant Curator Division of Mollusks, United States National Museum.

The United States National Museum has recently received an extremely interesting collection of land shells from the Hon. Dean C. Worcester, secretary of the interior of the Philippine Islands. The shells were collected by him on two small and little-visited islands, Calusa, the westernmost of the Cagayanes Islands, and Olanivan, the northern of the Sarangani group off southeastern Mindanao.

The three species in the lot are all new; their affinity will be discussed under each species, descriptions of which follow.

OBBA WORCESTERI, new species.

Plate 43, figs. 1–3.

Shell lenticular, marked by decidedly retractive lines of growth and very fine, closely spaced spiral striations, excepting the first whorl (the nucleus), which is smooth. The following whorl is light horn-yellow; the succeeding turn gradually darkens to chocolate brown On the third whorl three spiral bands of chocolate brown become apparent, which eventually cover more of the space between the sutures and the periphery than the buff flushed areas that separate them. The middle one of these three bands is the darkest and widest and occupies the middle of the whorls between the sutures. The posterior band is separated from the summit by a very narrow light zone; the spaces separating the median from the anterior and posterior bands are of equal width and as wide as the median dark zone. Periphery strongly keeled. Base moderately broadly umbilicated; marked by two brown bands, the first of which, the narrower, is separated from the periphery by a very narrow light line; the second, which equals the median band of the spire in width, is a little farther anterior to the other band than its own width. The light zone separating these two bands and the rest of the base, yellow with a greenish flush. Aperture suboval, somewhat angulated at the junction of the superior and basal lip; the angle corresponding to the peripheral keel; peristome thickened and reflected; basal lip

without tooth; parietal wall provided with a thick cord which joins the outer and basal lips and practically renders the peristome complete. The peristome is white, excepting at the peripheral angle where the brown band continues over it.

Type.—Cat. No. 252067, U.S.N.M. This and 37 specimens were collected by the Hon. Dean C. Worcester on Olanivan Island (Sarangani group). The type has 4½ whorls and measures: Altitude, 9.5 mm.; greater diameter, 24 mm.; lesser diameter, 20.3 mm.

Ten additional specimens taken at random yield the following data:

Number of whorls.	Altitude.	Greater diameter.	Lesser diameter.
	mm.	*mm.*	*mm.*
4.3	10	22.5	19
4.5	9.5	23	19
4.6	10.5	24	20
4.3	9.5	23	19.6
4.4	10	22	18.5
4.5	10	22	18.8
4.6	10.2	20.4	17.3
4.5	10	22.7	19.7
4.4	10.3	23.2	19.3
4.3	10	21.3	18

This species is nearest related to *Obbina saranganica* Hidalgo, which comes from Sarangani Island. This is a much larger race, a specimen of 4.3 whorls measuring: Altitude, 13.4 mm.; greater diameter, 36.4 mm.; lesser diameter, 29.7 mm.

COCHLOSTYLA CALUSAENSIS, new species.

Plate 43, figs. 9, 10, 12–14.

Shell depressed, conic to ovate, marked by fine, decidedly retractive lines of growth and very fine, closely spaced spiral striations. Ground color of the first three whorls white, while that of the subsequent whorls is suffused with sage green on the base, with a band of greenish color in front of the suture on the last whorl which leaves a whitish border on both sides of the median brown band, or the whole ground color may be nearly white if slightly weathered. Beginning with the second whorl, a faint broad brown spiral band makes its appearance on the middle of the space between the summit and the periphery of the whorls, increasing steadily in intensity until it acquires a deep chocolate brown on the last turn. A second brown band, equaling the above in width, encircles the whorls immediately anterior to the periphery. Aperture moderately large; columella oblique, white; peristome reflected, white. Color bands within the outer lip as intense as on the exterior.

Six specimens of this species were collected by the Hon. Dean C. Worcester on Caluga Island (Cagayanes).

Type.—Cat. No. 252069, U.S.N.M.

These yield the following measurements:

Number of whorls.	Altitude.	Greater diameter.	Lesser diameter.
	mm.	*mm.*	*mm.*
5.5	31.8	27	25.5
5.3	25.8	23.6	21
5	25	26.8	23.7
4.6	23	24.4	21.3
4.4	20.7	23.6	20
4.4	20.3	21.8	18.5

This species is nearest related to *Cochlostyla tenera* Sowerby, from Mindoro. The latter is of much more constant form and size and has instead of the green suffusion a narrow green spiral band a little anterior to the summit and a second one of about equal width a little nearer to the subperipheral brown band than to the median. The median brown band also extends to the very tip of the shell.

Three specimens of *C. tenera* Sowerby yield the following data:

Number of whorls.	Altitude.	Greater diameter.	Lesser diameter.
	mm.	*mm.*	*mm.*
4.9	25.2	27.6	22.4
5	26.7	27.4	23.5
5	24.5	25.2	22

COCHLOSTYLA OLANIVANENSIS, new species.

Plate 43, figs. 4–8, 11.

Shell broadly depressed conic; entire surface marked by fine, decidedly retractive lines of growth and very fine, closely spaced spiral striations. Ground color white, slightly suffused with yellowish, or even white with a suffusion of light russet vinaceous; the dark tint, if present, is usually on the later whorls. In addition to the ground color, the whorls are marked with a deep chestnut band at the periphery; the summit of the succeeding turns leaving this exposed as a suprasutural band. The extreme appressed summit of the whorls is also edged with a very narrow zone of dark chestnut which is usually covered by a hydrophanous yellowish white band that extends over the posterior fourth of the space between the summit and the periphery of the whorls. The rest of this space is covered by several very narrow spiral hydrophanous lines. Base marked by a rather broad hydrophanous band, situated immediately anterior to the periphery; a second one of about half the width of this encircles the base at the posterior extremity of the anterior fourth, while between these two there appear to be several additional slender hydrophanous lines. The base of the columella is encircled by a narrow, dark chestnut zone, which is sometimes interrupted, and in some instances

fades to yellow. The anterior end of the columella is tinged on the inside by this purple zone in those specimens in which this color appears intense; in the weakest colored ones it is almost white. Peristome usually white, or nearly so, in some individuals very slightly suffused with russet vinaceous.

Eleven specimens of this species were collected by Mr. Worcester on Olanivan Island, Philippine Islands, which yield the following data:

Number of whorls.	Altitude.	Greater diameter.	Lesser diameter.
	mm.	*mm.*	*mm.*
4.3	17.5	25.3	[1]22
4.3	19	25	21
4.3	17	24.4	21.2
4.4	16.5	24	21
4.5	17.5	25.6	22
4.2	16.2	23.7	21.1
4.5	17	24.5	20.8
4.3	17	23.6	20.5
4.3	16.3	23.5	22.3
4.5	18.3	26.0	22.5
4.4	18	26.2	22.5

[1] Type.

This species is nearest related to *C. saranganica* Möllendorff. It differs from it by its uniformly lesser size and coloration, which is in every way much darker, half of the base about the columella being chestnut brown and the entire peristome being of a light purplish brown color.

Type.—Cat. No. 252068, U.S.N.M.

Six specimens, of *Cochlostyla saranganica* Möllendorff Cat. No. 195405, U.S.N.M., received from the von Möllendorff collection, come from Balut Island, one of the Sarangani group. These yield the following data:

Number of whorls.	Altitude.	Greater diameter.	Lesser diameter.
	mm.	*mm.*	*mm.*
4.3	19.5	28.5	24
4.4	21.5	29.3	24.3
4.1	19.8	27.5	23.3
4.3	19.8	30	24.4
4.3	18	28	23.5
4.4	19.8	26.5	22.2

Cochlostyla saranganica Möllendorff is not *Cochlostyla indusiata* Pfeiffer, as supposed by Hidalgo. That is quite a different species and comes from Tukan Bessi, an island southeast of Celebes.

EXPLANATION OF PLATE 43.

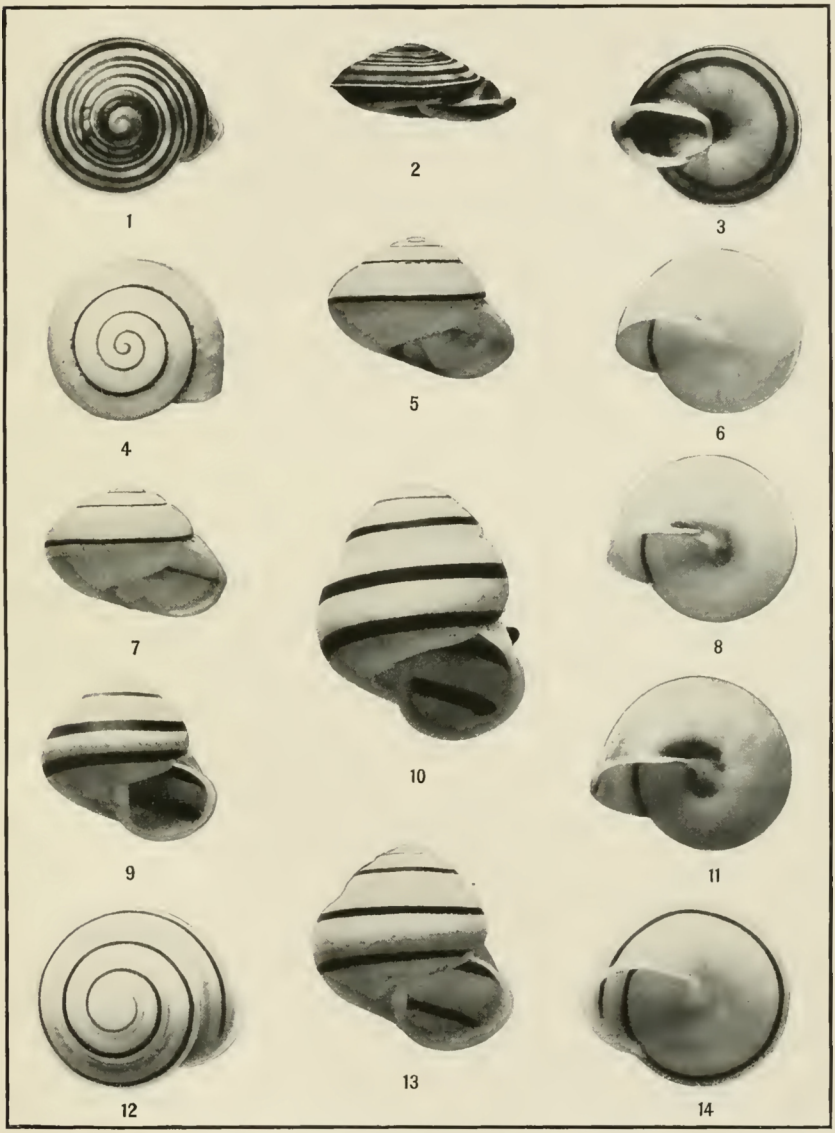
(All figures are natural size.)

Fig. 1. *Obba worcesteri*, top view. Type. See page 549.
2. *Obba worcesteri*, profile view. Type.
3. *Obba worcesteri*, basal view. Type.
4. *Cochlostyla olanivanensis*, top view. Type. See page 551.
5. *Cochlostyla olanivanensis*, profile view. Type.
6. *Cochlostyla olanivanensis*, basal view.
7. *Cochlostyla olanivanensis*, profile view.
8. *Cochlostyla olanivanensis*, basal view. Type.
11. *Cochlostyla olanivanensis*, basal view.

Figures 6, 7, and 11 showing the variations of the dark basal area.

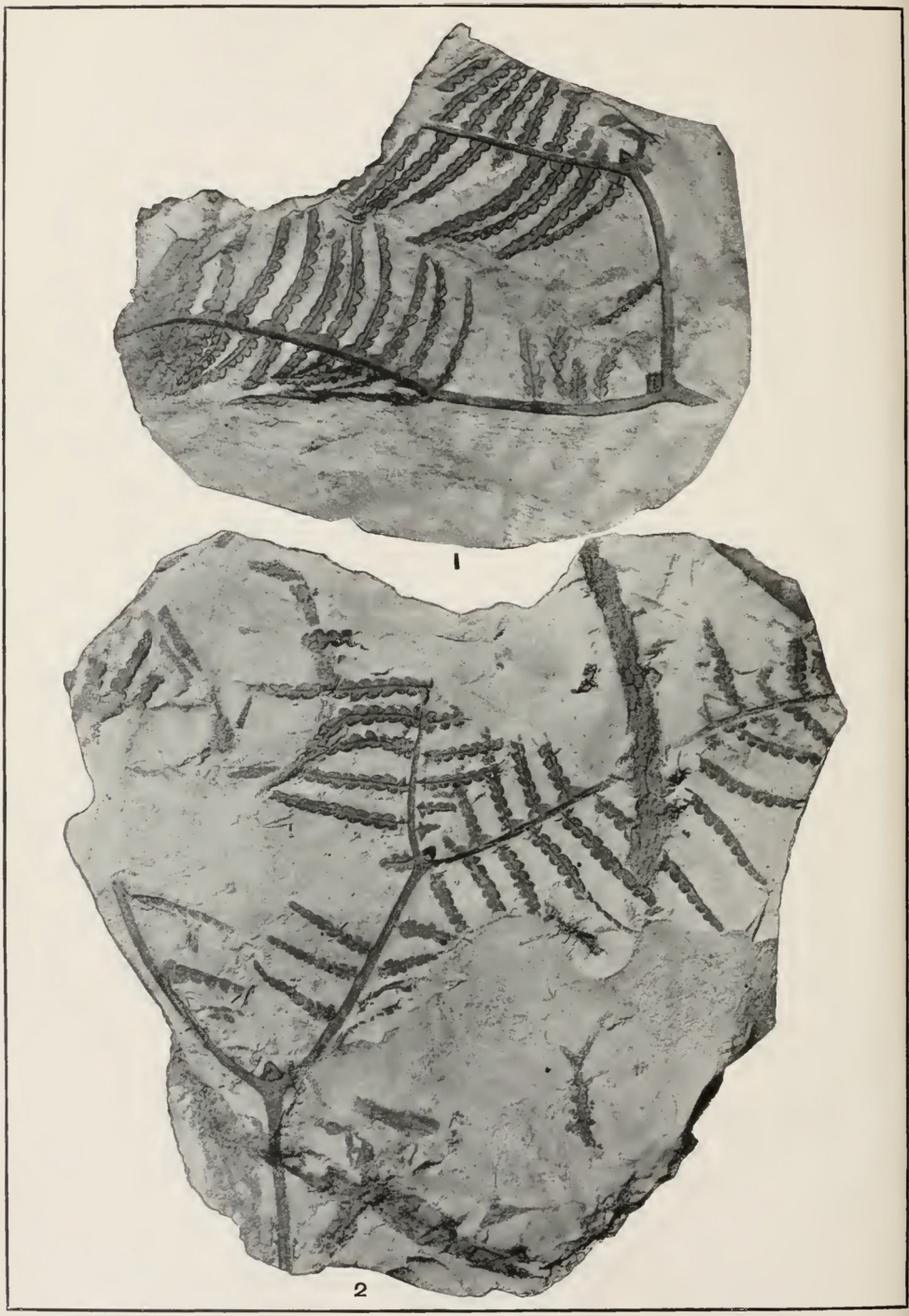
9. *Cochlostyla calusaensis*, profile view. See page 550.
10. *Cochlostyla calusaensis*, profile view.
12. *Cochlostyla calusaensis*, top view. Type.
13. *Cochlostyla calusaensis*, profile view. Type.
14. *Cochlostyla calusaensis*, basal view. Type.

Figures 9, 10, and 13 show variations in size and shape of shell.



NEW LAND SHELLS FROM THE PHILIPPINE ISLANDS.

FOR EXPLANATION OF PLATE SEE PAGE 553.



A New Fossil Fern of the Genus Gleichenia.

For explanation of plate see page 557.

DESCRIPTION OF A NEW FOSSIL FERN OF THE GENUS GLEICHENIA FROM THE UPPER CRETACEOUS OF WYOMING.

By Frank H. Knowlton.

Custodian of Mesozoic plants, United States National Museum.

The family Gleicheniaceæ is undoubtedly a very old one, though there is perhaps still reasonable doubt as to its being quite so ancient as it was at one time believed to be. The genus *Gleichenites*, so named on account of its supposed affinity to the living family, was instituted by Göppert [1] for certain fronds from the Carboniferous of Silesia, but this group was evidently composite and the several species have been allocated in *Neuropteris*, *Sphenopteris*, *Eremopteris*, etc., some or all of which are now known to be included in the Pteridosperms. A number of other Carboniferous fronds, such as *Mariopteris* Zeiller, *Diplothmema* Stur, etc., on account of their regular, dichotomous, gleichenoid habit of branching, have a more or less strong resemblance to the living Gleicheniaceæ, but both these forms are now placed in the Pteridosperms, and the dichotomous branching can not be regarded as establishing affinity to the living family. Much more important in this connection are specimens showing the arrangement and character of the fruiting organs, but even when these are present great caution is necessary since the accidents of preservation may render a correct interpretation difficult, if not impossible. Thus, Williamson [2] figured from the English Coal Measures a specimen which he regarded as the "sporangium of a fern allied to the Gleicheniaceæ or Schizaeaceæ," which certainly appears to possess a complete annulus, but this has been interpreted by later authors as a mistaken observation on an exannulate Marattiaceous sporangium. A much better case appears to be made out for the fruit of *Oligocarpia* of Göppert (especially *O. brongniarti* Stur), these being small ferns with Sphenopteroid foliage bearing circular sori made up of from 6 to 10 pyriform sporangia. Zeiller [3] in particular has claimed that they show a complete transverse annulus, and though this has been ques-

[1] Syst. Fil. Foss., 1836, p. 181.

[2] Philos. Trans., vol. 167, pt. 1, 1877, pl. 7, figs. 27, 28.

[3] Bassin Houiller du Valenciennes, Flore fossile, 1888, p. 53 et seq.

tioned by Stur, Solms-Laubach, Schenk, and others, Scott,[1] who has seen some of the material, inclines to give it credence. He says: "Each sporangium shows a transverse, or somewhat oblique annulus, just as in that genus [*Gleichenia*]; though some authors have denied that the apparent annulus is really distinct from the rest of the sporangial wall, the inspection of the specimens, especially those of *O. robustior* Stur, leaves no doubt that the former interpretation is correct."

Briefly, to sum up the arguments for the presence of the Gleicheniaceæ in the Paleozoic, it may be admitted that the dichotomous branching can not be taken as proof positive of Gleicheniaceous affinity, but with the fruiting characters the question seems to be on a slightly better plane. That the fruit in *Oligocarpia* is disposed in a circular sorus composed of from 6 to 10 pyriform sporangia, there can not be doubt, but whether they have, or have not, an annulus is perhaps not definitely settled. If the annulus is indisputably present, this genus should apparently be regarded as closely allied to, if not, indeed, belonging to, the Gleicheniaceæ, while the absence of the complete annulus would refer it to the Marattiaceæ. We may conclude with Seward,[2] who says: "We find in Carboniferous types undoubted indications of anatomical and other features which in succeeding ages became the marks of Gleicheniaceæ."

The presence of the Gleicheniaceæ in the Triassic and Jurassic is attested at a number of points, though not all the forms so considered by their authors can always be accepted. Thus, Fontaine's genus *Mertensides*, from the Upper Triassic of Virginia, is now generally accepted as being Marattiaceous; it lacks the characteristic forking of *Gleichenia*, but has the 4 to 6 sporangia arranged in a circular sorus. From the Upper Triassic of Basel Leuthardt[3] has described a species as *Gleichenites gracilis*, which shows the sori composed of 5 sporangia, each sporangium with a horizontal annulus, and Schenk has figured a species as *Gleichenites microphyllus* from the Rhaetic of Franconia, but no fruiting organs have been found for it.

In the Jurassic the forms referred to the Gleicheniaceæ become increasingly evident, though relatively few have the sporangia preserved. So many of these have the small rounded pinnules and the dichotomous habit of branching so very like the Gleichenias that there can be little or no doubt as to the correctness of their reference to this family.

In the Cretaceous the Gleicheniaceæ were evidently well established and widely distributed, for in the Wealden we find them present in England, Belgium, North Germany, and other localities, while in the

[1] Studies in Fossil Botany, ed. 2, vol. 1, 1908, p. 290.

[2] Fossil Plants, vol. 2, 1910, p. 351.

[3] Die Keuperflora von Neuewelt bei Basel, Abh. Schweiz. Pal. Ges., vol. 31, 1904, p. 40, pl. 18 ,fig. 3.

United States remains so described are known from the Kootenai, Dakota, Raritan, and in the Montana. From the Kome (Urogonian) of Greenland Heer has described many beautifully preserved examples, a few of which show the characteristic sporangia.

In the course of investigations by the United States Geological Survey into the coal resources of the West that have been going on for the past six or eight years, many beautifully preserved ferns have been found, among them a considerable number that clearly belong to *Gleichenia*.[1] The specimens here considered may be known as:

GLEICHENIA PULCHELLA, new species.

Plate 44, figs. 1, 2.

Frond probably of large size, distinctly xerophilous in habit; primary leaf axis unknown; secondary axis stiff, naked, terete and smooth, dichotomous, or pseudo-dichotomous, the included bud large, always (?) undeveloped; internodes apparently equal, each with about three or four pairs of alternate, scattered pinnules; terminal branches (pinnæ) apparently equal, erect, stiff, each with numerous pairs of mainly alternate, rather remote, sessile, linear-lanceolate pinnules; pinnules with a larger basal segment, thence cut nearly to the midrib into numerous round moniliform lobes, these being reduced until near the tip they are merely undulations; margins clearly revolute; midrib relatively thick, 3-striate; nervation of segments obscure but apparently not forked, delicate; fruit-dots (?) immature, minute, usually about two to each segment.

Type.—Cat. No. 34,446, U.S.N.M. (pl. 44, fig. 2); *para-type*, Cat. No. 34447, U.S.N.M. (pl. 44, fig. 1).

Locality.—One-half mile north of mine D, Superior, Wyoming (sec. 17, T. 21 N., R. 102 W.).

Geological horizon.—Cretaceous (Montana). Rock Springs coal group, Mesaverde formation.

This species is represented by a large number of examples, the two figured being in some respects perhaps the best. Judging by analogy with living species, it probably bore fronds of large size, for which supposition there is some warrant in larger fragments of what appear to have been axes lower than the ones shown in the figures. The lowest segment of the axis, or internode, figured is nearly 2 mm. thick and is preserved for a length of 2.5 cm. The internodes are 3 to 4 cm. long, apparently nearly or quite equal, and, as stated above, bear 3 or 4

[1] The generic name *Gleichenites*, established by Göppert in 1836 for certain Paleozoic ferns, is not tenable for Mesozoic or later fossil forms. The type species of *Gleichenites* is *G. linkii*, but this, according to the opinion of David White, is a *Sphenopteris* of the group represented by *S. hoeninghausi* Brongniart, 1828, which is the frond of the best known of the Pteridosperms, Lyginodendron (Lygenopteris). The other four species originally placed in the genus by Göppert are now distributed among *Sphenopteris*, *Neuropteris*, and *Eremopteris*, and the name *Gleichenites* is abandoned for Paleozoic ferns. On the principle of "once a synonym always a synonym," it can not be resurrected for subsequent use.

pairs of alternate remote pinnules. The terminal leafy branches (pinnæ) exceeded 6 cm. in length. The pinnules range in length from about 1 to 2.5 cm.; their width is between 2 and 3 mm. The pinnules were clearly coriaceous in texture, as they appear thick and rigid, and have the margins distinctly revolute.

The presence of sori in these specimens is more or less in doubt, there being only a number of minute dots or pits, usually about two in each segment, that may represent very immature fruit. Their relation to the veins can not be certainly ascertained.

The living representatives of the Gleicheniaceæ, upward of 100 in number, according to American students, are comprised in four genera, two of which (*Platyzoma* and *Stromatopteris*) are monotypic. The other species are distributed among *Gleichenia* proper and *Dicranopteris*, the latter covering the ground of the former section *Mertensia*.[1] These are distinguished mainly as follows: In *Dicranopteris* the veins are free, once or several times forked, and the sori dorsal on the veins, while in *Glechenia* the veins are simple and the sori terminal on the veins. According to Underwood,[2] followed by Maxon,[3] who has recently monographed the American forms, the genus *Gleichenia* as now restricted is not found in the New World, all being referable to *Dicranopteris*. It is believed that the fossil form under consideration, belongs, so far as the essential features can be made out, to *Gleichenia*. If this is correct, and it is thought to be, it is of interest as showing that in the late Cretaceous time the genus *Gleichenia* was an inhabitant of America, and many hundreds of miles north of the present habitat of any living representative of the family.

In many cases the absence of fructification in fossil ferns makes their classification more or less a matter of question, but with the present specimens there can hardly be the possibility of error. The manner of forking, the included terminal bud and the coriaceous, narrow, moniliform pinnules with revolute margins, are so exactly the characters of *Gleichenia* that there can be no reasonable question. It is, for instance, very much like the Australian *G. circinata* Swartz, which is itself apparently a variable species.

Among fossil species referred to *Gleichenia* the present one is perhaps closest to several described by Heer[4] from the Kome (Lower Cretaceous) of Greenland. It has the same habit as *G. zippei* Heer, but is much smaller. It is nearest to *G. gracilis* Heer and to *G. delicatula* Heer, but differs in regard to the lobation and shape of the pinnules.

[1] *Mertensia* is preoccupied by the Boraginaceous genus of this name.
[2] Bull. Torr. Bot. Club, vol. 34, 1907, pp. 243–262.
[3] North Amer. Flora, vol. 16, pt. 1, 1909, pp. 53–63.
[4] Flora Foss. Arct., vol. 3 (Kreide-flora d. Arct. zone), 1874, pls. 3–11.

THE ISOPOD GENUS ICHTHYOXENUS HERKLOTS, WITH DESCRIPTION OF A NEW SPECIES FROM JAPAN.

By Harriet Richardson,

Collaborator, Division of Marine Invertebrates, United States National Museum.

In 1870 Herklots [1] described the type-species of the genus *Ichthyoxenus* which was found parasitic on the fish *Barbodes maculatus* Bleeker from Java. The mode of life of this isopod is peculiar and interesting. It bores a hole in the body of the fish just back of the lateral fin, where it lives with its mate. It enters this cavity when young. As it grows in size, it is unable to leave the body of the fish and becomes many times larger than the opening through which it entered. This species was named after Mr. Jellinghaus, who was the first to notice the parasite, which he called "songkoat," and who in 1860 wrote a note concerning it to the Société physique des Indes néerlandaises.[2] The fish was taken from the River Tjikerang, district of Tjilokotot, regency of Bandong.

The second species of the genus, *Ichthyoxenus montanus*, was described by Schiœdte and Meinert [3] in 1884. It was found on *Puntius sophores* in the Himalayan Mountains.

Up to the present time these two were the only species known.

In 1908 Maj. P. A. Ouwens [4] mentioned another host for *Ichthyoxenus jellinghausii*, the fish *Nemacheilus fasciatus* van Hasselt, from the Tji-Seroema near Batavia.

Not long ago Dr. Harold Heath wrote to me concerning some parasites which were found on Japanese fishes from Lake Biwa. They were described as living in the body of the fish, which they entered through a hole bored just back of the lateral fin. The specimens were sent to the United States National Museum by Mr. Will Thompson, and the parasites proved to be a new species of *Ichthyoxenus*. The hosts are *Acheilognathus rhombeum* (Schlegel),

[1] Archives Néerlandaises des Sciences, vol. 5, 1870, pp. 128–137, pl. 5, figs. 10–18.
[2] Natuurk. Tijdschr. Nederl.-Indië, vol. 22, 1860, p. 378.
[3] Nat. Tidsskrift (3), vol. 14, 1884, pp. 303–309, pl. 11, figs. 10–11.
[4] Natuurk. Tijdschr. Nederl.-Indië, vol. 67, 1908, pp. 29–35.

Gnathopogon elongata (Schlegel), *Acheilognathus tabira* Jordan and Thompson, MSS., *Acheilognathus lanceolatum* (Schlegel), and *Acheilognathus cyonostigma* (Jordan and Fowler). I have since found this parasite on *A. limbatum* Jordan and Snyder from the same locality.

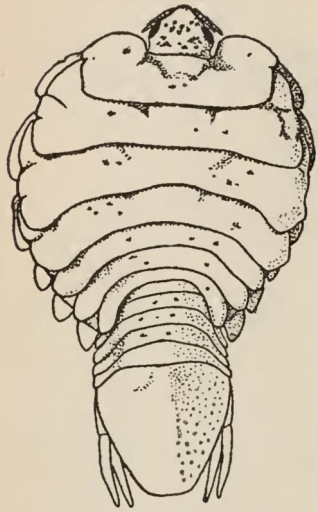


FIG. 1.—ICHTHYOXENUS JELLINGHAUSII, BUITENZORG. FEMALE. × 3½.

ICHTHYOXENUS JELLINGHAUSII Herklots.

Ichthyoxenus jellinghausii HERKLOTS, Archives Néerlandaises, vol. 5, 1870, pp. 128–137, pl. 5, figs. 10–18.—SCHIŒDTE and MEINERT, Naturhistorisk Tidsskrift (3), vol. 14, 1884, pp. 298–303, pl. 11, figs. 5–6.—MAX WEBER, Zool. Ergebnisse, vol. 2, 1892, pp. 557–560, pl. 30, fig. 1.—WILLINK, Natuurk. Tijdschr. Nederl.-Indië, vol. 64, 1905, pp. 156–161.—OUWENS, Natuurk. Tijdschr. Nederl. Indië, vol. 67, 1908, pp. 29–35.

Locality.—A male and a female, collected by Dr. Owen Bryant and Mr. William Palmer in Java, are in the United States National Museum. The host is not known.

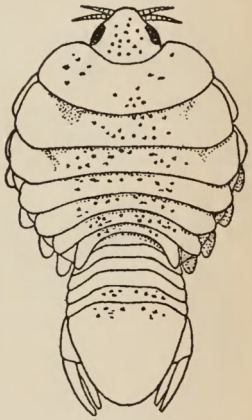


FIG. 2.—ICHTHYOXENUS JELLINGHAUSII, BUITENZORG. MALE. × 5½.

This species has been recorded from Bandong and Batavia. The specimen in the United States National Museum is from Buitenzorg, and if the figures of Herklots and Schiœdte and Meinert are correct it differs from the type in the following points: The first segment of the thorax in the female has the anterior margin deeply excavate in the middle, the excavation being rectangular; the seventh pair of legs have the carpus and merus very much inflated, with the inner margin produced in a rounded expansion; the merus is also much elongated.



FIG. 3.—ICHTHYOXENUS JELLINGHAUSII, BUITENZORG. SEVENTH LEG OF FEMALE. × 7½.

For the purpose of comparison with the new species from Japan, I have figured the specimen in the United States National Museum, which I have identified as *Ichthyoxenus jellinghausii* Herklots. Since I have not seen the type-species and find the Buitenzorg specimens so close to the description and figures of this form, I have thought it best to do this.

ICHTHYOXENUS JAPONENSIS, new species.

Body of female oblong-ovate, almost twice as long as wide, 13 mm. long, 7 mm. wide. Surface smooth. Color pale yellow, with scattered black dots.

Head small, triangular, 2 mm. long, 2½ mm. wide; front rounded. Eyes large, oblong, about 1 mm. in length and separated by a distance equal to 1 mm. or the length of one eye. First antennæ short, composed of six articles and extending to the middle of the eye or to the end of the fifth article of the second antennæ. Second antennæ composed of seven articles and extending almost to the post-lateral angle of the head.

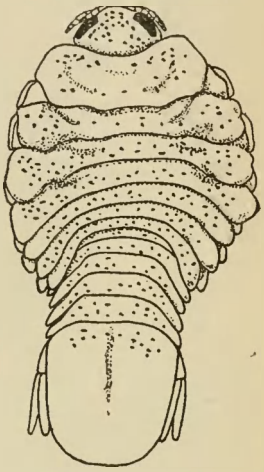


FIG. 4.—ICHTHYOXENUS JAPONENSIS, LAKE BIWA, FROM ACHEILOGNATHUS CYONOSTIGMA. FEMALE. × 5.

The first segment of the thorax is about twice as long in the median line as any of the three following, being 1½ mm. in length. The second, third, and fourth segments are subequal. The last three segments gradually decrease in length, the three together measuring 1½ mm. The anterior margin of the first segment is sinuate in the middle, the lateral parts projecting laterally beyond the head and being posteriorly constricted. Epimera are present on the last six segments, those of the second, third, and fourth segments being narrow, elongate plates occupying the anterior half of the lateral margin; those of the last three segments are about as long as wide, with the posterior extremities rounded, and are placed just anterior to the lateral margin of their respective segments.

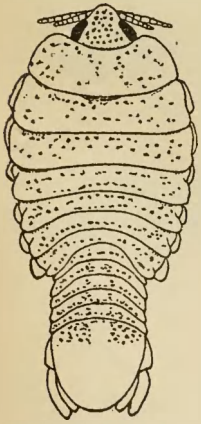


FIG. 5.—ICHTHYOXENUS JAPONENSIS, LAKE BIWA, FROM ACHEILOGNATHUS LIMBATUM. MALE. × 5½.

The abdomen is deeply immersed in the thorax, the lateral parts of the first two segments being completely covered on one side, the second segment partly showing on the other side. The first five segments gradually increase in length, all together measuring 2½ mm. The sixth or terminal segment is a little longer than wide, 4½ mm. long, 4 mm. wide, and is posteriorly widely rounded. Its posterior half is thin, semitranslucent, and colorless, with no markings. The uropods are much shorter than the terminal segment of the abdomen, and do not reach its extremity by a distance equal to 1 mm.; the branches are equal in length, narrow, tapering, with rounded extremities, the outer one being slightly narrower than the inner one. The pleopods are also short, not quite reaching the

tip of the uropods and being 1 mm. shorter than the extremity of the terminal abdominal segment.

All seven pairs of legs are prehensile. The last pair has the carpus and merus dilated in rounded expansions on the inferior side. The merus is short, being about one-third the length of the ischium. In the last four pairs of legs these articles show an increasing expansion.

Some of the specimens obtained are larger than the one figured and described, but in most of these the abdomen is curled up at the extremity. I have therefore taken the smallest one as the type.

The male differs from the female in size, being much smaller; in the more symmetrical body, longer antennæ, narrower head, and smaller terminal segment of the abdomen.

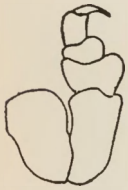


FIG. 6.—ICHTHYOXENUS JAPONENSIS, LAKE BIWA, FROM ACHEILOGNATHUS CYONOSTIGMA. SEVENTH LEG OF FEMALE. ×14½.

The type-specimens, male and female, were taken from *Acheilognathus cyonostigma* (Jordan and Fowler), found in Lake Biwa, and two males and two females were taken from the same host at Omi, Lake Yogo.

Other specimens are as follows: A male and a female on *Acheilognathus lanceolatum* (Schlegel) from Funayado, Kiusiu, Japan, and a male and a female on the same host from Omi, Lake Yogo; a male and a female on *Acheilognathus tabira* Jordan and Thompson, MSS., from Lake Biwa; one female on *Gnathopogon elongata* (Schlegel) from Lake Biwa; two males and two females from two specimens of *Acheilognathus rhombeum* (Schlegel) from Lake Biwa; two males and two females from *Acheilognathus limbatum* Jordan and Snyder from Lake Biwa.

This species differs from *I. jellinghausii* in the larger eyes, the larger and more circular form of the terminal segment of the abdomen, the shorter uropoda, the shorter and differently shaped merus of the seventh pair of legs, and the larger head and wider abdomen, compared with the thorax.

Type.—Cat. No. 45617, U.S.N.M.

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[1] I have not been able to obtain this paper.

SOME NEW HAWAIIAN CEPHALOPODS.

By S. Stillman Berry,
Of Redlands, California.

The following brief notices of additional new forms of cephalopods from the United States Bureau of Fisheries steamer *Albatross* Hawaiian collections are offered in advance of the publication of the main report. A previous paper on the fauna has appeared in these Proceedings.[1]

LAETMOTEUTHIS, new genus.

Finned Octopods close to *Cirroteuthis*, but with the paired cirri apparently wanting. The well-developed radula has seven rows of teeth. The umbrella is ample as in *Cirroteuthis;* there is no "intermediate web."

Type.—*Laetmotheutis lugubris*, new species.

LAETMOTEUTHIS LUGUBRIS, new species.

Body large, rounded posteriorly; a pair of small, transversely elongate fins attached one at either side. Funnel very large.

Arms long, appearing merely as thickenings in the very extensive umbrella. Suckers large, flattened, distant; placed in a single somewhat zigzag series; paired cirri indistinguishable.

Beak large and powerful. Radula large and perfect, comprising seven rows of teeth, of which the tricuspid medians are conspicuously the largest.

Color a dark livid brown (chocolate colored when captured).

Type.—Cat. No. 214385, U.S.N.M. [S. S. B. 211]. From *Albatross* station 3904, off the north coast of Molokai.

Length of right dorsal arm, 430+mm.; of umbrella between dorsal arms, 300 mm.; of extracted radula, 22 mm.

This specimen is very fragmentary and was taken from the surface. A second similar specimen was taken at station 3898.

[1] Vol. 37, pp. 407–419, published December 30, 1909.

SCAEURGUS PATAGIATUS, new species.

Body small, short, rounded, compact; dorsal surface heavily tuberculate with small rounded papillæ which often coalesce to form longitudinal ridges, the arrangement of the latter showing a greater or less bilateral symmetry; a narrow keel bounds the periphery of the body on the sides but is discontinuous posteriorly; there is a large cirrus over each eye opening, with a smaller one just in front.

Head broad, but narrower than the body; eyes large. Funnel organ W-shaped.

Arms stout, somewhat over twice as long as the head and body taken together; subequal, the second pair slightly the longest. Umbrella well developed, especially between the dorsal arms. Third left arm in the male conspicuously hectocotylized; calamus very long and slender; the ligula spoon shaped, its inner face deeply excavated.

General color of living animal, pale green; of alcoholic specimens, a brownish buff marbled with chocolate.

Type.—Cat. No. 214379, U.S.N.M. [S. S. B. 204]. From *Albatross* station 4079, off the island of Maui.

Length (total), 152 mm.; posterior tip of body to base of dorsal arms, 46 mm.

EUPRYMNA SCOLOPES, new species.

Body small, sepioliform, of variable outline. Fins large, semicircular, attached in advance of the middle of the body. Nuchal commissure wide.

Head short, about the same width as the mantle; eyes large.

Arms short, stout, about as long as the mantle, their order of relative length 2, 3, 4, 1. Umbrella rudimentary between the dorsal arms and those of the ventral pair, but elsewhere better developed. Suckers on all the arms in four rows except at the extreme base and tip, where they are in two rows; pedicels short, stout; cups spherical, with small apertures; horny rings smooth. In the female the suckers on all the arms are relatively minute and subequal, but in the male some 6 to 10 suckers in each marginal row on the second, third, and fourth arms undergo a conspicuous enlargement; left dorsal arm of male hectocotylized—the first four pairs of suckers at the base in two rows, these succeeded by 10 quartets of small suckers, the two basalmost of the ventral row of which are reduced to slender papillæ; beyond its basal third the arm becomes much swollen, while the suckers of the two ventral rows are replaced by an irregular crowded series of transversely compressed papillæ, which continue to the tip, each bearing a minute aperture at its inner apex with a minutely toothed horny ring; the suckers of the two dorsal series undergo modification a little later than their ventral neighbors, finally appearing as a crowded double series of swollen tubercles which are neither so com-

pressed nor so closely palisaded as the latter. Tentacles of variable length; inner aspect of club of a villous appearance due to the exceeding minuteness of the numerous long-pediceled suckers which it bears.

Type.—Cat. No. 214380, U.S.N.M. [S. S. B. 320]. From *Albatross* station 3905, off the island of Molokai.

Length (total), 63 mm.; length of mantle (dorsal), 25 mm.

E. scolopes is a near ally of *E. stenodactyla* (Grant), but differs in the details of the hectocotylized arm and other secondary sexual characters in the male.

TELEOTEUTHIS COMPACTA, new species.

Small; mantle nearly cylindrical, ending posteriorly in an acute point. Fins enormous, broadly sagittate; their total width about equal to the length of the mantle; length a little more than half that of the mantle.

Head squarish, narrower than the body; eyes little prominent.

Arms short, stout, their order of length 3, 2, 4, 1; suckers in two widely interspaced rows; umbrella wanting. Tentacles little longer than the arms; clubs not thickened and bearing four series of acetabula, those of the medio-ventral series being transformed to hooks; the latter 10–11 in number, the first 5 quite small, next 3 larger, distal ones diminishing again; the two dorsal rows of suckers irregular, the first 5 pairs small and closely placed, the succeeding ones slightly larger and more distant, becoming smaller again distally; those of the inner dorsal row persist to the tip of the club, but the marginal series becomes obsolete distally and comprises only about 8 suckers; suckers of ventral row exceedingly minute, especially distally where they are placed very far apart; fixing apparatus well developed, comprising a quadruple series of small suckers and pads in alternation, about 12 of the former to 8 of the latter.

Type.—Cat. No. 214381, U.S.N.M. [S. S. B. 238]. From *Albatross* station 3989, vicinity of the island of Kauai.

ABRALIA TRIGONURA, new species.

Mantle short, wide and inflated in front, tapering to a point posteriorly. Fins large, a little over half as long as the mantle.

Head small; eyes large and prominent.

Arms over two-thirds as long as the body; nearly equal, but the dorsal pair distinctly the shortest; each bears two rows of small alternating hooks, succeeded by suckers at the extremities.

Structure of tentacles unknown.

Buccal membrane papillose and uniformly pale within; its outer surface dotted with small reddish chromatophores.

Photogenic organs of the ventral aspect of the head and mantle of two main types differing both in size and pigmentation; on the lower surface of the mantle the larger organs are arranged in longitudinal series, with the smaller organs irregularly scattered between them. The ventral surface of the funnel shows two large triangular groups of organs symmetrically disposed; four of these are of the larger type but do not lie in a single transverse series.

Type.—Cat. No. 214387, U.S.N.M. [S. S. B. 275]. From *Albatross* station 4087, northeast entrance to Pailolo Channel.

The single specimen seen is badly macerated, but does not seem to be conspecific with *A. andamanica* Goodrich, which it undoubtedly much resembles. The chief differences appear in the detailed distribution of the photogenic organs. In the present species the two median series of large organs which adorn the ventral aspect of the mantle are an especially conspicuous feature.

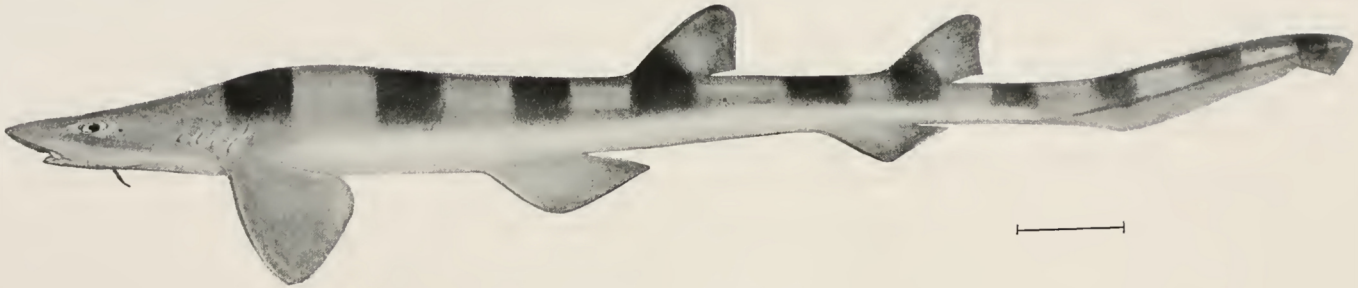
PTERYGIOTEUTHIS MICROLAMPAS, new species.

Body small, cylindro-conical, terminating posteriorly in a sharp spine-like process extending well past the rather large circular fins; fins attached along their inner margins for less than half their total length.

Head large, rounded; eyes large and prominent.

Arms short, nearly equal, their order 3, 2=4, 1; suckers in two rows, on the dorsal arms about 14 pairs, the ventral members of the eighth to tenth pairs transformed into hooks; second and third arms similar; ventral arms without hooks, their suckers very minute and confined to the more distal portion of the arm. Tentacles stout, but little longer than the arms; stalk thickened but constricted at base; club not expanded, bearing four series of minute suckers, of which the five proximal members of the dorsal row are distinctly the largest; two suckers and two pads in the fixing apparatus on the carpus. Subocular photogenic organs 14 in number; arrangement very similar to that described for *P. giardi* Fischer, but four instead of five small anterior organs, and the most anterior of these displaced laterally so that it is not in line with the others.

Type.—Cat. No. 214386, U.S.N.M. [S. S. B. 277]. From *Albatross* station 4105, in the Kaiwi Channel.



CIRRHOSCYLLIUM EXPOLITUM.

FOR DESCRIPTION SEE PAGE 568.

[SCIENTIFIC RESULTS OF THE PHILIPPINE CRUISE OF THE FISHERIES STEAMER "ALBATROSS," 1907–1910.—No. 28.]

THE HEMISCYLLIID SHARKS OF THE PHILIPPINE ARCHIPELAGO, WITH DESCRIPTION OF A NEW GENUS FROM THE CHINA SEA.

By Hugh M. Smith,

United States Commissioner of Fisheries and Director of the Albatross Philippine Expedition.

The family of Hemiscylliidæ is only sparsely represented in the *Albatross* collections made during the Philippine cruise. Two well-known species were obtained, and in addition a new genus (*Cirrhoscyllium*) from moderately deep water in the China Sea. The relations of the new genus to the genera previously described are in part shown in the following key:

KEY TO THE GENERA OF HEMISCYLLIIDÆ.

a [1]. Anal fin behind second dorsal; spiracles large.
  b [1]. No labial fold on lower jaw..... *Hemiscyllium.*
  b [2]. A labial fold on lower jaw..... *Chiloscyllium.*
a [2]. Anal fin in advance of second dorsal; spiracles minute.
  c [1]. Nape not conspicuously elevated; no appendages on under side of throat; teeth of lower jaw with indistinct lateral cusps..... *Parascyllium.*
  c [2]. Nape conspicuously elevated; a pair of thread-like appendages on under side of throat; teeth of both jaws with distinct lateral cusps..... *Cirrhoscyllium.*

CHILOSCYLLIUM PUNCTATUM Müller and Henle.

The collection contains three specimens referable to this species, heretofore known from the India seas, China seas, and Australia. The smallest example, a female 40 cm. long, obtained in the Siasi market on February 17, 1908, shows in alcohol about 10 distinct dark brown cross bands on head, body, and fins. The largest specimen, 90 cm. long, secured in the Zamboanga market on May 27, 1908, is of nearly uniform gray coloration with faint indication of dark bands; it is a female and contains two large, thick chitinous egg cases. The third specimen, a female 65 cm. long, taken in the Cebu market on August 16, 1909, is colored like the second example.

CHILOSCYLLIUM INDICUM (Gmelin).

This species, recorded from Manila by Günther,[1] does not appear to have been noted by more recent writers. The *Albatross* collection contains no specimens from the Philippines, but two specimens 65 and 58 cm. long, obtained in the market of Kowloon (China) on October 5 and October 21, 1908.

CIRRHOSCYLLIUM Smith and Radcliffe; new genus.[2]

Similar to *Parascyllium* Gill. Body slender; anal fin in advance of second dorsal; head much depressed; conical teeth with strong lateral cusps in both jaws; spiracles minute; fourth and fifth gill slits confluent; dermal denticles elongate-ovate, three-keeled; a pair of widely separated skin-covered, thread-like appendages on under side of throat.

Type of genus.—Cirrhoscyllium expolitum Smith and Radcliffe.

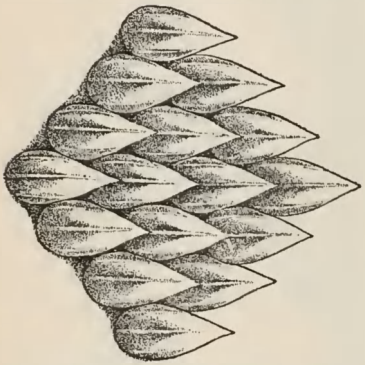


FIG. 1.—DERMAL DENTICLES FROM SIDE OF CIRRHOSCYLLIUM, ENLARGED.

CIRRHOSCYLLIUM EXPOLITUM Smith and Radcliffe, new species.

Plate 45.

Form very elongate; body slightly compressed, abruptly elevated at nape and tapering regularly from nape to tail; head depressed, broad, its length (to posterior gill slit) contained 5.5 times in total length of fish, its width at first gill slit about 0.5 length, its depth 0.5 width; tail straight, depth of peduncle greater than diameter of eye; eye small, lateral, its diameter equal to last gill slit and contained 2.5 in snout and 7.5 times in head, a well-developed naked fold of skin around eye, this most evident below; interorbital broad, flat, 2.5 times diameter of eye; snout flat, sharp in profile, under surface slightly upturned, tip obtusely rounded; mouth wide, slightly curved, entirely anterior to eye, the angle nearer to eye than to end of snout; a well-developed fold at angle of mouth which extends to symphysis of lower jaw; nasal valves much convoluted; spiracles minute, below and slightly behind posterior angle of eye; four anterior gill slits narrow, the fourth opening on margin of anterior wall of the fifth which is very wide and above pectoral base; teeth in both jaws conical, with well-developed lateral cusps; teeth constricted just below gum, their base expanded and excentric; base of teeth in upper jaw with a deep antero-posterior groove, much shallower and broader in lower jaw; entire surface and

[1] Voyage of *Challenger*, Zoology, vol. 1, pt. 6.

[2] In the study of this shark the writer has been associated with Mr. Lewis Radcliffe, who assumes joint authority for the new genus and species described.

fins closely covered with flat, imbricated denticles, those on upper surface pointed elongate-ovate, with median and lateral keels, those on abdomen and under surface of head smaller, smoother, and less pointed; a long, slender dermal appendage, covered with small denticles, on each side of throat at a point under posterior angle of eye and separated from eye by a space equal to its diameter, the length of the appendages 0.75 diameter of eye, distance of appendages apart more than twice diameter of eye.

Dorsal fins small and of nearly equal size; the anterior midway between tip of snout and end of tail, its origin about midway between origin of ventral and that of anal, its base equal to 0.4 space between the two dorsals; second dorsal beginning over middle of base of anal; caudal fin long, its length greater than head, upper lobe very low and appearing as a mere ridge anteriorly, lower lobe also low, its height less than 0.5 base of first dorsal, a notch near tip; anal fin low, its base equal to distance from fin to lower caudal lobe; ventrals rather broad, the lateral angle rounded, the posterior angle acutely pointed and reaching to a point under origin of first dorsal; pectorals short, broad, the length equal to distance from anterior angle of eye to their base, the angles rounded, distance between two fins at their posterior base equal to distance between spiracle and anterior margin of fin.

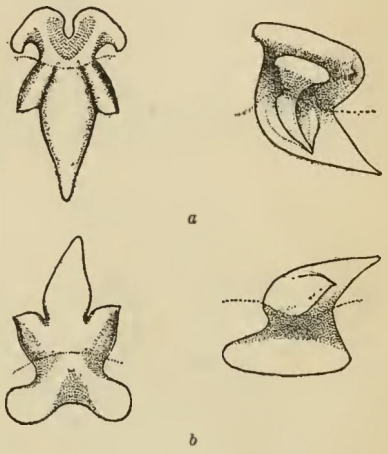


FIG. 2.—FRONT AND SIDE VIEWS OF TEETH OF CIRRHOSCYLLIUM NEAR SYMPHYSIS, GREATLY ENLARGED. THE DOTTED LINES INDICATE THE MARGIN OF THE GUMS. *a*, UPPER JAW; *b*, LOWER JAW.

Color in life, cinnamon-brown above, with blotches of darker brown on head, body, and tail; whitish below; when dry, the entire surface glistens as though varnished, owing to the peculiar character of the dermal denticles.

Type.—Cat. No. 74603, U.S.N.M., a female specimen 33.5 cm. long, taken with a beam trawl on November 4, 1908, at station 5310 (lat. 21° 33′ N.; long. 118° 13′ E.), in the China Sea between northern Luzon and China, at a depth of 100 fathoms.

NOTES ON A SMALL COLLECTION OF AMPHIPODS FROM THE PRIBILOF ISLANDS, WITH DESCRIPTIONS OF NEW SPECIES.

By A. S. Pearse,
Of the University of Wisconsin, Madison, Wisconsin.

The following notes pertain to a small collection made at St. Paul Island, Pribilof Islands, by Mr. M. C. Marsh and Mr. W. L. Hahn of the United States Bureau of Fisheries.

ALLORCHESTES MALLEOLUS Stebbing.

This species was apparently abundant in the skeletonizing box at the village landing, and collections were made on November 30 and December 12, 1911. The color in life was brown or reddish-brown. These specimens are larger (22 mm.) than the total length given by Stebbing for the species (7 mm.). The flagellum of the first antenna is 22-segmented; that of the second 18-segmented. The last three peræon and the first four pleon segments are carinate dorsally.

GAMMARUS LOCUSTA (Linnæus).

About 25 specimens were taken from the skeletonizing box at the village landing, December 12, 1911. Color in life, blue or bluish-black. Length, 17 mm.

GAMMARUS PRIBILOFENSIS, new species.

Head with lateral lobes rounded. Side plates 1–3 rather deep; nearly as broad as deep. Pleon segments 2 and 3, posterior angles produced and armed with a seta. Pleon segment 4 with a row of about 12 spinules along posterior dorsal margin; pleon segment 5 with one strong acute posterior median dorsal spine; pleon segment 6 with one submedian and three lateral spines (total 8) on each side of the posterior margin.

Eyes plump, small, somewhat reniform, black. Antenna 1 not half as long as body; first segment about as long as second and third combined; flagellum one and one-half times as long as peduncle,

13-segmented; accessory flagellum, 5-segmented. Antenna 2 about as long as antenna 1; flagellum about as long as peduncle. Gnathopod 1 in male with palm somewhat oblique, larger than gnathopod 2, in which the palm is transverse. Uropod 3 elongate, rami fringed with plumose setæ and spines; inner ramus three-fourths as long as first segment of outer ramus; second segment of outer ramus, small. Telson cleft to base, with three pairs of spines along outer margins and a seta near tip. Length, 9 mm.

Type-locality.—St. Paul, Pribilof Islands; from skeletonizing box. November 30, 1911.

Type.—Cat. No. 45710, U.S.N.M.

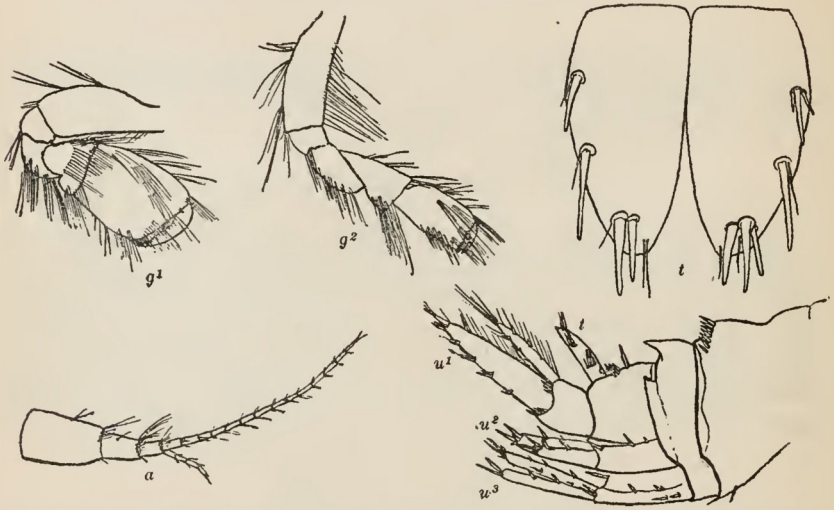


FIG. 1.—GAMMARUS PRIBILOFENSIS. a, FIRST ANTENNA; g^1, FIRST GNATHOPOD; g^2, SECOND GNATHOPOD; t, TELSON; u^1, u^2, u^3, UROPODS.

CHIRONESIMUS MULTIARTICULATUS, new species.

Body robust, back broadly rounded. Cephalon about the length of the first body segment, lateral corners produced and rounded. Anterior coxal plates twice as deep as the body; first pair slightly expanded below, rounded at anterior angle; fourth pair deeply emarginated posteriorly and forming a rather angular expansion below; fifth pair small, longer than deep. Third epimeral plates of abdomen produced at posterior angles and somewhat upturned.

Eyes oval, broader below, constricted in the middle. First antennæ as long as cephalon and first two body segments combined; first segment of peduncle very large and thick; flagellum more than twice as long as peduncle, 28–30-segmented; 18-segmented in female; accessory flagellum about as long as peduncle, 8-segmented in male, 7-segmented in female. Second antennæ usually folded under body,

more than twice as long as first, flagellum 60-segmented. First gnathopods with propodus one-third longer than carpus and nearly as wide, palm defined by a tooth. Second gnathopods with propodus nearly half the length of carpus, oblong-oval, not dilated distally, dactyl minute. Posterior pereopods about as long as fourth pair, basal segment large, meral segment expanded. Third uropoda reach beyond the end of the second pair; inner ramus little shorter than outer. Telson nearly twice as long as broad; cleft beyond middle; terminal lobes blunt, each with a spine and a seta. Said to have more or less pink on back when alive; eyes black in alcohol. Length, 22 mm.

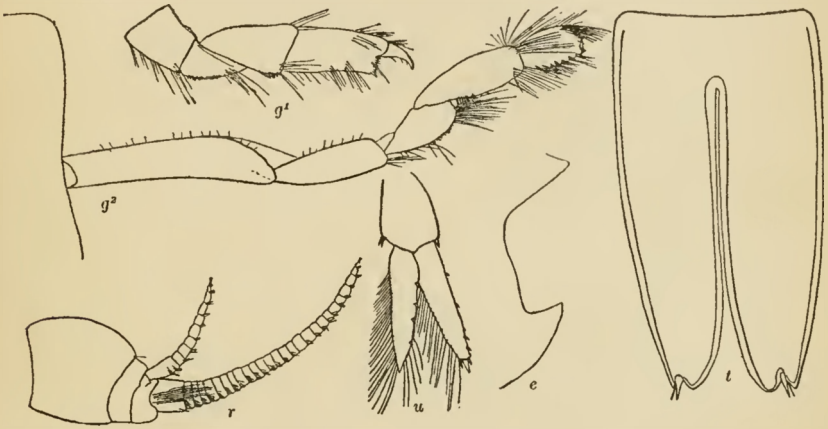


FIG. 2.—CHIRONESIMUS MULTIARTICULATUS. *e*, THIRD ABDOMINAL EPIMERITE; g^1, FIRST GNATHOPOD; g^2, SECOND GNATHOPOD; *r*, FIRST ANTENNA; *t*, TELSON; *u*, THIRD UROPOD.

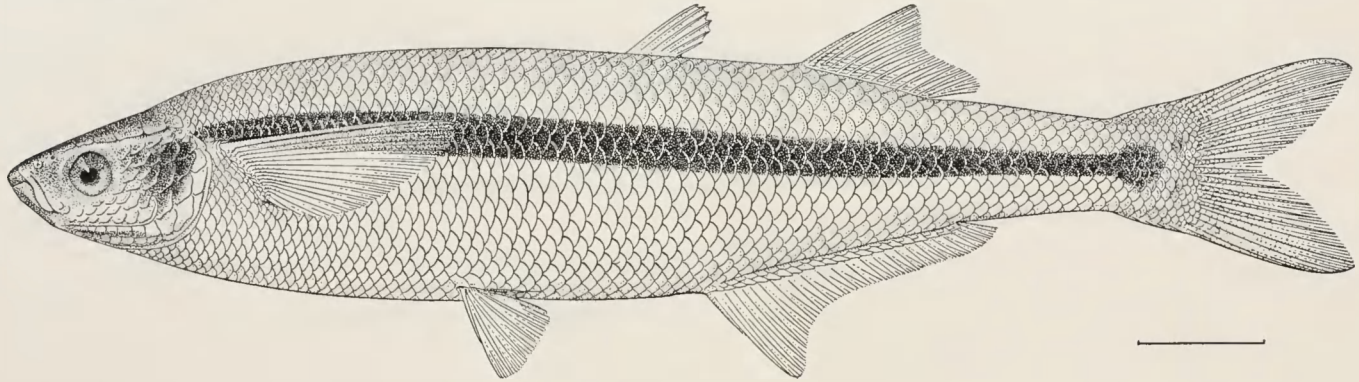
Forty-seven specimens were taken from a skeletonizing box November 23, 1911, at the village landing, St. Paul, Pribilof Islands. The types are among these. Other collections were made on November 20, 1911, and May 5, 1912, at the same place.

Type.—Cat. No. 45711, U.S.N.M.

PONTOGENEIA INERMIS (Krøyer).

Two collections of this species were made from the skeletonizing box, March 7 and November 30, 1911. All specimens were females; two on the latter date carrying eggs. The gnathopods are rather robust; otherwise the specimens examined agree with Sars's[1] figures.

[1] G. O. Sars, The Crustacea of Norway, vol. I, 1895, pl. 159.



ATHERINOPS OREGONIA, NEW SPECIES.

FOR EXPLANATION OF PLATE SEE PAGE 575.

DESCRIPTION OF THE YACHATS "SMELT," A NEW SPECIES OF ATHERINOID FISH FROM OREGON.

By David Starr Jordan and John Otterbein Snyder,
Of Stanford University, California.

We here describe a new species of Atherinoid fish, of the group known locally, but wrongly, as "smelt," on the Pacific coast of the United States. The type, now in the United States National Museum, is from the mouth of the Yachats River, where it was obtained by Mr. R. E. Clanton, secretary of the Oregon Fish and Game Commission. It is said that the species runs in large numbers into the Yachats River, which is a small stream emptying into the Pacific Ocean some 4 or 5 miles south of the Alsea Bay. It is a common food fish, locally known as "Yachats smelt."

ATHERINOPS OREGONIA, new species.

Plate 46.

Head 5.6 in length to base of caudal; depth 4.6; depth caudal peduncle 13.3; length snout 3.5 in head; diameter eye 4.4; width interorbital space 2.7; scales in lateral series 67; dorsal rays VI–I, 12; anal rays I, 24.

Body deep, resembling that of *Atherinops affinis*, the common California species, except that it is arched behind the occiput and somewhat broader; head very small and pointed, shorter than that of related species; snout short; eye small; depth of caudal peduncle, width of interorbital area, width of mouth, and depth of head like that of *A. affinis* or *A. insularum*, the local species of the Santa Barbara Islands; 39 rows of scales between occiput and spinous dorsal; 10 rows between dorsals, 16 between spinous dorsal and anal, 5 between spinous dorsal and lateral stripe, and 4 rows between soft dorsal and stripe. Membranes of dorsal fins naked; anal with a low sheath of small, elongate scales; pectorals with a few fine scales on basal portion of the rays. Head entirely scaled except space before eye and edges of opercles. Teeth in single rows on the jaws; not quite evenly forked, the inner prong in most cases being somewhat

smaller and shorter. Gill-rakers on first arch 8+23, long and slender. Pectoral fins pointed, the upper rays longest, contained 5.3 times in the length. Ventrals 1.8 in head. Second and third dorsal spines highest, equal to snout in length. Anterior dorsal rays 1.7 in head; first anal rays somewhat longer than those of dorsal. Caudal deeply forked, the lobes acutely rounded; slightly shorter than pectoral. Dorsal fin inserted in advance of a vertical through anal opening, entirely anterior to origin of anal. Base of anal extending well beyond a vertical through last dorsal ray.

Color in spirits yellowish; a dusky stripe, 1 scale wide extending from occiput to base of caudal; a dusky (silvery in life) lateral stripe, 2 scales wide, extending from upper edge of gill-opening to caudal peduncle, where after narrowing somewhat it ends in a large circular spot at base of caudal. Head with a large dusky spot on opercle; occiput dusky.

This species appears to be related to *Atherinops insularum* or *A. affinis*, differing greatly from *A. regis* in having more symmetrical teeth. From *A. insularum* it differs principally in having a shorter head, a deeper and more robust body, a shorter snout, smaller eye, and one more dorsal spine; from *A. affinis* in having a smaller head, shorter snout, smaller eye, more widely spaced dorsal fins, smaller scales, and a larger number of dorsal and anal rays. These characteristics are best shown in the following table:

	A. oregonia.	*A. insularum.*		*A. affinis.*	
Length of body in millimeters	227	220	181	131	123
Length head	.18	.20	.20	.215	.22
Depth body	.22	.19	.20	.23	.22
Length snout	.05	.065	.061	.06	.06
Diameter eye	.04	.05	.052	.06	.061
Distance between dorsal fins	.115	.11	.125	.08	.075
Distance between ventral and anal	.21	.19	.19	.21	.19
Scales in lateral series	67		62 to 68		52 to 56
Dorsal spines	6		5		5 to 6
Dorsal rays	12		10 or 11		11
Anal rays	24		20 or 21		22

Type.—Cat. No. 74762, U.S.N.M., a specimen 11½ inches long, from Yachats River, Oregon, collected by Mr. R. E. Clanton.

The accompanying figure is drawn by Mr. W. S. Atkinson.

TWO FOSSIL INSECTS FROM FLORISSANT, COLORADO, WITH A DISCUSSION OF THE VENATION OF THE AESHNINE DRAGON-FLIES.

By T. D. A. Cockerell,

Of the University of Colorado, Boulder.

The Florissant shales continue to yield important new materials for the study of Tertiary insect life. The specimens now discussed are of special interest because of their relation to certain modern forms, and in one case the investigation has been extended to include the venational characters of the allied modern genera.

Order ODONATA.

Family AESHNIDÆ.

OPLONÆSCHNA LAPIDARIA Cockerell and Counts, new species.[1]

Hind wing of male; length about 42 mm.; hyaline, venation piceous; stigma dark piceous; stigma 5 mm. long, bounding 3½ long cells below; triangle of five cells, two basal, the formula 2, 1, 1, 1; branches of media leaving arculus considerably below middle; M_3 and M_4 at margin of wing separated by two cells, M_4 and the supplement also separated by two (one only in *O. armata*); M_4 without any evident deflection or bulging about six cells from margin (such a bulging very distinct in *O. armata*); Rs unbranched, separated from the supplement below it by about five rows of cells at widest part (three or four in *O. armata*).

Compared with the living *O. armata*, the stigma is much longer, and in the type-specimen has a cross vein (Mr. E. B. Williamson thinks this is a freak, but that such freaks are probably confined to species with a long stigma. Needham's figure of *Tachopteryx*, which has an excessively long stigma, appears to show a cross vein); the cell beyond the stigma is not nearly twice as long as the next following one; the origin of the branches of the media from the arculus is

[1] This species was first studied and drawn by Miss Hilda Counts, whose work has been incorporated in this paper.

quite different. Compared with the Florissant fossil *O. separata* (Scudder), *O. lapidaria* is at once separated by the low origin of the branches of the media from the arculus, which is certainly not due to distortion. From the level of the arculus to the lower corner of the triangle there are three full cells, whereas *O. separata* and *O. armata* show only 2 to 2½. The ends of M_3 and M_4 and the supplement agree remarkably well with the European fossil *O. metis* (Heer), but *metis* has the branches of the media arising from even a little above the middle of the arculus. The radial sector and its supplement, with the cells between, are more like those of *O. metis* than those of the living *O. armata*.

Locality.—Miocene shales of Florissant, Colorado, Station 13 B, University of Colorado Expedition; collected by S. A. Rohwer.

Cotypes.—Cat. No. 59922, U.S.N.M.

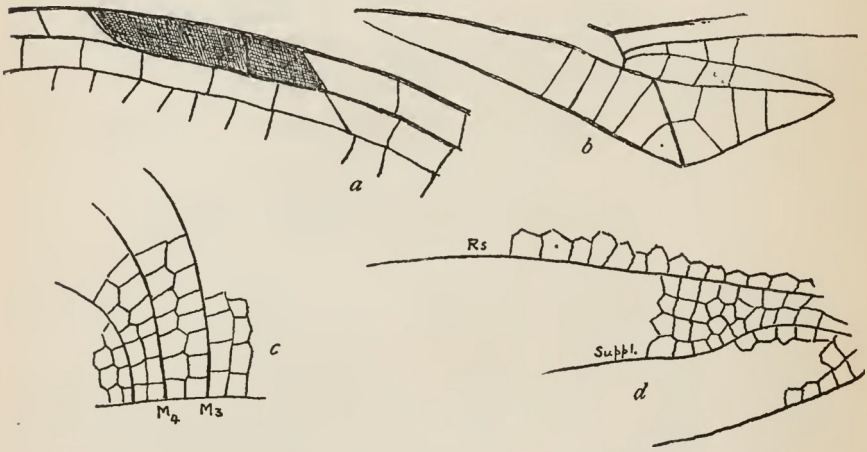


FIG. 1.—OPLONÆSCHNA LAPIDARIA. *a*, STIGMA; *b*, TRIANGLE AND ARCULUS; *c*, ENDS OF VEINS M_3 AND M_4; *d*, RADIAL SECTOR AND SUPPLEMENT.

This specimen puzzled us much, on account of the peculiar origin of the branches of the media from the arculus, a condition not found in the allied species or genera. There are genera, as *Planæschna* (fig. 2, *b*, *c*), in which the origin is below the middle, but these are otherwise quite different; as this character shows no evidence of being abnormal in any way, we can only regard the wing as representing a new species.

I consulted Mr. E. B. Williamson on some of the characters of this species, and he was so kind as to loan me a very fine series of photographs of various Aeshnine genera. Using these with other materials already in my possession, I have made a key to the principal genera of Aeshninæ, based on the venation. This is given below, and it is hoped that it will be of service in determining fossils, which are usually represented only by the wings. An effort has been made

to cite truly generic characters as far as possible, but the specific names are usually given, to show what species were used in the study. In some cases other species were available, but were not included, as they introduced no important additional characters.

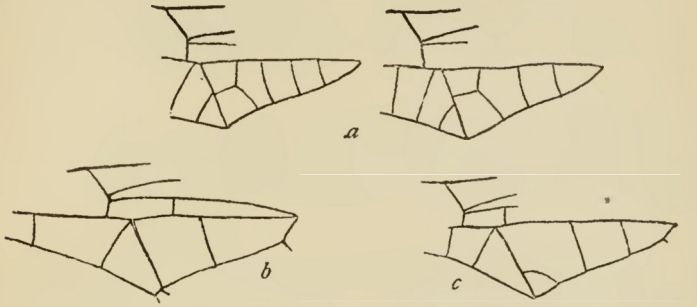


FIG. 2.—*a*, OPLONÆSCHNA SEPARATA (SCUDDER), TRIANGLES FROM TWO SPECIMENS COLLECTED AT STATION 14, FLORISSANT; *b*, PLANÆSCHNA MULTIPUNCTATA, TRIANGLE OF HIND WING; *c*, PLANÆSCHNA FORCIPATA, TRIANGLE OF HIND WING.

It is generally recognized that *Oplonaeschna* is a relatively primitive member of the Aeshninæ; it is therefore interesting to find it in the Tertiary rocks of both America and Europe. Nevertheless true *Aeshna*, of the modern type, was present in the Miocene of Florissant.

KEY TO THE PRINCIPAL GENERA OF AESHNINÆ, BASED ON THE VENATION.

(A) *Basal space without cross veins.*

(*a*) *Radial sector not branched; branches of media leaving arculus at or near middle* [below middle in *Oplonaeschna lapidaria*].

Radial sector separated from supplementary vein below it by one row of cells..... 1

Radial sector separated from supplementary vein below it by two rows of cells; triangle of anterior wings much longer and more slender than that of hind (the latter only three-celled).....*Allopetalia reticulata* [Williamson photo.].

Radial sector separated from supplementary vein below it by three rows of cells for a considerable distance; triangles of anterior and posterior wings more alike.. 3

Radial sector separated from supplementary vein below it by four rows of cells.....*Oplonaeschna metis* (Heer).[1]

1. Anal loop of hind wings of three cells; triangle of three cells; [abdomen modified].....*Oligoaeschna* [*Dolaeschna* Needham].

   Anal loop of hind wings of more than three cells..... 2

2. Stigma bounding 1½ cells below; anal loop of 4 cells; triangle of 2 cells. *Gomphaeschna furcillata.*

   Stigma bounding 2½ cells below; anal loop of 5 cells. (Miocene genus). *Lithaeschna.*[2]

3. Stigma narrow and elongate, bounding about 4½ cells below; triangle of anterior wings with three cells.....*Basiaeschna janata.*

   Stigma much shorter and deeper, bounding about 2½ cells below; triangle of anterior wings with six cells.....*Oplonaeschna armata.*

[1] This is *Aeschna metis* Heer, fossil at Radoboj. Handlirsch, following Hagen, refers it to *Anax*, but Heer's figure shows that this can not be correct. The reference to *Oplonaeschna* has already been indicated by Needham. I reached the same conclusion before noticing Needham's remarks.

[2] The characters of *Lithaeschna* are set forth at length, and contrasted with those of *Gomphaeschna*, etc., in Bull. Amer. Mus. Nat. Hist., vol. 23, (1907) pp. 133–136. The triangle of *Lithaeschna* is three-celled by the division of the basal cell, as in *Allopetalia*. The genus is perhaps too close to *Gomphaeschna*.

(*b*) *Radial sector without a distinct branch, but with many slender branch-like veins arising from its lower side; branches of media leaving arculus near the top; supplementary vein below M_4 in hind wings with an extremely strong, almost S-like curve.* (Tribe Anacini, new.)

Triangle of hind wings four-celled, the basal cell not double; Cu_2 bent so that the part below the triangle is nearer the wing-margin than that just beyond.

Hemianax ephippigera [Williamson photo.].

Triangle of hind wings six-celled, with two basal; Cu_2 not bent as in *Hemianax*.

Anax junius.

(*c*) *Radial sector branched* (*forked*).

Radial sector separated from supplementary vein below it by only one row of cells; triangles with not more than three or four cells..... 1

Radial sector separated from supplementary vein below it by more than one row of cells..... 4

1. Stigma long, bounding about 3½ cells below..... 2

   Stigma short, bounding 2–2½ cells below; branches of Cu below triangle in hind wing separated by only one row of cells; branches of media leaving arculus considerably below its middle..... 3

2 Branches of Cu below triangle in hind wing separated by only one row of cells (but three rows near margin of wing); triangles of two cells..*Brachytron pratense*.

   Branches of Cu below triangle in hind wing separated in part by two rows of cells; triangles with three or four cells.....*Nasiaeschna pentacantha*.

3. Triangles normally with three cells (sometimes a small fourth cell)..*Planæschna forcipata* [photo. of this Queensland species sent by R. Martin to Williamson].

   Triangles with only two cells.....*Planæschna multipunctata* [Williamson photo.].

4. Triangles with eight cells; Rs separated from supplementary vein below it by many rows of cells (6 or 7 in widest part); branches of Cu below triangle in hind wing separated by two rows of cells; arculus far basad of triangle; wings more elongated than in *Gynacantha*..*Staurophlebia reticulata* [Williamson photo.].

   Triangles with three to six cells..... 5

5. Not more than two rows of cells between M_4 and supplementary vein below it in hind wing; triangles with five cells, the apical one very long; Rs separated from supplementary vein below it by more than one row of cells (3 in widest part); branches of Cu below triangle in hind wing separated in one place by two rows of cells; arculus of anterior wing not more remote from triangle than the equivalent of half length of base of latter.....*Aeschnophlebia anisoptera*.

   More than two rows of cells between M_4 and supplementary vein below it in hind wing..... 6

6. Fork of radial sector below middle of stigma (or a little before middle); triangles of four cells, only one basal; Rs separated from supplementary vein below it by 4 or 5 cells at widest part.....*Coryphæschna ingens*.

   Fork of radial sector before level of middle of stigma, nearly always before level of beginning of stigma..... 7

7. Triangles in both wings three celled, with only one basal cell; stigma longer and narrower than in *Ae. cyanea*..... 8

   Triangles with two basal cells, or rarely only one in anterior wing..... 9

8. Fork of radial sector considerably before level of stigma; branches of Cu below triangle in hind wings separated by two rows of cells.

   Aeshna bonariensis [Williamson photo.] female.

   Fork of radial sector below beginning of stigma; branches of Cu below triangle separated by one row of cells (except one double cell).

   Aeshna sp. from Brazil [Williamson photo.].

9. Triangles, at least in anterior wings, of six cells, a basal pair, and four simple ones beyond..... 10

Triangles with not more than five cells, or when rarely with six, two pairs, the formula 2, 2, 1, 1..... 11

10. Anal loop of seven cells.....*Gynacantha trifida.*
Anal loop of twelve cells.....*Gynacantha* from Siam [Williamson photo.].

11. M_3 and M_4 separated by one cell only at margin of wing, but a short distance before by two rows of cells, owing to the deflection of M_4 from the straight course; cell formula of triangles 2, 1, 1; upper branch of radial sector in a line with stem; Rs separated from supplementary vein below it by only three rows of cells; fork of Rs a short distance before level of beginning of stigma (subgenus HESPERAESHNA, new subgenus).....*Aeshna californica.*
M_3 and M_4 separated by at least two cells at margin of wing, so that they are almost or quite as far apart here as at any part of their course; triangles with five cells, at least in anterior wings; Rs separated from supplementary vein below it by four rows of cells, at least at widest part (mainly three rows, with four only at one place, in *Ae. solida*)..... 12

12. Anal loop in hind wings very large, with about 15 cells; stigma comparatively short.....*Aeshna cyanea* [Williamson photo.].
Anal loop in hind wings not so large..... 13

13. Branches of Cu below triangle separated by a single row of cells for the most part, but a few paired cells present, the number variable; upper branch of radial sector making a strong angle with the stem, but the lower branch nearly in a straight line with the stem.....*Aeshna solida* [fossil at Florissant].
Branches of Cu below triangle separated through most of their course by two rows of cells.....*Aeshna eremita.*

NOTE ON AESHNA.—I am unable to find any satisfactory generic characters in the venation to separate *Aeshna* from *Gynacantha*. According to E. M. Walker's phylogenetic tree, *Gynacantha* is derived from *Aeshna*. The number of cells in the triangle in *Aeshna* varies within specific limits, as was fully shown in American Journal of Science, vol. 26, 1908, p. 74. Walker, in his revision of North American *Aeshna*, finds the following venational characters valid for groups:

Anal triangle of males three-celled..... 1
Anal triangle of males two-celled; females with fork of Rs decidedly asymmetrical at base.....*Cærulea*, *juncea* and *clepsydra* groups.

1. Females with fork of Rs nearly symmetrical at base.
Californica and *multicolor* groups.
Females with fork of Rs decidedly asymmetrical at base.....*Cyanea* group.

For a further discussion of *Aeshna* venation see Entomological News, Dec., 1908, pp. 455–459.[1]

(B) *Basal space with cross veins.*

(*a*) *Radial sector not branched; branches of media leaving arculus at or near middle.*

Radial sector separated from supplementary vein below it by two rows of cells; stigma bounding more than three cells below; triangle of anterior wings with three cells.....*Boyeria irene.*

(*b*) *Radial sector branched.*

[1] An elaborate table, contrasting the venation of *Aeshna*, *Coryphæschna*, *Epiæschna*, *Planæschna*, and *Nasiæschna*, is given by Williamson in Entomological News, 1903, pp. 5–7. *Epiæschna* has a curiously intermediate, or as it were undecided, venation. Run in the table above, it goes to the vicinity of *Hesperæshna*, but with difficulty, because (1) Rs is separated from supplementary vein below it by a *partially* double row of cells; triangles have five cells; (2) M_4 is separated from supplementary vein below it in hind wing by only about three triple cells, the rest being double; (3) the triangle of *hind* wing has a simple basal cell in Williamson's figure; (4) M_3 and M_4 are separated by one cell at margin of wing, but although there is some doubling higher up in hind wing, M_4 is not deflected out of its course. Williamson states that the basal cell of triangle in *Epiæschna* is divided in front wing, and rarely divided in hind wing. He also states that the basal cell of the triangle is very rarely divided in *Coryphæschna*.

Triangles with 8 or 10 cells; M_2 strongly arched above fork of Rs; branches of Cu below the triangle in hind wing separated for a considerable distance by three rows of cells; branches of media leaving arculus distinctly above middle.
Neuræschna costalis [Williamson photo.].

Triangles with not more than 7 cells; M_2 more gently and regularly arched above fork of Rs; branches of Cu below the triangle in hind wings separated by one or (*Amphiæschna*) two rows of cells..... 2

1. Stigma very short, bounding about 2 cells below; triangle of three cells, the basal one not divided; branches of media leaving arculus well below its middle.
Caliæschna microstigma [Williamson photo.].

Stigma longer, bounding at least three cells below; triangle of at least five cells, two basal, at least in hind wing..... 2

2. Branches of media leaving arculus below the middle; only one row of cells between the Rs and supplementary vein below it; arculus close to base of triangle; stigma more or less swollen, bounding 5–5½ cells below; a dark patch at nodus.
Telephlebia godefroyi [Williamson photo.].

Branches of media leaving arculus above the middle; many rows of cells (about six at widest part) between Rs and supplementary vein below it; arculus not so close to base of triangle; stigma bounding 3–3½ cells below..... 3

3. Branches of Cu below triangle in hind wing separated by only one row of cells.
Amphiæschna from Siam [Williamson photo.].

Branches of Cu below triangle in hind wing separated by two rows of cells for a considerable distance.....*Amphiæschna ampla* [Williamson photo.].

The Jurassic *Cymatophlebia* and *Morbæschna* (see Bull. Amer. Mus. Nat. Hist., vol. 23, pp. 133–134, 141, 142) are certainly to be excluded from the Aeshninæ.

On other grounds, E. M. Walker divides the Aeshninæ into five groups. One of these corresponds with the Anacini above. The others may represent a number of tribes as follows:

Walker's divisions.	Radial sector not forked.		Radial sector forked.	
	Basal space with cross veins.	Basal space without cross veins.	Basal space with cross veins.	Basal space without cross veins.
BRACHYTRON GROUP.	BOYERIINI.	ALLOPETALIINI.		
Boyeria series.	*Boyeria.*	*Allopetalia.*		
		Gomphæschna.		
Brachytron series.			TELEPHLEBIINI.	BRACHYTRONINI.
			Telephlebia.	*Nasiæschna.*
			Caliæschna.	*Epiæschna.*
				Brachytron.
				Aeschnophlebia.
AESHNA GROUP.		BASIÆSCHNINI.	AMPHIÆSCHNINI.	AESHNINI.
		Basiæschna.	*Amphiæschna.*	*Aeshna.*
Aeschna series.		*Oplonæschna.*		*Coryphæshna.*
Gynacantha series.			NEURÆSCHNINI.	GYNACANTHINI.
			Neuræschna.	*Gynacantha.*
				Staurophlebia.

This agrees well enough with Walker's phylogenetic tree, except that *Neuræschna* can not apparently be derived from *Gynacantha*, nor *Amphiæschna* from *Aeshna*.

Order DIPTERA.

Family PHORIDÆ.

PARASPINIPHORA LAMINARUM (Brues).

Phora laminarum BRUES, Bull. Amer. Mus. Nat. Hist., vol. 24, 1908, p. 275.

This was described from a single imperfect specimen. Three others have been found at Florissant, all at station 17, two by Mrs. Cockerell, one by Mr. S. A. Rohwer. From these I have prepared the accom-

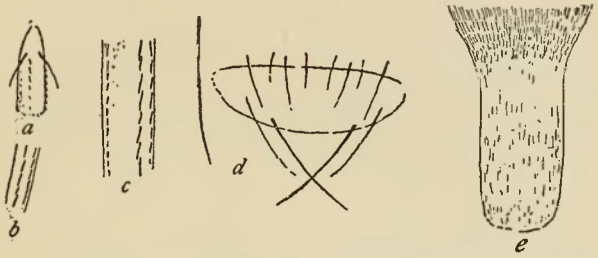


FIG. 3.—PARASPINIPHRA LAMINARUM. *a*, DIAGRAMMATIC FIGURE OF MIDDLE TIBIA; *b*, PART OF MIDDLE TARSUS, SHOWING ARMATURE; *c*, PART OF HIND TARSUS, SHOWING ARMATURE; *d*, SCUTELLUM AND ADJACENT PARTS, SHOWING BRISTLES; *e*, END OF FEMALE ABDOMEN.

panying figures, which explain themselves. *a* is from one specimen; *b*, *c*, *d*, from another; *e*, from the third. All show the characteristic armature of the hind tibiæ, resembling that of the recent species *P. multiseriata* (Aldrich). The modern representative, however, has only two scutellar bristles instead of four.

The new material of *P. laminarum* shows that the species has well-developed wings.

Plesiotype.—Cat. No. 59923, U.S.N.M.

RESULTS OF THE YALE PERUVIAN EXPEDITION OF 1911. ORTHOPTERA (ADDENDA TO THE ACRIDIIDÆ—SHORT-HORNED LOCUSTS).

By Lawrence Bruner,

Of the University of Nebraska, Lincoln, Nebraska.

Since writing the report on the Acridiidæ[1] a few additional specimens collected after the main expedition had started home have been received. These are of sufficient interest to merit an additional report.

Family LOCUSTIDÆ (OEDIPODINÆ).

TRIMEROTROPIS OCHRACEIPENNIS ? Blanchard.

A single female specimen doubtfully referred to this species from Coropuna, taken in October. The altitude given is 14,500 feet.

TRIMEROTROPIS SIGNATIPENNIS Blanchard.

One pair bearing same data as the preceding species.

Family CYRTACANTHACRIDÆ (ACRIDIIDÆ).

SCHISTOCERCA MACULATA, new species.

Of medium size, and with the tegmina regularly and coarsely maculate with fuscous, and the pronotum longitudinally lined with the same color.

Head rather narrow but fairly high, not prominent, the eyes also narrow, being fully twice as long as wide and plainly longer than the anterior margin of the cheeks below them, separated on the vertex by a space equal to the widest portion of the frontal costa; fastigium nearly twice as wide as long, very shallowly sulcate and with coarse antero-lateral carinæ; lateral ocelli large, pallid, touching the compound eyes; frontal costa moderately prominent, shallowly sulcate at the ocellus and below. Pronotum rugoso-punctate, narrow in front, the anterior lobe a little expanding caudad, the hind lobe much more rapidly so; the median carina fairly prominent and deeply

[1] Proceedings U. S. National Museum, Vol. 44, 1913, pp. 177–187.

severed by all three transverse sulci, the last plainly in advance of the middle, hind border gently obtusangulate, the apex rounded. Tegmina ample, tapering but little apically, extending beyond the tip of the abdomen and apex of the hind femora nearly double their width; wings broad. Anterior and middle legs rather slender, the hind femora short, robust at base, slender apically, the external carinæ prominent; hind tibiæ noticeably sinuose and also provided with prominent external carinæ, 9-spined externally, 11-spined internally, the inner ones decidedly larger than the outer. Prosternal spine moderately coarse, decidedly transverse, the sides parallel, the apex broadly rounded, gently directed caudad but not curved.

General color brunneo-cinereous, strongly maculate, mottled, streaked and flecked with fuscous. Tegmina coarsely maculate on disk, the maculæ on the apical half tending to form obliquely transverse bands, anterior and posterior areas also distinctly mottled with the same color. Pronotum plainly marked with alternate longitudinal pallid and fuscous bands, the middle of the lateral lobes provided with a quadrate pallid macula. Vertex and occiput showing traces of lateral fuscous lines, between and below these lines cinereous except for an inconspicuous fuscous line extending partly across the cheeks below each eye. Hind femora with a pallid external disk; upper margin showing traces of two transverse fuscous bands, lunules and base of tibiæ black, the genicular lobes dirty white, the carinæ very conspicuously black mottled; the tibiæ cinereo-purple, the spines pale, black-tipped. Hind margin of abdominal segments prominently dotted with fuscous. Wings pellucid, becoming yellowish basally, the principal veins and the transverse ones on apical portion infuscated.

Length of body, female, 42 mm.; of pronotum, 9.5 mm.; of tegmina, 43 mm.; of hind femora, 23.5 mm.

Habitat.—The only specimen at hand was taken at Chuquibamba, Peru, during October, 1911. The label bears the note "10,000 feet (Yale Peru expedition)."

Type.—Cat. No. 15598, U.S.N.M.

This insect is rather closely related to both *S. columbina* Thunberg and *S. interrita* Scudder, the former species coming from Colombia and the latter from Peru. It is also related to an insect found in the windward of the West India Islands and Trinidad, and that has been referred erroneously to Thunberg's species. It is likewise related to *S. maculipennis* Bruner, which latter locust will shortly be described in a forthcoming paper soon to be published in the current volume of the Annals of the Carnegie Museum.

DIAGNOSES OF NEW SHELLS FROM THE PACIFIC OCEAN.

By William Healey Dall.

Curator Division of Mollusks, United States National Museum.

For several years new species of shells from Northwest America and other parts of the Pacific Ocean have been accumulating in the national collection, and, as some of them have been furnished with manuscript names for the convenience of collectors, it was thought best to prepare diagnoses of some of these species before the manuscript names found their way into print.

Some of the specimens have long been in the collection, but remained unstudied on account of the pressure of other duties; some have been contributed by generous correspondents, and others obtained from various sources. Figures of many of them have been prepared and will appear later.

CHRYSODOMUS EULIMATUS Dall.

Chrysodomus eulimatus Dall, Smiths. Misc. Coll., vol. 50, No. 1727, p. 156, July, 1907.

Shell large, with a thin dehiscent periostracum, and about eight whorls without the (lost) nucleus; shell substance white with the outer layer more or less tinged with rosaceous purple; whorls well inflated, the suture appressed, with a band of minor sculpture in front of it; upper whorls with eight or less rounded prominent flexuous ribs extending from suture to suture, most prominent at the shoulder of the whorl and least so on the presutural band; they become obsolete on the first half of the last whorl; spiral sculpture of three sizes of spiral threads, the larger, of which there are eight between the sutures at the beginning of the last whorl; the second size running in the middle of the wide interspaces between the major cords; and lastly the finer ones which cover the surface of the presutural band and the interspaces between the other threads. All these are crossed by fine rather prominent incremental lines. Aperture elongate-ovate with a wide somewhat recurved canal; body with a thin layer of callus; pillar with a thick white callous border; siphonal fasciole well marked; outer lip thin, simple, sharp,

crenulate by the external sculpture; throat white, smooth; height of shell 168; of last whorl 134; of aperture and canal 105; maximum diameter 78 mm. Operculum large, dark brown, normal to the genus.

Dredged at Aniwa Bay, Sakhalin Island, at station 5009, in 25 fathoms, mud, bottom temperature 38° 5 F. 38.5°. U. S. Bureau of Fisheries steamer *Albatross*. Cat. No. 205371 U.S.N.M.

Only a single adult specimen of this fine species was obtained. It is one of the largest of the genus. Originally described from a very young specimen, it was thought best to give a new diagnosis from the adult.

TRITONOFUSUS JORDANI, new species.

Shell of moderate size, of about seven and a half whorls, the nucleus rounded, not swollen but rather large; suture distinct, the whorls moderately rounded; surface covered with a dark orange-brown periostracum, beneath which the shell substance is white; sculpture of incremental lines, not prominent but regular and close set, crossed by numerous flat spirals with very narrow interspaces, this sculpture covering the whole surface, the spirals being slightly narrower in front of the suture; on the periphery of the last whorl there are about two spirals with their interspace in the width of one millimeter; aperture less than half the length of the shell; canal wide, short, sharply recurved; outer lip simple, flexuous, expanded, receding behind the periphery and advancing near the suture, connected over the body with the pillar by a thin layer of white callus; pillar short, attenuated in front; throat smooth, bluish white; operculum ovate, with apical nucleus, dark brown. Height of shell 43; of last whorl 31; of aperture 20; maximum diameter of shell 21 mm.

Puget Sound, Sucia Island, and Gulf of Georgia in 67 fathoms, sand, bottom temperature 48° 5 F. Also in Bering Sea off the southeast coast of Kamchatka in 96 to 100 fathoms, sand, temperature 31° F. to 33° 1 F. Cat. No. 22642, U.S.N.M.

The specimens are quite uniform, and nearly all have a ferruginous incrustation on the early whorls. The young have a lighter colored, more or less olivaceous periostracum. The suture is not closely appressed and gives the aspect of being minutely channeled, especially on the last whorl.

It is named after Dr. David Starr Jordan, of Stanford University.

BOREOTROPHON GORGON, new species.

Shell elongate, white, of seven whorls, the nucleus small, smooth, rounded, of two whorls; subsequent whorls with a peripheral spinose carina or cord, with two additional cords on the base of the last whorl; last whorl with six, preceding whorl with eight or nine sharp-edged varices, which become prominently spinose where they intersect the cords; interspaces smooth except for incremental lines; aperture ovate, with a raised margin except at the canal; throat white, smooth; operculum muricoid, canal long, slightly

recurved. Height of shell 38; of last whorl 30; of aperture 13; maximum diameter, exclusive of the spines, 18 mm.

Dredged off Hondo, Japan, at station 3698, in 153 fathoms, mud, bottom temperature 65° F. Cat. No. 110771, U.S.N.M.

This elegant species has somewhat the aspect of a *Muricidea* except for its long canal, and it is possible that it should be referred to some section of *Murex* rather than to *Boreotrophon* to which it seems also closely allied.

Genus AMPHISSA H. and A. Adams.

COSMIOCONCHA, new subgenus.

Buccinum sp., POWYS, 1835.
Truncaria sp., H. and A. ADAMS, 1853.
Columbella sp., CARPENTER, 1856.

Type.—Buccinum modestum Powys, Proc. Zool. Soc. London, 1835, p. 94. Bay of Montijo, Central America.

The type of *Amphissa* is *Buccinum corrugatum* Reeve. The genus is typically represented by a group of species peculiar to the Northwest coast of America, and which does not extend into the Tropics. They are, in short, Columbellids with a Buccinoid shell, with strong axial, crossed by more or less marked spiral, sculpture.

The group now segregated is tropical, with its focus in the Gulf of California, and with a Columbelloid operculum and radula has a shell practically without axial sculpture and with strong spiral striation, especially on the region near the canal, and sometimes with a single groove directly in front of the suture. There is a marked thickening behind the outer lip, which is sharp and simple, the typical species has lirations inside the aperture on the outer wall of the throat, but some of the others seems to be devoid of this feature. The anterior end of the columella is markedly attenuated; the colors are usually brown and yellow. There is some superficial resemblance to the typical *Truncaria*, which, however, has a very different, narrowly ovate, operculum with the nucleus apical, as in many species of *Turris*.

AMPHISSA (COSMIOCONCHA) PALMERI, new species.

Shell smaller than *A. modesta* Powys, and of a uniform pale brownish color when fresh, with a loosely coiled, smooth, glassy nucleus of two whorls and two subsequent nepionic whorls which show obscure traces of axial ribbing; subsequent whorls about five, smooth except for a faint impressed line in front of the suture, six or seven strong cords on the base of the shell behind the siphonal fasciole, and more or less striation on the fasciole, beside incremental lines; whorls moderately rounded, suture very distinct, not appressed; a strong rounded varix behind the outer lip; aperture elongate, oval, a small callus on the body, but no subsutural sinus; outer lip sharp, simple,

internally with nine or ten short liræ, the series not extending to the extremes of the lip; canal short, deep, rather markedly recurved. Height of shell 19; of last whorl 13; of aperture 10; maximum diameter 9 mm. The same dimensions in *A. modesta* average respectively 24, 17, 13, and 10 mm.

Head of the Gulf of California, Dr. E. Palmer, Cat. No. 182587, U.S.N.M., also at station 3034, in 24 fathoms off Point Fermin in the Gulf, by the U. S. Bureau of Fisheries steamer *Albatross*.

AMPHISSA (COSMIOCONCHA) PERGRACILIS, new species.

Shell elongate, slender, whitish, with brownish flammules, part of which are grouped in an obscure band in front of the suture; nucleus lost; subsequent whorls about eight, moderately convex, with no line in front of the rather deep suture; spiral sculpture on the canal and base of about 20 channeled grooves with wider flattish interspaces; aperture elongate, the inner lip, as far as the end of the canal with a rather thick layer of white callus; outer lip sharp with a feeble varix behind it and with about 15 fine lirations internally; canal short, wide, slightly recurved. Height of shell 24; of last whorl 15; of aperture 10; maximum diameter 7 mm.

Dredged at station 3017 on the west coast of Mexico, in 58 fathoms, green mud, off Cape Lobos. Cat. No. 211030, U.S.N.M.

This is much more slender than the preceding species.

AMPHISSA (COSMIOCONCHA) PARVULA, new species.

Shell small, pale olivaceous, slender, of about 7 moderately convex whorls; suture distinct, minutely channeled, without any depressed line in front of it; sculpture of incremental lines and on the base and canal about 25 channeled grooves with flattish, wider interspaces; the grooves grow fainter and narrower and the interspaces wider, till the sculpture becomes obsolete near the periphery of the whorl; aperture long and narrow, body with a light wash of callus; outer lip sharp, simple, with a narrow but well-marked varix behind it, internally with about 20 fine, sharp, short lirations which extend practically the whole length of the aperture; canal wide, deep, slightly recurved. Height of shell 15; of last whorl 10; of aperture 6.5; maximum diameter 5 mm.

Dredged at station 2996, off La Paz Bay, Gulf of California, by the U. S. Bureau of Fisheries steamer *Albatross* in 112 fathoms, green mud. Cat. No. 211029, U.S.N.M.

At first sight this looks like a miniature *A. pergracilis*, but on closer scrutiny it is seen to have differential characters other than those of size.

LIOTIA LURIDA, new species.

Shell small, dull red or purplish brown, more or less articulated on the ridges, of about four and a half whorls; nucleus minute, flattish;

last whorl with four strong, beaded, spiral cords with subequal interspaces, peripherally; between them and the suture, three slightly smaller similar cords, the space at the suture giving a channeled effect; on the base two less prominent cords and two wider nodulous ridges around the deep, rather narrow umbilicus; aperture circular, the outer lip thick, fringed by the ends of the spiral cords; axial sculpture of numerous fine radial threads, most obvious in the channels between the cords; height of shell, 4.5; maximum diameter of base, 5.5 mm.

Beach, San Josef Island, Gulf of California, Cat. No. 264972, U.S.N.M.

Operculum multispiral, calcareous externally with a small central pit.

BOLMA BARTSCHII, new species.

Shell thin, trochoid, yellowish white with rose-colored flammules and nebulosities, with more or less articulation on the spiral ridges. Nucleus very minute, glassy; nepionic shell white, depressed above, of three rather rounded whorls with numerous low radial plications or riblets; subsequent whorls four, with a sparsely imbricate keel at the periphery and a prominent, beaded, spiral cord one-third of the way from the appressed posterior suture toward the periphery. This arrangement gives a channeled or turriculate aspect to the shell in the sutural region. The last whorl has a third keel, imbricate like the peripheral one but less prominent, bordering the base; the space between the beaded cord and the peripheral keel is on the upper whorls finely spirally striated, but on the last whorl, first two, and then a third, small spiral equidistant threads, articulated white and dark rose color, are developed; the imbrications on the two keels are short, distant, subspinose, and channeled in front; the base is nearly smooth, with fine spiral striation and a widespread, transparent, thin layer of enamel in front of the aperture; pillar smooth, arcuate, pearly; outer lip thin, sharp, markedly expanded; throat pearly; aperture quite oblique; operculum white, smooth, constructed like that of *B. rugosa*, but with the external depression much less marked; altitude of shell 30, maximum diameter 35, diameter of operculum 15 mm.

Dredged in 205 fathoms, sand, off Dowarra Island, near Ternate, Moluccas. Cat. No. 214444, U.S.N.M.

The shell was so tightly closed by the operculum that the animal had decayed, though put in spirits, but the radula was preserved and showed a central tooth of squarish form without cusps, on a larger base, with four laterals on each side; their cusps denticulate with a prominent spur below, behind the cusp, and the usual large mass of uncini. From what was left of it, the sides of the foot seemed destitute of any epipodial appendages.

This very lovely shell is so thin and delicate that it was a surprise to find it possessing a heavy calcareous operculum.

It is named after Dr. Paul Bartsch.

MARGARITES SIMBLUS, new species.

Shell pale gray, beehive-shaped, with a blunt apex and five and a half rapidly enlarging convex whorls; nucleus minute; subsequent whorls polished, finely spirally striate, crossed by very fine flexuous striæ corresponding to the lines of growth, which more or less microscopically crenulate the interspaces between the spirals; suture not impressed; base with an obscure angulation peripherally, the sculpture similar to the rest of the shell but more pronounced; umbilicus narrow, deep; aperture subquadrate, oblique; the pillar thin, white; the throat pearly. Height of shell, 13; of last whorl, 10; maximum diameter of base, 14 mm.

Dredged in deep water, off Santa Barbara Channel, California. Cat. No. 267172, U.S.N.M. The specimen did not contain the animal or operculum.

CALLIOSTOMA NEPHELOIDE, new species.

Shell acute-conical, trochiform, of about nine whorls, yellowish, with radiating dark-purple nebulosities and flammules; nucleus more or less inverted, white, glassy, minute; a nepionic whorl and a half follows, with three spiral, latterly beaded cords; the remaining sculpture comprises a strong prominently beaded cord at the periphery immediately in front of which the suture is laid; on the last whorl, between the periphery and the suture behind it, are about a dozen threads smaller than that at the periphery but equally and uniformly beaded, with subequal, smooth interspaces, and mostly alternating in size; there is no obvious axial sculpture; base bordered by a cord (without beading) of the middle size, between which and the center of the base are 18 to 20 flattish straplike spirals, faintly irregularly undulated and with subequal or narrower interspaces, except the three or four nearest the columella which are larger, more distant, and with more or less obscure nodulation; base only slightly convex; pillar arcuate, white, with an obscure ridge around the imperforate umbilical region, ending at the anterior end of the pillar in a nodulous swelling. Aperture broken, but evidently subquadrate with thin, simple, outer lip. Height of shell, 25; of last whorl, 15; maximum diameter of base, 22 mm.

Station 2804, Panama Bay, in 47 fathoms, muddy bottom, Cat. No. 96637, U.S.N.M.

This species is represented only by one broken specimen, but when perfect must be one of the most elegant of the West American species of this elegant group, and quite distinct from any of the others.

PECTEN (PSEUDAMUSIUM) ARCES, new species.

Shell hyaline white, with no anterior ear, subcircular, slightly convex; hinge line rather long, ligament and pit very small, entire surface of convex valve sculptured with subequal radial threads and similar

concentric threads, forming nearly square equal reticulations, about four to a square millimeter; the intersections are slightly prominent on the disk and more or less minutely spinose on the ends of the valve; beside these the entire valve is sculptured with minute equal radial lines, about six to a reticulation; the interior of the valve is glassy, the sculpture showing through. The flatter valve has similar sculpture, with a narrow smooth submargin, a ctenolium of five or six free teeth, a moderately deep byssal notch and five imbricated rays on the ear above the fasciole of the notch.

Height, 35; length, 34.5; diameter, 6.0 mm.

Off Santa Barbara, California, in over 500 fathoms, muddy bottom. Cat. No. 267169, U.S.N.M.

A neat species, remarkable for the even character of its reticulation and its uniformity over both valves.

CUSPIDARIA SUBGLACIALIS, new species.

Shell large for the genus, chalky, with a coarse dehiscent olivaceous periostracum; equivalve, nearly equilateral. Beaks nearly in the center of the shell, anterior dorsal margin arcuately descending, anterior end of shell ovately rounded; posterior slope straight, or slightly distally recurved, with a short compressed distally gaping rostrum, terminally subtruncate; base arcuate, somewhat patulous below and behind the beaks, incurved at the beginning of the rostrum; hinge in the left valve with a small obliquely backwardly directed chondrophore; in the right valve there is also a strong lamina parallel with the dorsal margin and separated from it by a groove which receives the edge of the opposite valve in closing; beaks opisthocoelous, inconspicuous. Height, 24; length, 39; diameter, 20 mm.

Off the Californian coast in deep water. Cat. No. 265904, U.S.N.M. Nearest to *C. glacialis* M. Sars, from which it differs in the less prominent and less posterior beaks and less recurved rostrum.

PSEPHIDIA CYMATA, new species.

Shell small, white, solid, rounded triangular, with inconspicuous, somewhat anterior beaks, the lunule and escutcheon very feebly indicated; surface with fine concentric but not perfectly regular low threadlike sculpture; periostracum yellowish, rather coarse; hinge of the genus; inner margins smooth, interior disk polished, the pallial sinus small, ascending, the inner extreme bluntly rounded; muscular impressions distinct, ligament small and weak. Height 5.5; length 6.0; diameter 2.5 mm.

Near Cerros Island, Lower California, in shallow water. Cat. No. 266158, U.S.N.M.

This has nearly the profile of *P. lordi* Baird, but is much less inflated, and the surface is concentrically sculptured instead of smooth.

HALICARDISSA, new genus.

Shell recalling *Halicardia* and *Verticordia*, finely granulose externally, with a few strong radial ribs; the distinctive characters are anatomical. The shell has been figured.[1]

The soft parts recall those of *Halicardia* but instead of having a thin netlike gill attached on each side to a more or less convoluted fleshy siphonal septum, thus completing the separation of the pedal and siphonal chambers, the septum is thin and incomplete behind, so that it does not cut off the siphonal from the pedal chamber completely, and the gills form no part of it but are free, except at the proximal end, and appear to have both direct and reflexed laminæ; the foot is more like the usual pelecypod foot, with no developed opisthopodium, and the palps offer nothing exceptional. The soft parts, in brief, are intermediate between those of *Verticordia* proper and the ordinary pelecypod, anatomically, and much nearer the former than to the typical *Halicardia*.

Type.—*Verticordia perplicata* Dall, from 812 fathoms near the Galapagos Islands. Cat. No. 266804, U.S.N.M.

Shells of the genus *Halicardia* were referred to *Mytilimeria* by Verrill and Locard, and the present species would from the shell alone be suspected to belong to *Halicardia*.

LYONSIA (ALLOGRAMMA) AMABILIS, new species.

Shell thin, with a pale olivaceous periostracum and pearly interior, the lithodesma small. The sculpture resembles closely that of the type of the group, *L.* (*A.*) *formosa* Jeffreys, from the Canaries, but differs in the following details; the anterior transverse ripples, the central nodulous ray, and the radial ridge below the posterior dorsal area are more vertically directed; on the latter area there is only faint indication of the radial ribbing which in *L. formosa* is distinct and minutely spinose; the anterior end is longer than the posterior, while in *formosa* the reverse is the case; the coloration of the periostracum is olivaceous green while in *formosa* it is ferruginous brown. Length 23; of anterior end 12; height 15; diameter 12 mm.

Santa Barbara Channel, California, in deep water. Cat. No. 267161, U.S.N.M

This is a much larger shell than the Atlantic species of the same group.

LYONSIA (ALLOGRAMMA) OAHUËNSIS, new species.

Shell resembling the preceding, but somewhat smaller, pale brown, with the anterior transverse ripples fewer and less vertical than in either of the other species, the median ray less distinct and wider, composed of feeble undulations; the posterior dorsal area with low transverse instead of radial sculpture over its lower half; the posterior

[1] Proc. U. S. Nat. Mus., vol. 12, 1889, pl. 8, fig. 1.

end more attenuated, and the beaks almost exactly central. Length 21.75; of anterior end 10.75; height 13.0; diameter 10.0 mm.

South coast of Oahu Island, Hawaiian Islands, in 310 fathoms, sand, bottom temperature 43.5° F. Cat. No. 252329, U.S.N.M.

LYONSIA PUGETENSIS, new species.

Shell large, thin, pearly under a thin olivaceous gray periostracum which is covered with fine radial lines to which fine sand adheres strongly, so that an attempt to remove the sand also destroys the greater part of the periostracum; the shell is slightly inequivalve and very inequilateral, the anterior end being much shorter; the periostracum projects over the shelly margin; the anterior end is evenly rounded, the posterior rostrate, the beaks not conspicuous; the base is convexly arcuate in the middle but is rapidly attenuated toward the rostrum, which is terminally truncated; interior pearly, pallial area relatively small within the somewhat irregular unsinuated pallial line; hinge edentulous with a small narrow lithodesma. Length of shell 36; of anterior portion 15; height at beaks 17; maximum diameter 10 mm.

Another specimen is 50 mm. long and 22 mm. high, while a third is 52 mm. long and 28 mm. high.

The type, Cat. No. 249966, U.S.N.M., is from the coast of Washington (H. Hannibal); another is from Chignik Bay, Alaska, in 16 fathoms, sand (Dall); and a third from Puget Sound (Kincaid).

This is the largest *Lyonsia* of the coast, if we except *Entodesma* (*Agriodesma*) *saxicola* Baird. The smaller specimen was taken as type because of the better condition of the surface, the periostracum in adults being largely dehiscent.

LYONSIELLA MAGNIFICA, new species.

Soft parts; siphonal orifices not produced, both profusely papillose and separated externally by a bare space; incurrent siphon with a strongly marked circular valve internally. Gills flat, fleshy, with two laminæ completely soldered to the fleshy siphonal septum and with that completely separating the pedal and siphonal chambers; there are no perforations in the septum and no free portions of the gills; foot cylindrical, grooved behind, with a long and profuse byssus of numerous threads; mantle closed except for the narrow byssal foramen and the siphonal orifices; palps short, soldered to the mantle except behind in front of the foot; mantle margins smooth. The excurrent siphon has a small short valve projecting from its orifice, which when contracted is bilabiate, the fold vertical. The general anatomy recalls that of *Lyonsiella abyssicola*, in which, however, Pelseneer indicates an excurrent siphonal tube of moderate length.

Shell thin, inflated, subquadrate, inequilateral, inequivalve, gaping behind; the right valve a little larger than the other; color pearly

white with a pale olive periostracum and a minutely granular surface, the granules being disposed in radial lines with wider interspaces; beaks small, acute, very anterior, prosocœlous, with a minute lunular depression in front of them; a wide shallow depression with an obscure ridge above it extends backward dorsally to the posterior margin, with a lanceolate area between the ridges of the two valves; base almost parallel with the dorsal hinge line; margins of the valves simple, sharp, slightly tortuous; interior pearly; hinge with a small internal resilium on an inconspicuous nymph, with a very small oval lithodesma. Height 16.5; length 25; length of anterior end 4; diameter, 16 mm.

In deep water off Mazatlan, Mexico, Cat. No. 266802, U.S.N.M. This is the largest of the genus yet described.

POROMYA (DERMATOMYA) TENUICONCHA, new species.

Shell small, thin, olivaceous, the pearly luster showing through the periostracum; equivalve, inequilateral, anterior end shorter, rounded in front; posterior end longer, roundly truncate; beaks prominent, prosocoelous, with a marked but uncircumscribed depression in the lunular region in front of them; interior pearly, brilliant; margins simple, sharp; hinge in the left valve with a small internal resilium seated on an inconspicuous oblique chondrophore, with a notch immediately in front of it, into which fits a projecting denticle on the corresponding part of the opposite valve. Height, 13; length of shell, 16; of anterior portion, 6; diameter, 10 mm.

In deep water off Monterey Bay, California. Cat. No. 266865, U.S.N.M.

This recalls *P.* (*D.*) *equatorialis* Dall, but is more delicate, less inflated and smaller.

ERYCINA COLPOICA, new species.

Shell small, white, equivalve, very inequilateral, the anterior end much the longer and somewhat expanded, posterior shorter and smaller, both rounded; the dorsal and basal margins slightly arcuate, subparallel; surface sculptured only with concentric incremental lines, covered with a thin, pale yellowish periostracum; beaks low, inconspicuous, valves rather compressed; interior polished, hinge formula $\frac{\text{lo.01.olo}}{\text{ol.10.lol}}$; chondrophore very narrow, oblique, and posteriorly directed. Length of shell, 10; of anterior part, 8; height, 6; diameter, 3.5 mm.

Beach at the head of the Gulf of California. Dr. E. Palmer, Cat. No. 267408, U.S.N.M.

ROCHEFORTIA COMPRESSA, new species.

Shell small, thin, glassy, compressed, subovate, inequilateral; beaks low, pointed, inconspicuous; surface very finely, sharply, evenly, concentrically striated; anterior end longer, evenly rounded; poste-

rior more pointed; interior polished, the muscular scars perceptible, small; hinge small and weak, constructed of two feeble laterals in each valve and a median internal resilium. Length of shell, 7; of anterior part, 4; height, 6; diameter, 2 mm.

With the last. Cat. No. 214445, U.S.N.M.

ALIGENA NUCEA, new species.

Shell small, white, rather solid, ovate, slightly inequilateral, moderately inflated; surface rather rude, with irregular, rather coarse incremental lines; beaks full, somewhat posterior, the anterior end of the shell shorter; interior porcellanous, the muscular scars unusually large, the pallial line irregular, entire; hinge with a long, strong, narrow, chondrophore, a small pustular projection in front of it, as usual in the genus. Length of shell, 4.0; of anterior portion, 1.75; height, 3.0; diameter, 2.2 mm.

Gulf of California. Cat. No. 267149, U.S.N.M.

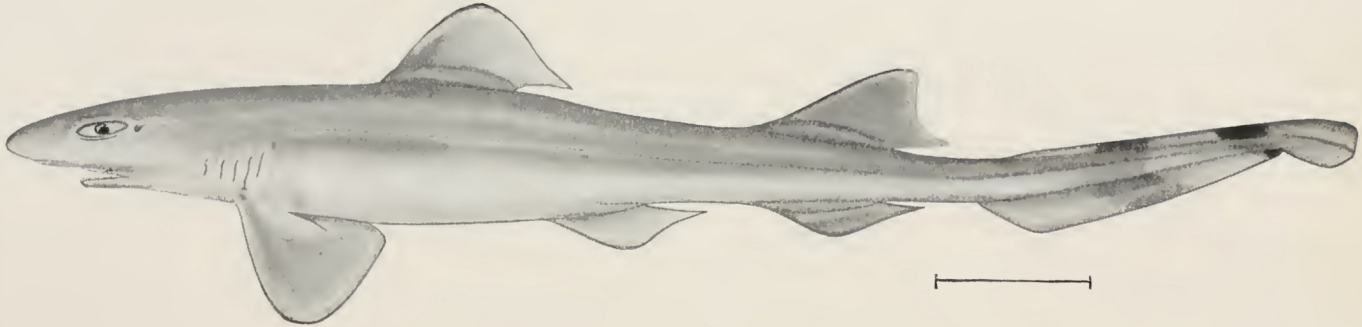
This species recalls *A. cokeri* Dall, of Peru, but wants the median radial depression and has a proportionately stronger hinge.

VESICOMYA (ARCHIVESICA?) SUAVIS, new species.

Shell oval, white, with an elegantly polished, minutely concentrically sparsely lamellose periostracum, smoother near the beaks; equivalve, inequilateral, the beaks nearer the anterior end; there is no lunule, but a long lanceolate depression radiating from the beaks, bordered on each side by an obscure radial rib, simulates an escutcheon though not defined by any incised line; shell moderately inflated, the beaks full but low and prosocoelous; the ligament external, strong, and conspicuous; the two ends of the shell subequal and rounded, the anterior end a little smaller; interior chalky, with large adductor scars and an entire pallial line; hinge like that of *V. gigas* but less developed; length of the shell, 34; of the anterior part, 10; height, 22; diameter, 13 mm.

West of Tiburon Island, Gulf of California, in deep water. Cat. No. 266881, U.S.N.M.

This species, by the shell, belongs to the group of *V. lepta* and *gigas*, but the soft parts being unknown its place must remain uncertain.



ERIDACNIS RADCLIFFEI. FROM THE TYPE.

FOR EXPLANATION OF PLATE SEE PAGE 599.

[SCIENTIFIC RESULTS OF THE PHILIPPINE CRUISE OF THE FISHERIES STEAMER "ALBATROSS," 1907–1910.—No. 29.]

DESCRIPTION OF A NEW CARCHARIOID SHARK FROM THE SULU ARCHIPELAGO.

By Hugh M. Smith,

United States Commissioner of Fisheries and Director of the Albatross Philippine Expedition.

Among the deep-water sharks collected by the United States Bureau of Fisheries steamer *Albatross* on the Philippine cruise is a small, undescribed species representing a new genus of Carchariidæ, obtained off the island of Jolo (Sulu).

ERIDACNIS, new genus (Carchariidæ).

Small, deep-water, viviparous sharks with nictitating membrane; well-developed spiracle behind eye; wide, angular mouth, without labial grooves; small, erect, pluricuspid teeth of somewhat variable shape but similar in two jaws; rather narrow gill openings of which the last 2 or 3 are above pectoral base; subequal dorsal fins, the first entirely anterior to ventrals; anal fin opposite second dorsal and much smaller; elongate, nearly straight caudal, with notch near tip of basal lobe; no pit at root of tail; no caudal keel; closely imbricated shield-shaped dermal denticles which are finely reticulate on base and sides.

Type of genus.—Eridacnis radcliffei, new species.

This genus is related to *Triakis* Müller and Henle, but differs in shape of mouth, absence of labial grooves, shape of teeth, form of dermal denticles, etc.

ERIDACNIS RADCLIFFEI, new species.

Plate 47.

Form elongate, rather slender, body compressed, depth at origin of first dorsal about 0.5 length of head (to posterior gill opening); head broad, depressed, its width equal to distance from pupil to posterior gill opening, its length contained 5.2 times in total length of fish; eye equal to snout, its anterior margin in line with middle of

upper jaw; interorbital space convex, broad, 1.66 diameter of eye; spiracle rather large, functional; snout semicircular in outline, the preoral space greater than diameter of eye; nostrils large, with square flaps; mouth large, its width twice eye, angular, the two sides forming an angle of 45°; teeth small, similar in two jaws, about 28 in first

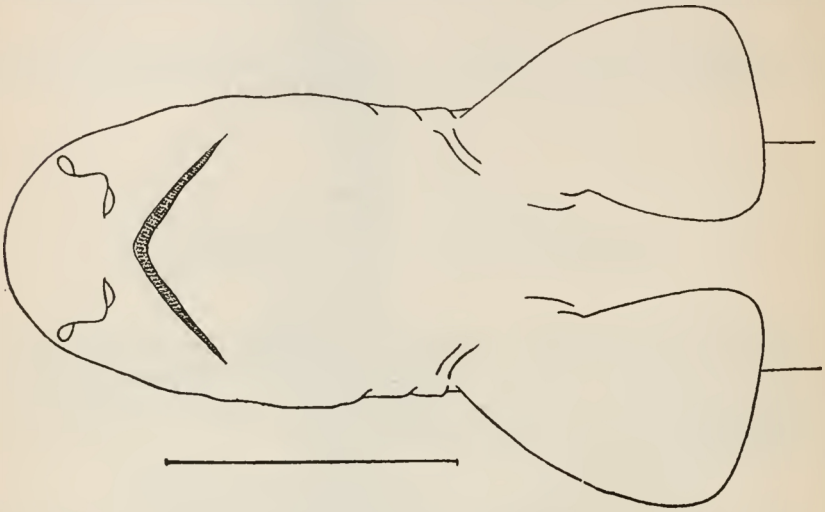


FIG. 1.—ERIDACNIS RADCLIFFEI. UNDER SIDE OF HEAD.

row in each side of each jaw, pluricuspid, the central cusp rather larger in upper jaw, with 2 or 3 proximal cusps and 1 distal cusp on each tooth except 3 teeth nearest symphysis, which have a middle cusp and 2 lateral cusps on each side; 3 teeth nearest symphysis in lower jaw with middle cusp and 1 lateral cusp on each side, the number of cusps on proximal side increasing to 2, 3, and 4, while the distal side has only 1 cusp; gill apertures rather narrow, the last two posterior to anterior margin of the pectoral, the fourth slit widest;

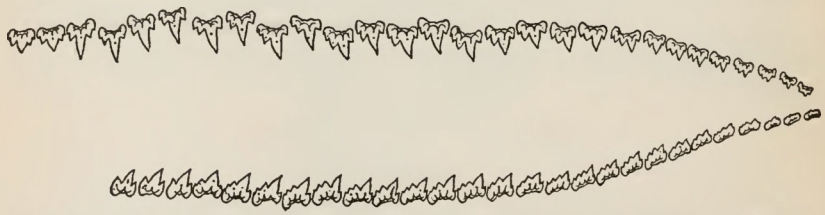


FIG. 2.—ERIDACNIS RADCLIFFEI. TEETH OF UPPER AND LOWER JAWS, GREATLY ENLARGED.

dermal denticles with rounded base, a central sharp point, and a short rectangular shoulder on each side, a central groove flanked by lateral keels extending from base to sides of the pointed extremity, and another groove on the outer side of each keel, the sides and base of denticles having several rows of minute reticulations (not shown in figure).

Dorsal fins well developed, subequal, origin of first midway between tip of snout and origin of second, the first dorsal directly over space between pectorals and ventrals; caudal long, nearly straight, a deep notch near tip, its length equal to distance from tip of snout to origin of first dorsal, upper lobe low, and rounded lower lobe deeper than anal; anal under second dorsal but less than half its size; ventrals small, about size of anal; pectorals broad, rounded, their length slightly less than breadth of head.

Color: Light brown above, whitish below; posterior half of body with several faint, irregular, dark brown cross bands.

Type.—Cat. No. 74604, U.S.N.M., a female specimen 23.0 cm. long, taken with a beam trawl at station 5135 (lat. 6° 11′ 50″ N.; long. 121° 08′ 20″ E.), off Jolo light, island of Jolo, February 7, 1908, at a depth of 161 fathoms.

This fish was taken aboard the fisheries steamer *Albatross* alive, and contained 2 large embryos inclosed in thin membranous sacs. One of the sacs was opened, and the young, when placed in a dish of

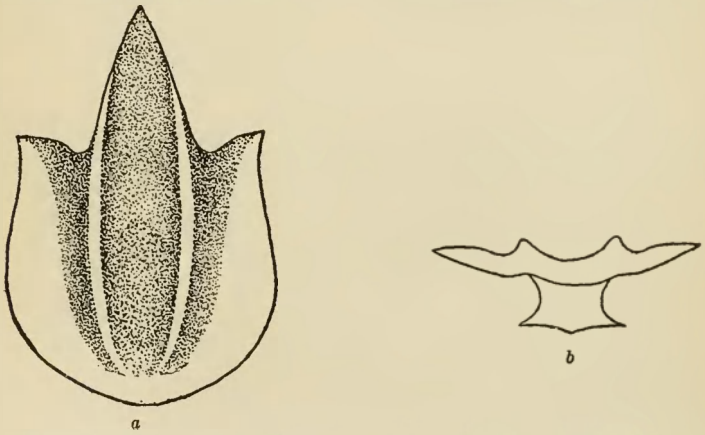


FIG. 3.—ERIDACNIS RADCLIFFEI. *a*, A DERMAL DENTICLE FROM SIDE; *b*, CROSS SECTION OF DERMAL DENTICLE, THROUGH MIDDLE, SHOWING ATTACHMENT.

salt water, swam actively. When in the sac, which was 4.7 cm. long and 1.7 cm. wide at its widest part, the body of the embryo was bent sharply to the left, just posterior to the ventral base, and the end of the tail was curved around the snout. The length of the embryo was 11.3 cm., or nearly half that of the mother.

This species is named for Mr. Lewis Radcliffe, scientific assistant of the Bureau of Fisheries and a member of the *Albatross* Philippine expedition.

THREE NEW SPECIES OF ANTHOMYIDÆ (DIPTERA) IN THE UNITED STATES NATIONAL MUSEUM COLLECTION.

By J. R. Malloch,

Of the Bureau of Entomology, United States Department of Agriculture.

The three species herein described have been standing in the United States National Museum collection without names for several years, and in working over some Anthomyidæ belonging to the Division of Cereal and Forage Crops I had occasion to compare them with some specimens contained therein. I consider it advisable to publish descriptions of those new forms, as probably they are present in other collections also without names.

TETRAMERINX FEMORATA, new species.

Male and female.—Black, shining. Mesonotum unstriped. Abdomen with large, paired, subtriangular spots. Legs black, tibia brown-black. Wings clear. Calyptræ white. Halteres yellow.

Male.—Frons distinctly over one-third the head width, center stripe, viewed from behind, opaque black, intersected by the whitish pollinose, wedge-shaped frontal triangle to the anterior margin, viewed from in front the whole stripe is whitish pollinose; orbits narrow, whitish pollinose, four orbital bristles present, which increase in length from the posterior (upper) one to the moderately long anterior one and become slightly wider spaced; antennæ elongate, third joint about four times as long as second, reaching almost to mouth margin; one weak bristle on dorsal surface of second joint; arista almost bare, thickened on almost the basal half, basal joints short; face and cheeks with silvery white pollinosity; cheek about one-sixth as high as eye, marginal bristles numerous, downwardly directed, of moderate strength, vibrissæ differentiated; palpi linear, black, with a few long hair-like lower marginal bristles; proboscis of good length, glossy black-brown on apical half. Mesonotum grayish pollinose, with very faint indications of three stripes, the center one double; four post-sutural bristles, the two pairs behind suture weaker than the two presutural pairs; acrostichals 3-rowed; pleuræ with faint grayish pollinosity. Abdomen short, not longer

than thorax, ovate, glossy black, anterior margin of each segment with a gray pollinose, laterally dilated spot, and generally with a narrow dorso-central line of the same nature, which gives the segments the appearance of having a large subtriangular black spot on each side; all segments with scattered, surface, hairlike bristles, those on the lateral and posterior margins longest, no strong discal bristles on last segment; hypopygium glossy black, of moderate size, but not protruding much. Legs rather elongate, mid tarsus longer than mid tibia by almost the length of the last two joints; fore tibia without bristles except at apex; mid femur without any distinct ventral bristles; mid tibia bare; hind femur with a comblike fasciculus of short, stiff, black bristles, which begins at near base on the ventral surface and runs for a short distance on to the postero-ventral surface; antero-ventral surface with 2 to 3 long bristles on apical third; hind tibia bare, except for one short, preapical bristle at near to apex on dorsal surface, and in one specimen a weak antero-ventral bristle at about apical third. Wings clear; costal thorn indistinguishable; third and fourth veins convergent, as in *Muscina stabulans;* last section of fourth vein twice as long as penultimate section; outer cross vein slightly waved. Calyptræ with the under scale much the largest.

Length, 3 mm.

Female.—Similar to the male in color, etc., but differs considerably in the bristling of the legs; the fore tibia has one short postero-ventral bristle on near middle; the mid femur has one strong bristle on the middle of the anterior surface; the mid tibia has on the posterior surface one moderately strong bristle above the middle and another, weaker, one below middle; the hind femur has the comb absent, and one strong preapical antero-ventral bristle; the hind tibia has two close placed weak antero-ventral bristles below middle, one on antero-dorsal surface at middle, and one weak preapical dorsal bristle. Wings as in male, but the last section of fourth vein is not twice as long as penultimate section.

Length, 4 mm.

Type, Allotypes, and *Paratype.*—Cat. No. 15670, U.S.N.M.

Type-locality.—Los Angeles County, California, March (collection Coquillett). Two males and two females.

PARALIMNOPHORA, new genus.

Generic characters.—Eyes bare or with very short, sparse pilosity; frons broad, at vertex about one-third the head width, in male distinctly narrower at vertex than above antennæ; orbits distinct, orbital bristles situated on near to inner margin of orbits, lower pair very strong, the three pairs above them decreasing in size, all four pairs incurved; upper two pairs backwardly directed; ocellar bristles very

strong, and long, widely divergent, and forwardly directed; post-vertical bristles weak, divergent; antennæ distinctly shorter than face, second joint with three strong dorsal bristles, the one nearest apex the longest; arista subplumose, the hairs most distinct on upper surface, basal joints short, terminal portion only slightly swollen and tapering at base, cheeks with 2 to 3 rows of bristlelike hairs, the upper series of which are slightly upturned; vibrissæ distinct, bristles carried up beyond vibrissæ on facalia (3–4); proboscis and palpi normal. Mesonotum with 2 presutural, 3 postsutural, and 2 humeral bristles, pleuræ with two bristles situated above fore coxæ, 4 to 5 on hind margin of mesopleura, and 3 (1–2) on sternopleura. Wings with sixth vein reaching only halfway to margin; veins 3–4 slightly divergent. Calyptræ with the under scale very much larger than the upper.

Type of genus.—Paralimnophora brunnesquama, new species.

PARALIMNOPHORA BRUNNESQUAMA, new species.

Male.—Black, shining. Frons with center stripe, viewed from in front, gray dusted; face gray dusted. Mesonotum shining, deep black, unstriped, in some lights with an indication of grayish-yellow pollinosity on humeri, lateral, and posterior margins; acrostichal bristles irregular (3–4) rowed. Abdomen ovate; with very distinct grayish-yellow pollinosity, which covers all the segments except the base of first, two large subtriangular spots on second, and two smaller, less distinct spots on third, which are deep black; all segments with setulose hairs, which are longest laterally, and on apices of segments, as well as on disk of apical segment; hypopygium retracted, shining black. Legs black, hind tibiæ brownish black; fore tibia with one short bristle on slightly below middle of posterior surface, apex with one strong and one weak dorsal bristle, and one posterior apical spur; mid femur on antero-ventral surface with an irregular row of numerous, moderately long bristles, postero-ventral surface with six almost equally long bristles on basal half, then the row rapidly decreases in length and becomes closer placed, the apical half having 12 to 13 bristles on it; mid tibia with two posterior bristles, the upper just above the middle, the lower at just above one-third from apex; antero-ventral surface of hind femur with a series of about eight bristles, which begins just before middle with short, weak bristles and the last 4 to 5 of which are almost equally strong and regularly placed, the row on the postero-ventral surface is slightly weaker, more numerous, begins weak at base, lengthens on middle, and finishes at before apex equal in strength to the basal portion of series; hind tibia with one dorsal preapical bristle, two antero-dorsal, one a little above and the other below middle, two

antero-ventral, each slightly below the corresponding antero-dorsal, and one weak postero-dorsal bristle on middle; pulvulli white, long; claws long. Wings grayish; costal thorn distinct, but not large; penultimate section of fourth vein distinctly over one-half as long as last section; outer cross vein slightly waved. Calyptræ black-brown. Halteres yellow.

Length, 4–5 mm.

Type.—Cat. No. 15671, U.S.N.M.

Type-locality.—Franconia, New Hampshire (Mrs. A. T. Slosson).

Paratypes.—Ottawa, Canada; Montreal, Canada; St. John, New Brunswick, June 25, 1901 (W. McIntosh); White Mountains, New Hampshire (Morrison). This species comes close to some of those which have been placed in *Limnophora*, but the much more widely separated eyes should readily separate it from any species in that genus.

ANTHOMYIA BIDENTATA, new species.

Male.—Deep black, subopaque. Frontal triangle reddish-brown; face black, white pollinose, cheeks brown, silvery pollinose. Mesonotum without stripes or spots, lateral margins slightly gray pollinose. Abdomen deep black, with only two small grayish-white, dentate, post-marginal marks on each segment. Legs entirely black. Calyptræ white. Halteres yellow. Wings clear.

Head rather large; frons in profile barely projecting; eyes very large, almost twice as high as long, leaving a rather narrow cheek; frontal triangle rather broad in front, almost triangular, the eyes widely separated to near ocelli where, shortly in front of that part, the frontal stripe becomes linear; orbital bristles numerous, but not strong; antennæ distinctly shorter than face; second joint with one long and several short bristles; third joint about 2½ times as long as second; arista rather short, barely 1½ times as long as third antennal joint, swollen at base, slightly pubescent; vibrissa slightly differentiated from the numerous, and moderately strong, marginal bristles; palpi rather above normal size, slightly spatulate, bristles numerous, but not strong, proboscis thick. Mesonotum with acrostichal bristles 2-rowed, three pairs anterior to the suture; the tuft of hairs above fore coxæ strong and dense. Abdomen short, not as long as thorax, broad, subovate; whole surface covered with rather long, setulose hairs. Fore tibia with a weak bristle on the postero-dorsal surface near middle and one on dorsal surface near to apex; mid femur with a row of hairs on postero-ventral surface, which are at base longer than the diameter of the femur and end at about middle much shorter than they are at base; mid tibia with one dorsal bristle slightly above the apical third, and two on postero-dorsal surface, one below the level of the dorsal one, and the other at about middle, all three bristles weak; hind femur, antero-ventral side, with a

series of (9–10) long bristles from base to tip, which are of about equal length throughout, but are more hairlike toward base, the postero-ventral surface has a series of equally long bristles, but they extend but little beyond the middle of femur; hind tibia with two dorsal, one antero-dorsal, and one antero-ventral bristles. Calyptræ with the under scale very much the larger.

Length 3 mm.

Type.—Cat. No. 15642, U.S.N.M.

Type-locality.—Kaslo, British Columbia (R. P. Currie). One male.

THE MOUNT LYELL COPPER DISTRICT OF TASMANIA.

By Chester G. Gilbert and Joseph E. Pogue,
Of the Department of Geology, United States National Museum.

INTRODUCTION.

The present paper is based upon a study of a representative collection of rocks and ores received in 1910 by the United States National Museum from Robert Sticht, manager of the Mount Lyell Mining & Railway Co. (Ltd.). The geologic and technical information is derived largely from the writings of Gregory and of Sticht (see Bibliography), which embrace the most authoritative expressions on those subjects. Mr. Sticht has also generously assisted the undertaking by supplying copies of his papers and communicating unpublished data.

LOCATION.

The Mount Lyell mining district, comprising the Mount Lyell Mine, the North Mount Lyell Mine, the South Tharsis and Royal Tharsis Mines, and other workings of less importance, occupies an area of 9 square miles situated 18 miles inland from Macquarie Harbor on the west coast of the island of Tasmania. The field is reached over a railway 28 miles in length from Strahan, the harbor port, to Queenstown, the mining center. The region is wild and inhospitable, is covered with a dense undergrowth, and is scarcely penetrable except along streams and where cleared by man or forest fire. The colony is under British rule and lies off the southernmost point of Australia, from which it is separated by Bass Strait, about 150 miles in width.

HISTORY.

Discovered in 1642, but not settled until 1803, Tasmania attracted no mining interest until the early sixties of the nineteenth century, when gold was discovered in the western interior. In 1881 prospectors came across gold-bearing alluvium near Mount Lyell, and in 1883 the ferruginous outcrop of the Mount Lyell ore body was encountered.

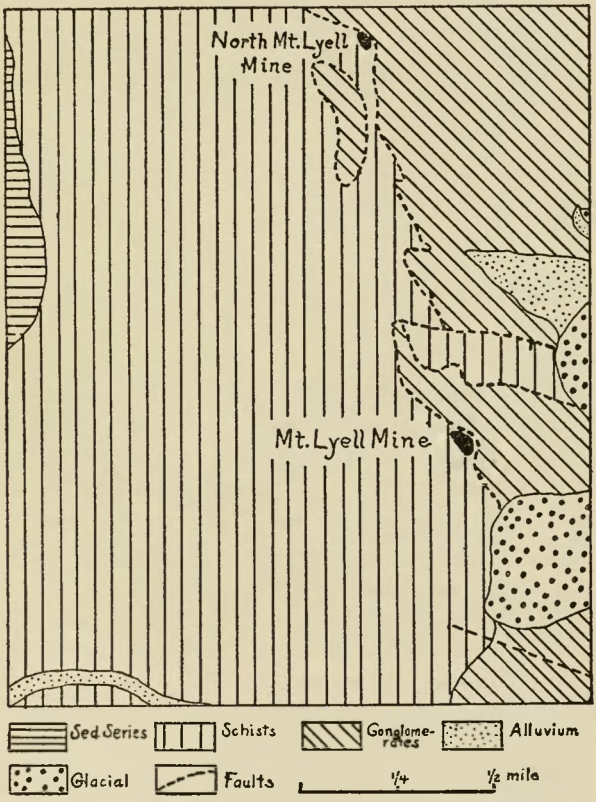
Good values in gold were found here and although the underlying pyritic mass was soon detected, its significance was not recognized, and attention was confined to the oxidized ore, the valuable portion of which was depleted within a few years. In 1891 lagging interest in the deposit was revived by the recognition of the copper potentialities of the pyritic mass, and a syndicate was organized for working the ore on a systematic scale. In 1893 the company was incorporated as the Mount Lyell Mining & Railway Co. (Ltd.), which to the present has retained control of practically the entire field. At its inception this company was fortunate in securing the services of an eminent metallurgist, E. D. Peters, whose favorable report and recommendations, coupled with a very timely find of rich silver-copper ore, insured the financial backing necessary for the success of the enterprise. Development work was at once actively prosecuted and a coast-to-mine railway projected and started. Robert Sticht, an American engineer, was engaged to direct the undertaking, and to his administrative ability and scientific skill the subsequent success of the company is largely due. In 1895 the open-cut system was adopted for working the ore body and a system of pyritic smelting was planned and inaugurated whereby the sulphur and iron of the ore served as fuel for its smelting, admitting of an economical recovery of copper and the precious metals. Success amply rewarded the introduction of this treatment, which at the time was little understood and had not been tested on a large scale upon regular copper ores.

In the meantime an independent company was developing a property (the North Mount Lyell) to the north of the pyritic mass, but encountered little ore until, in 1897, a rich body of siliceous bornite was accidentally located. The treatment adopted, however, proved unsuccessful, and in 1903 the company was merged with the Mount Lyell Mining & Railway Co. (Ltd.)—a happy combination, for the ores of the two deposits were metallurgically complementary and were amenable to more economical treatment than could be applied to either alone. Many other mining companies have operated in the field, but all the important ones have been added by the principal company to the original holdings.

The history of the Mount Lyell district is unique and affords an example of notable success in the face of great natural obstacles. The profitable exploitation of a low grade deposit in a remote and isolated region, where labor costs and difficulties are at a maximum, is an important achievement. The secret of this success is to be sought in the application from the outset of the highest type of technical, scientific, and administrative ability to the problem.

GEOLOGY.

The geology of the Mount Lyell district is shown on the accompanying sketch map. A narrow belt of deeply dipping schistose rocks is bordered on the east by an area of quartzitic conglomerates, while to the west lies a sedimentary series of Silurian age, composed of sandstones, quartzites, and clay slates with limestone intercalations. The ore is confined to the schists, lying along their contact with the conglomerate, which is marked by an important overthrust fault. Igneous rocks, both acid and basic, are rather extensively developed near the western coast of the island and approach in bulk



SKETCH MAP OF THE MOUNT LYELL DISTRICT. (MODIFIED FROM GREGORY.)

to within 1½ miles of the deposits; dikes of diabasic character come nearer, though none are in contact with the ore. The region shows signs of glaciation.

The conglomerate is younger than the schists, containing inclusions of the latter, and normally overlies them except near the mines, where the relations are reversed by the overthrust fault. The formation is predominantly reddish in color and is composed of rounded to subangular pieces of quartz and quartzite, ranging from small

grains to bowlders a foot or two in diameter, and consolidated by siliceous cement. Its lowest member is a typical quartzite, and other quartzite beds are intercalated through the series. The formation is unmineralized except in proximity to its schist contact, where it shows pyrite, chalcopyrite (in places some bornite and chalcocite), and hematite, all in unimportant amounts. Specimens near the fault plane show results of the fault pressure by a schistose tendency, and under the microscope by undulatory extinction and shattered condition of some of the quartz grains.

The schist series forms a belt three-fourths to 1½ miles wide, with north–south course. The strike is N. 50° W. to N. 60° W., with dip of 60–80° to the southwest. The rocks range in color from light grayish green to dark blue and in structure run from moderately schistose to highly schistose. The light-colored members are typical sericite schists, resolvable under the highest power of the microscope into a dense quartz mosaic, knit with shreds of sericite in parallel alignment. The darker members, which have the greater distribution, are chloritic schists showing under the microscope predominant chlorite, accompanied at times with sericite, enwrapping grains and mosaic masses of quartz. All sections are mineralized with pyrite in minute grains and crystals, which are scattered through the quartz, chlorite, and sericite alike. As shown by the lack of pressure effects due to crystal growth and the frequent presence of pyrite crystals intercepting otherwise continuous laminæ, the pyrite is judged to have been deposited mainly through replacement. Gregory, who has made a detailed petrographic study of the schists, finds that they grade from those showing no original structure to those definitely of igneous origin, "formed by the alteration of quartz-porphyrites and probably also of acid volcanic tuffs." From a study of several thin sections, comparison with similar rocks of Virginia and North Carolina,[1] and careful consideration of the chemical analyses given by Gregory, the writers believe that it can be affirmed with considerable certainty that the schist series represents the mashed equivalent of volcanic rocks of acid to intermediate character.

Faulting has been profound in the region, but is largely localized in the major overthrust already referred to and attendant cross faults of minor development. The ore deposits are confined to the fault zone, and the principal deposition has taken place in the angles formed by the intersection of the cross faults with the major fault. The latter may be traced along the surface and is marked by outcrops of hematite which, however, according to Sticht, bear no relation to the pyrite and is not its gossan.

[1] The sericite and chlorite schists of Mount Lyell are strikingly similar, both in appearance and in microscopic detail, to analogous copper-bearing schists of the Virgilina, Gold Hill, and Cid districts in Virginia and North Carolina, which have resulted from the dynamic metamorphism of volcanic rocks.

THE MINES.

Two mines only need be considered in detail, as these represent the major development of the field and embrace the features of interest shown by the minor deposits.

Mount Lyell mine.—This mine has opened up a pyritic mass of remarkable size, carrying a low copper content and values in gold and silver. The ore is fine-grained, homogeneous pyrite, bearing chalcopyrite and including evenly distributed gangue of quartz and barite in extremely subordinate amount. The ore body lies entirely within deeply dipping schists, adjacent to and approaching on the foot-wall side within a few inches of the conglomerate fault contact. Its configuration is that of a horn-shaped body, tapering downward, with maximum dimensions of 270 by 660 feet at the 400-foot level. It has been mined *en masse* by the open-cut system, and in 1906 had been developed to a depth of 730 feet. At present the mining is carried on underground, the open cut nearing completion.

The body as a whole is low grade, the copper averaging from 0.6 to 0.75 per cent, with silver running from 1.10 to 1.75 ounces and gold from 0.06 to 0.08 ounce. The mass is singularly free from deleterious elements, containing only about 0.25 per cent arsenic, less than 0.17 per cent antimony, no bismuth, and traces only of selenium and tellurium. Along the contact and about the periphery the ore body is locally richer from deposition of higher percentage of chalcopyrite and addition of tetrahedrite and enargite bearing areas.

North Mount Lyell mine.—This mine is the richest property and largest producer in the district. It differs from the Mount Lyell in that the predominant ore is bornite, which, together with subordinate chalcocite and some tetrahedrite, pyrite, and chalcopyrite, forms lenticular masses in sericitic and chloritic schists. These minerals, with considerable silica and some barite, have been deposited as stringers and lenses following the lamination of the schistose rocks, forming impregnated zones or "fahlbands" of ill-defined limits, representing combined replacement and interlaminal deposition. The ore is worked by underground mining and the operations have penetrated to a depth of 1,100 feet. The values in copper run much higher than in the Mount Lyell mine, averaging from 5 to 7 per cent, though the precious-metal content is less. Owing to the siliceous character of the ore it forms an efficient flux for the pyritic ore of Mount Lyell, permitting the lowest grades of the latter to be profitably worked.

THE ORE MINERALS—MOUNT LYELL MINE.[1]

The ore minerals at the Mount Lyell mine, in the order of their observed prominence, are pyrite, chalcopyrite, enargite, tetrahedrite, sphalerite, galena, bornite, and chalcocite.

Pyrite.—The Mount Lyell ore is dominantly pyritic and the average ore specimen appears to consist purely of densely granular pyrite with accessory quartz. Where the development of quartz is sufficient to be conspicuous its distribution is not uniform, but tends toward segregation into bands. In polished sections the banding becomes more apparent and presents a plicated and distinctly schistose aspect. (See fig. 1, Pl. 48.) Under magnification the pyrite appears characteristically granulated and is not intergrown with other sulphides. Its bearing toward quartz is both that of contemporaneous and of later development.

Chalcopyrite.—The copper content of the Mount Lyell ore is largely due to the presence of chalcopyrite, which permeates the pyritic ore in the most intimate fashion. It is imperfectly distinguishable in hand specimens, but under the microscope is seen to traverse the pyrite in stringers and form a network enmeshing grains and cementing fractured individuals. (See fig. 3, Pl. 49.) Its development is especially marked along the quartzose bands, and the inclosing filaments decrease outward from such areas, in some instances leaving the denser pyrite of the section entirely free from observable chalcopyrite. Such pyrite, free from visible chalcopyrite even at a magnification of 200 diameters, however, was found to react for copper.

Enargite.—The occurrence of this mineral is highly localized. Where present it does not permeate the ore after the fashion of chalcopyrite, but occurs as relatively large, irregular, confluent areas inclosing breccialike pieces of pyrite. (See fig. 2, Pl. 48.) Its most interesting microscopic feature is an ever-present impurity in the form of chalcopyrite, which is disseminated throughout the enargite in minute patches, networks, stringers, and disconnected points. (See

[1] The microscopic work was done on polished sections with a metallographic microscope using veritcal illumination from an acetylene light, at magnifications ranging from 30 to 200 diameters. The minerals were identified by noting their characteristics, such as color, hardness, structure, tarnish, and etching effects, upon areas sufficiently large to furnish fragments for blow-pipe tests; by which means criteria were obtained for the identification of these minerals even where microscopically developed. In making the photographs it was found desirable to increase the color contrasts by developing tarnishes by brief treatment with acid; for this purpose nitric acid was most useful.

A useful hardness test, applicable to the determinatiou of the relative hardness of adjacent grains in opaque sections, was developed during the course of the study, and may be applied as follows: Having centered the microscope tube on the contact between two mineral grains, place a small metal straightedge on the section and move until its edge intersects the two grains; then remove the section from the microscope stage, holding firmly the straightedge in place, and, by means of a knife point, draw a line across the two grains, being careful to press uniformly throughout. Replace the section under the microscope and note the size of the channel as it passes from one grain to the other. The larger channel, of course, will lie in the softer mineral. This method is sensitive to within a half degree of hardness in the customary scale and is applicable to grains as small as 0.5 mm. in diameter.

figs. 1 and 2, Pl. 50.) A noteworthy feature of this included chalcopyrite is that it is everywhere richer toward the margin of the enargite areas and is not infrequently strongly concentrated close to or at the border. It nowhere crosses into the pyrite, nor does it seem to be related to the chalcopyrite already referred to as disseminated through the pyrite ore.

Bornite, chalcocite, tetrahedrite.—These minerals, while important as correlating the Mount Lyell ores with those from North Mount Lyell, are exceedingly limited both in quantity and in extent, and since their mode of occurrence is analogous to that observed in ore from North Mount Lyell they may be reserved for discussion under that head.

Sphalerite and galena.—These minerals represent highly localized phases of the ore and are nowhere prominently developed. They are confined to the pyrite and were in no place observed in association with the copper sulphides. Sphalerite is much more prevalent than galena and wherever the latter does occur it is in intimate association with the former. Occasional sections show both together, or sphalerite alone, as disseminated grains in the pyrite ore; but commonly their occurrence is as veinlets traversing the section.

THE ORE MINERALS—NORTH MOUNT LYELL MINE.

In the North Mount Lyell workings the same minerals are to be found as at Mount Lyell, but in relative proportion so different as to produce ores of entirely divergent character. Here the minerals, in order of their importance, are bornite, chalcopyrite, chalcocite, tetrahedrite, and pyrite; and these form mineralized zones in the schists and not a great sulphide body as at Mount Lyell, where pyrite is dominant.

Bornite.—The ore mineral of widest development and greatest significance at North Mount Lyell is bornite. It occurs alone, in association with pyrite, and admixed with other copper sulphides. (1) Where occurring alone it forms lenses within the schists and presents no microscopic features of note. (2) In association with pyrite it is confined to quartzose patches and channels of megascopic proportions within a pyrite-quartz rock similar to the typical ore of Mount Lyell. (3) The third type of occurrence is the dominant one. The bornite is in close association with chalcopyrite, or chalcocite (with or without tetrahedrite), or both, and the ore forms lenticular areas and stringers within the inclosing schists. In polished sections scattering pyrite grains show up in ore and gangue alike, and in places granular pyrite aggregates are visible. Toward chalcopyrite, bornite has a varied bearing. While the two are often developed in intimate association, as if intergrown (fig. 2, Pl. 51), there is in other sections a distinctly noticeable tendency for the chalcopyrite to associate itself with granular pyrite aggregates where such occur in the section, and for the bornite in a general way to envelop the association as a whole. In

one section the bornite grains, when examined at 200 diameters, are seen to be bordered by chalcopyrite, or by tetrahedrite, or both. (See fig. 3, Pl. 51.) The relation between bornite and chalcocite is often that indicative of contemporaneity; the boundaries are ordinarily intricate and clear-cut, and good examples of graphic intergrowths were observed. (Figs. 3 and 4, Pl. 50.)

Chalcopyrite.—In addition to the associations with bornite just described, and minor interstitial development in pyrite, chalcopyrite at North Mount Lyell occurs alone inclosed in sericitic or chloritic schists. In polished sections under the microscope the chalcopyrite shows in every proportion from the merest development (fig. 1, Pl. 49) to a solid opaque body with only a scattering of gangue (fig. 2, Pl. 49).

Chalcocite.—So far as studied chalcocite is a rather minor constituent of the ore and is always in close association with bornite. In sections across such specimens the bornite occupies relatively large areas, with the chalcocite occurring here and there in smaller patches either as sharply defined individuals but with marginal lines variously embaying, and embayed in, bornite in the most completely intimate fashion, or rarely as graphic intergrowths. (See fig. 4, Pl. 50.)[1] Such chalcocite is clearly of contemporaneous development with bornite. Sections of this chalcocite, when etched by immersing a few minutes in dilute nitric acid, develop characteristic cleavage lines, as shown in figure 4, Plate 49. In two of the sections studied relatively large areas of bornite were found which assumed a granular character toward their margins, and were encased in pure chalcocite. This structure is suggestive of secondary chalcocite, but no further examples were found and even the ones in question were destroyed when the sections were repolished preliminary to more detailed study. It may be safely said that chalcocite deposited by descending surface waters is an unimportant constituent of the North Mount Lyell ore.

Tetrahedrite.—This mineral is somewhat analogous to enargite at Mount Lyell in that its development is highly localized. Like enargite, too, it is intimately associated with extremely fine chalcopyrite discernible only under high magnification. On the section tetrahedrite appears both as irregular patches up to 10 mm. in diameter, and as sharply defined, exceedingly narrow, marginal zones surrounding bornite grains. In many instances the bounding zone will consist in part of chalcopyrite, the two alternating and together forming a beautifully sharp, irregular zone completely encasing the bornite area. (See fig. 3, Pl. 51.) This mode of occurrence for chalcopyrite is confined absolutely to tetrahedrite-rich areas, and its relationship to bornite is totally different from that in the conventional tetrahedrite-free ores of the North Mount Lyell mine.

[1] These figures closely resemble crystallographic intergrowths of bornite and chalcocite in the copper ores of Virgilina, Virginia. See Laney, Proc. U. S. Nat. Mus., vol. 40, 1911, pl. 68.

PARAGENESIS OF ORE MINERALS.

The one mineral whose genetic relationships are everywhere sharply defined is pyrite. Its bearing toward the other sulphides is clearly that of a mineral of prior development. In most sections, however, there are certain examples of interassociation which suggest that the sulphide development from pyrite onward was one of sequential stages rather than of distinct isolated periods.

Among the copper minerals proper there is nowhere any sharply defined order of sequence such as exists between the group as a whole and the pyrite. Indications point strongly, however, to chalcopyrite as having been the first to follow the lead of the iron sulphide. Its wide diffusion, the intimacy of its occurrence everywhere with the manifestly earlier pyrite, and the frequency with which it is to be found inclosing and enmeshing pyrite clusters with the whole engulfed in bornite, by themselves would be conclusive. Elsewhere, however, chalcopyrite and bornite occur intimately intergrown (see fig. 2, Pl. 51) as if of contemporaneous development. From these two types of relationships the inference would be that a period of chalcopyritization passed into one productive of chalcopyrite and bornite together.

Of the rich copper minerals bornite shows itself not only the one most extensively developed, but the one most intimately associated in order of continuity with chalcopyrite. In some instances it is intergrown with chalcopyrite (fig. 2, Pl. 51); in other instances it is intergrown with chalcocite (fig. 4, Pl. 50); there are also numerous intermediate examples of its occurrence independently of chalcopyrite or chalcocite. These associations point strongly to a period of bornite development that was inaugurated while chalcopyrite was still forming, continued through a period of its own, and closed with simultaneous precipitation of bornite and chalcocite. Certain relations of the latter mineral tend further to indicate that it continued to form for a while after bornite ceased depositing.

Tetrahedrite, occurring as replacement rims to bornite grains, is distinctly later than that mineral. Though never associated with chalcocite so as to indicate relationship, tetrahedrite is judged to be subsequent to it also, since chalcocite is in part contemporaneous with bornite. With tetrahedrite occurs chalcopyrite, in minute proportions, having analogous bearing toward bornite; this chalcopyrite is of course also later than bornite and represents a second generation of chalcopyrite. This chalcopyrite and the tetrahedrite show every indication of synchronous deposition. Their formation is due either to descending waters or is the result of further changes in the primary ore-bearing solutions, dependent upon some specialized condition.

Tetrahedrite at North Mount Lyell is paralleled by enargite at Mount Lyell. Both minerals are of localized occurrence and are

characterized by a close association with chalcopyrite, of specialized development. The enargite forms an apparent fracture-filling in massive pyrite and incloses microscopic ramifications of chalcopyrite. These inclosures do not pass into the adjacent pyrite, nor do they possess any arrangement suggestive of subsequent penetration of the enargite by chalcopyrite-bearing solutions. On the contrary, they present rather strong evidence of simultaneous development along with the enargite, as a kind of a residual crystallization as a result of the molecular adjustment forming enargite. As the enargite has not been affected by the other mineralizing processes it may be inferred that its formation represents a late stage of the depositional epoch.

The microscopic study points unmistakably to the formation of the ores through replacement of the minerals of the schists; and the sericitic and chloritic components have been the first to be attacked and substituted. Gradual transitions from unmineralized rock to solid ore are often seen. In many places a schistose pattern delineated by residual quartzes has been inherited by massive pieces of ore. (See fig. 1, Pl. 50.) In most sections unreplaced shreds and fragments of the original schists may be detected. One section disclosed a hexagonal quartz crystal with embayments filled with pyrite and enargite, showing in striking manner the corrosive effects of sulphide solutions even upon that mineral. (See fig. 1, Pl. 51.) Accompanying dominant replacement a certain amount of interlaminal deposition is also evidenced, but few examples are free from some replacement as well; and this process is merely a preliminary to the dominant one.

The study leads also to the conception that the ore deposition took place during a distinct mineralizing epoch marked by solutions progressively changing in composition and depositing a series of sulphide minerals in sequential and transitional stages. The order of deposition, as evolved, runs from cupriferous pyrite through chalcopyrite, bornite, and chalcocite, to the tetrahedrite-enargite group (accompanied by chalcopyrite of a second generation). From this it must not be inferred that the formation of any one ore mineral was confined to any one period, or that the sequence was absolute; on the contrary there is ample evidence of transitions and overlappings, and many complications undoubtedly intervened to make the process even more involved. What is strongly manifest, however, is that the deposition of any one of the sulphide minerals, in so far as it is a prime essential in the ore as a whole, was confined to some given period in the evolution.

A further generality, so persistently applicable as to seem not without significance, is one involving a relation between three broad features of the principal ore minerals, namely, the proportion between their respective iron and copper contents, the order of deposition evidenced by them, and the extent of their individual participation in

the mineralization. The succession of deposition, as evolved, is in exact harmony with the order of increasing copper content and with that of decreasing iron content. Noting this apparent agreement as the work with the metallographic microscope progressed, a sample of pyrite free from included chalcopyrite, so far as could be detected with even the highest power objective, was tested qualitatively and found to give a copper reaction.[1] While it is by no means certain from this that the copper present in the pyrite is not due to chalcopyrite of submicroscopic order, it is of importance in coordinating the true pyrite with the chalcopyrite; for a dissemination of chalcopyrite so fine as not to be distinguishable under the highest magnification, must have been present during solidification of the pyrite, and from this submicroscopic chalcopyrite there is every gradation up to the megascopically prominent chalcopyrite of the pyrite ore, referred to a position consequent to pyrite in the order of crystallization. Accordingly, starting with what may reservedly be termed cupriferous pyrite, which is at once the most extensively developed and the earliest of the ore group, and passing successively through chalcopyrite, bornite, and chalcocite, the tendency is so marked as to make the different mineral species seem indicative of successive points in a steadily diminishing iron content and increasing copper content in solutions of constantly diminishing quantity.

SECONDARY ENRICHMENT.

This subject can be discussed only in a general way, because few only of the specimens available showed characteristics referable to this process. Also the writings of Sticht and Gregory, while making frequent reference to enrichments in the ore bodies, do not in every instance present criteria suitable for discriminating whether such enrichment is due to descending surface waters, or is merely a special phase of primary deposition; indeed, such criteria are difficult to obtain and a problem of this kind could be successfully attacked only through a metallographic study of specimens collected with this end in view. As the enriched portions of the ore are the ones naturally most completely worked out, such an attainment is obviously impossible.

In general, it may be said that enrichment is more prominent in the Mount Lyell body than in the North Mount Lyell deposit. The latter is marked by a uniformity of its mineral associations excepting a slight increase in proportion of chalcocite to bornite in the lower

[1] This result is the reverse of that obtained by Laney (Bull. 21, North Carolina Geol. and Econ. Survey, 1910, p. 92), Simpson (Econ. Geol., vol. 3, 1908, pp. 628–635), and Finlayson (Econ. Geol., vol. 5, 1910, p. 420), from metallographic study of "cupriferous pyrite" from Gold Hill (North Carolina), Butte (Montana), and Huelva (Spain), respectively; all of whom found that in these ores the copper content is due to definite copper minerals recognizable under the microscope, and where such are not visible the ore is copper-free.

levels. The pyrite mass, however, is not homogeneous throughout in values. Its footwall portion is richer in copper, gold, and silver than its hanging-wall portion, and several places about its periphery, but especially on the footwall side, are characterized by bonanzas formed of important admixtures of copper or silver sulphides, or both. Such areas of higher values are principally border phenomena; in the heart of the ore body only one such occurrence has been noted. This was a small, pipelike zone running from 3 to 6 per cent copper, due to chalcopyrite, and extended vertically from about the 400 to 500 foot level.

In the ore sections studied evidences of secondary enrichment were largely lacking. In certain specimens, however, chalcocite of probable secondary deposition was recognized as different from other and predominant chalcocite, which was in part of contemporaneous formation with the bornite and ever in sequential genetic relation with the other primary sulphides. Certain areas of tetrahedrite and chalcopyrite also showed relations suggestive of secondary origin.

GENESIS OF DEPOSITS.

To recapitulate, the ore deposits are of two kinds: (1) Great lens-shaped masses of nearly pure sulphide ores, the Mount Lyell type, and (2) mineralized bands of schist (fahlbands), the North Mount Lyell type. Microscopic study of the ores shows that this difference is one of degree and not of kind, and indicates that the same set of ore-bearing solutions gave rise to both kinds of deposition. Gregory [1] has discussed at length the ore genesis, and his conclusions may be briefly summarized as follows: Alkaline ore-bearing waters, rising along fault planes during the period of faulting, absorbed heat generated by these earth movements. With decreased pressure and lowered temperature incident upon approach to the surface, they deposited their content, forming fahlbands in the less shattered portions of the schists and producing replacement masses in the highly shattered and extremely permeable areas adjacent to fault loci. The deposition, therefore, is regarded as "due to tectonic and not to igneous action." Gregory does not explain the ultimate origin of the solutions nor of their metallic contents.

Consideration of the microscopic features of the ores has led the writers to believe that Gregory's explanation is not entirely adequate, and that the ore-bearing solutions were a deep-seated development from a differentiating mass of igneous rocks [2] and that these solutions rose along structurally developed channels, changing gradually in composition from the beginning to the end of the depositional epoch.

[1] Australian Inst. Min. Eng., vol. 10, 1905, pp. 145–156.

[2] A similar conception was developed by Spurr in 1907 (A theory of ore deposition, Econ. Geol., vol. 2, 1907, pp. 781–795) and later further elaborated by him (Econ. Geol., vol. 7, 1912, pp. 485–492). Finlayson applies a somewhat similar explanation to the origin of the Huelva pyrite deposits.

That the ore deposition was conditioned by structural features and represented a combination of replacement and impregnation, with predominance of the former, seems conclusive and needs no further elaboration here.

ANALOGOUS DEPOSITS.

Cupriferous pyritic deposits of the Mount Lyell type play so important a part in the world's copper reserve [1] and present features of such general interest that it may be profitable to review briefly the significant geological characteristics of the leading representatives.

Ural Mountains.[2]—Numerous lenses and sheets of massive cupriferous pyrite, occurring in schists and greenstones of the Ural Mountains, contribute to the copper output of that region. The pyritic ore runs about 3 per cent in copper, due to later interstitial chalcopyrite, which is associated with some sphalerite and galena, and in one mine, bornite. Both the wall and ore are cut by joint seams carrying enrichments of chalcopyrite and tennantite mixed with white vein quartz and sometimes barite; these are distinctly later than the pyrite, though not necessarily attributable to the action of descending waters. The masses are replacement deposits in the schistose rocks.[3]

Norway.—Copper-bearing pyritic ores are extensively developed in this country, the districts of greatest import being the Sulitelma, north of the Arctic circle, and the Röros and the Meraker near Trondhjem in central Norway. These deposits, which are notably similar in character, are lenticular masses of pyrite, with admixed chalcopyrite, averaging from 2½ to 3 per cent copper, and occurring within crystalline schists alongside intrusive masses of gabbro, or soda granite. The bodies are comparatively small in horizontal dimensions, rarely exceeding 60 feet in width, but extend downward to great depths. According to Vogt [4] they originated from solutions which were expelled from the intruding gabbroid and related granitic masses, and deposited their metallic content along the slipping planes of the schists during their metamorphism.

Rammelsberg.—The oft-discussed deposits of Rammelsberg, in the Hartz Mountains of central Germany, consisting of pyrite with chalcopyrite, galena, sphalerite, arsenopyrite, barite, etc., intercalated in metamorphosed clay slates, have been cited [5] as analogous to the Mount Lyell occurrence. According to Lindgren and Irving,[6] how-

[1] The importance of this type of copper deposit is apt to be underestimated in the United States where copper is obtained largely from ores of an entirely different order. Abroad the dominant type of copper deposit is pyritic.

[2] Turner, Mining Mag., June, 1912.

[3] Turner, Econ. Geol., vol. 7, 1912, p. 709. Knox, idem, pp. 295–297.

[4] Trans. Amer. Inst. Min. Eng., vol. 31, 1901, p. 141. (See also, Weed, The copper mines of the world, 1907, pp. 103–106. Beck-Weed, The nature of ore deposits, 1905, vol. 2, pp. 462–465.)

[5] See Gregory, Australasian Inst. Min. Eng., vol. 10, 1905, pp. 179–181

[6] Econ. Geol., vol. 6, 1911, pp. 303–313.

ever, the ore itself has been dynamically metamorphosed, the sulphide mass (excepting the pyrite which, being too hard, has suffered shattering only) having flowed like "thick muck."

Huelva, Spain.[1]—The greatest single copper-producing district abroad, ranking fourth among those of the world, occupies an east-west mineralized zone, lying mainly in the Province of Huelva, southern Spain, and including the well-known deposits at Tharsis and Rio Tinto. The ore is massive, homogenous pyrite, carrying chalcopyrite and subordinate associated galena and sphalerite, with local enrichments of chalcocite and minor bornite. The ore-bodies are lenticular masses, many in number and ranging up to enormous sizes (largest about 3,000 by 600 by 1,500 feet) and are mainly inclosed within those portions of Paleozoic slates and intrusive porphyries that have suffered severe dynamic metamorphism and been converted into schists (chiefly sericitic). The ore bodies are in proximity to extensive intrusions of acid and basic igneous rocks, showing advanced differentiation, and are usually located along lines of more or less fault movement. Microscopic examination of the ores by Finlayson results in the following conclusions:[2] (1) The copper occurs as a definite mineral in the ore and is not chemically combined with the pyrite. (2) The primary minerals have deposited in the following order: pyrite, chalcopyrite, sphalerite, galena. (3) The ore bodies have been secondarily enriched; in the lean deep ores chiefly by a change of chalcopyrite to chalcocite, and in the richer, or shallower ores, chiefly by a deposition of chalcopyrite followed by chalcocite. Bornite occurs in very subordinate amounts, and appears intermediate in formation between chalcopyrite and chalcocite. (4) The only primary copper mineral is judged to be chalcopyrite; the other copper minerals appear to have resulted from descending solutions.

The deposits are conceived by Finlayson to be due to the replacement of altered rocks by solution, rising along structural planes of maximum permeability, and originating through concentration by border segregation in deep-seated igneous rocks prior to their final intrusion and consolidation.

Shasta County, California.[3]—The deposits of this important copper district comprise numerous and extensive lenses of cupriferous pyrite inclosed within mashed alaskite-porphyry, which near the ore bodies is practically a schist, containing considerable sericite (with paragonite) and chlorite. The ore, which averages 3 to 3½ per cent copper, is pyrite with chalcopyrite and subordinate sphalerite and in less amounts still, galena, bornite, and chalcocite; the gangue is quartz, calcite, and barite. The deposition is attributed to replacement of the schistose rock by solutions, expelled from nearby igneous rocks

[1] Finlayson, The pyritic deposits of Huelva, Spain. Econ. Geol., vol. 5, 1910, pp. 356–372 and 403–437.
[2] Idem, p. 420.
[3] Graton, Bull. 430, U. S. Geol. Survey, 1910, pp. 71–111.

upon their final consolidation, which found congenial conditions for precipitation in the more schistose phases of the alaskite-porphyry where this rock presented maximum permeability and surface of attack.

Of the ore minerals pyrite was the first to crystallize in most instances; sphalerite, on the whole, is later. Chalcopyrite is the youngest of the important minerals, forming veinlets around and in other sulphides; it prefers the company of sphalerite to pyrite and shows also an affinity for quartz and barite. Primary bornite is commonly associated with chalcocite, and the two either take the place of chalcopyrite or are intimately associated with it. Secondary bornite and chalcocite are also present, but are readily distinguished from the former.

Ducktown, Tennessee.[1]—These important deposits, which are notable for successful working of low-grade ore, form lenticular to tabular masses, inclosed within deeply dipping schists of sedimentary origin, and represent limestone intercalations which have suffered replacement by ore-bearing solutions from probable magmatic sources. The primary ores consist of pyrrhotite and pyrite with chalcopyrite and subordinate sphalerite; these are associated with specularite, magnetite, actinolite, calcite, tremolite, quartz, pyroxene, garnet, zoisite, chlorite, mica, graphite, titanite, and feldspar. Secondary enrichment has proved of importance only near the surface, where chalcocitization has taken place in a narrow zone rarely over a few feet in thickness, between the gossan and primary sulphide zone. The Ducktown occurrence is not a strict analogue of the Mount Lyell deposit, though presenting many features in common.[2]

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Same as preceding.

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[1] Emmons and Laney, Preliminary report on the mineral deposits of Ducktown, Tennessee. Bull. 470, U. S. Geol. Survey, 1910, pp. 151–172.

[2] From the foregoing review it is seen that the great cupriferous pyrite deposits of the world are strikingly alike in their geologic relations, mineralogic content, and origin. It may therefore be generalized that any region of schistose rocks (especially sericite and chlorite schists) that is intruded by a differentiated series of igneous rocks, is one favorable to the occurrence of such deposits, and where in such regions gossans are found, which in their outcrops show values in gold and silver and the presence of barite, lenses of cupriferous pyrite at depth may be anticipated with considerable confidence.

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Text-figure: Sketch map of the Mount Lyell District. (Modified from Gregory.)

EXPLANATION OF PLATES.

PLATE 48.

Fig. 1. Polished section of typical cupriferous pyrite ore from Mount Lyell Mine, showing schistose pattern resulting from replacement. Natural size. Cat. No. 77549.

2. Polished section of pyrite (light) with seams and veins of enargite (dark). Mount Lyell Mine. Natural size. Cat. No. 77552.

PLATE 49.

Fig. 1. Incipient stage of replacement. Chalcopyrite (white) subordinate to gangue (gray). × 30. North Mount Lyell Mine. Cat. No. 77571.

2. Advanced stage of replacement. Chalcopyrite (light) predominating over gangue (dark). × 30. North Mount Lyell Mine. Cat. No. 77571.

3. Chalcopyrite (dark) cementing granulated and shattered pyrite (light). × 30. Mount Lyell Mine. Cat. No. 77549. Shows that the chalcopyrite was developed later than the pyrite.

4. Area of primary chalcocite, showing characteristic cleavage developed by etching with dilute nitric acid. × 30. North Mount Lyell Mine. Cat. No. 77593.

PLATE 50.

Fig. 1. Enargite field (light) including minute ramifications of chalcopyrite (dark). Pyrite grain to left of section. × 30. Mount Lyell Mine. Cat. No. 77552.

2. Portion of enargite field of figure 1, enlarged to 180 diameters, showing the included chalcopyrite (dark). The latter, though appearing so in the photograph, is probably not a fracture filling in the enargite, but of contemporaneous development.

3. Bornite (dark) and chalcocite (light), showing crystallographic intergrowth between the two, indicative of simultaneous development. × 30. North Mount Lyell Mine. Cat. No. 77593.

4. Crystallographic intergrowth of bornite (dark) and chalcocite (light). Portion of figure 3 with magnification × 120. North Mount Lyell Mine. Cat. No. 77593.

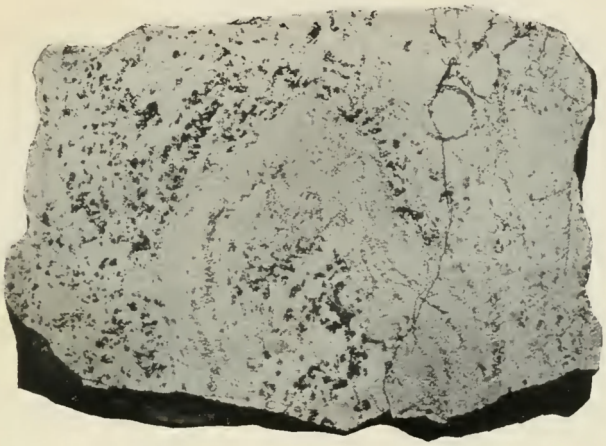
PLATE 51.

Fig. 1. Quartz crystal partly replaced by enargite (light) and pyrite (dark). The black areas are irregularities in the section. × 40. Mount Lyell Mine. Cat. No. 77552.

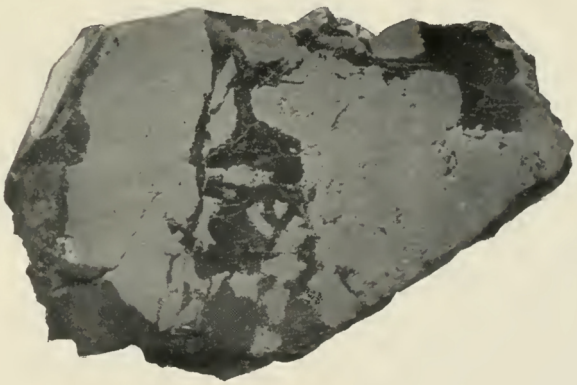
2. Intergrowth of bornite (dark) and chalcopyrite (light), indicative of simultaneous development. North Mount Lyell Mine. × 40. Cat. No. 77601.

3. Grain of bornite (*b*) in gangue (*g*), surrounded by border of tetrahedrite and chalcopyrite (white). The tetrahedrite and chalcopyrite can not be differentiated in the photograph, but their relations to bornite are similar; they were probably developed simultaneously and are later than the bornite. × 200. North Mount Lyell Mine. Cat. No. 77597.

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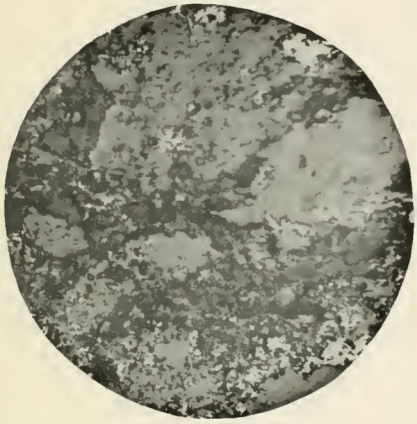
1



2

POLISHED SECTIONS OF ORE.

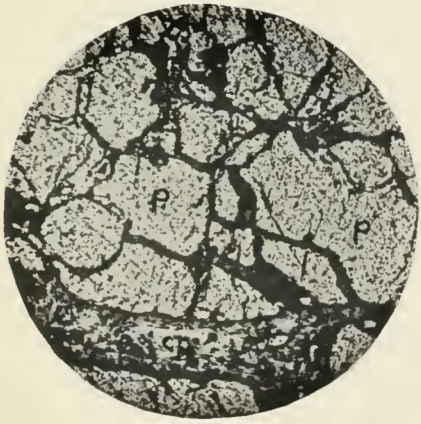
FOR EXPLANATION OF PLATE SEE PAGE 624.



1



2



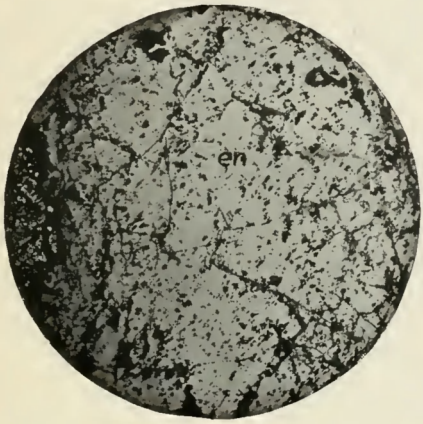
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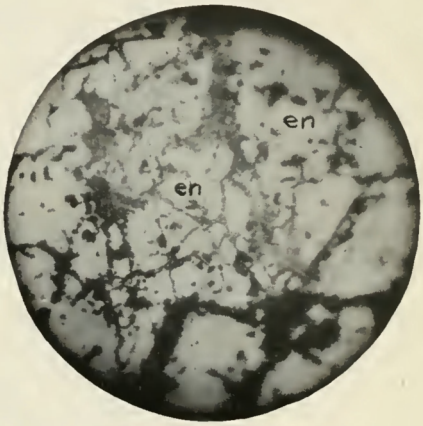
4

PHOTOMICROGRAPHS OF POLISHED ORE SECTIONS

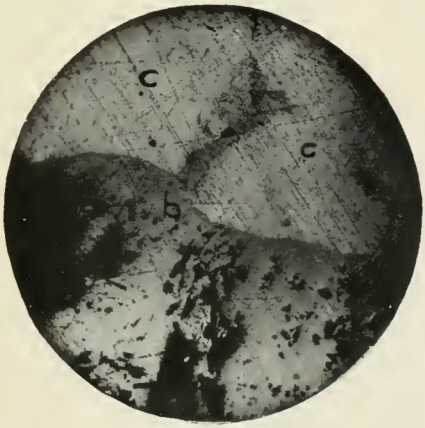
FOR EXPLANATION OF PLATE SEE PAGE 624.



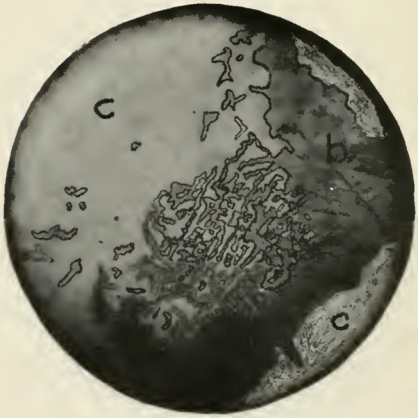
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2



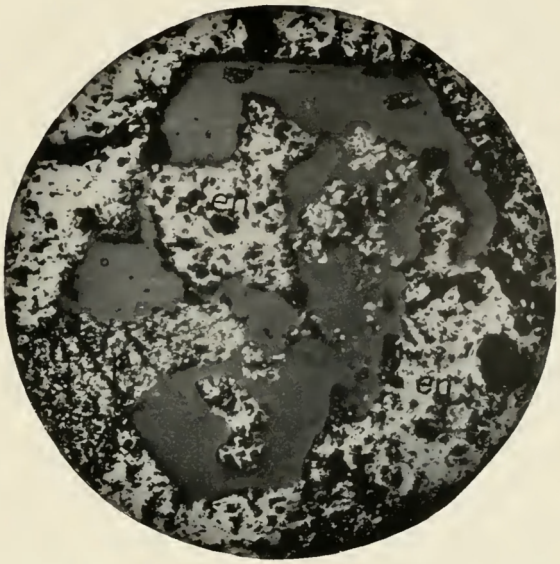
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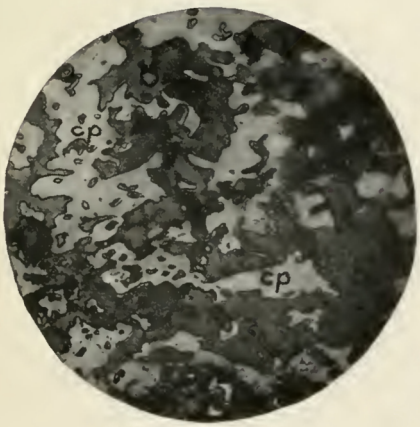
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PHOTOMICROGRAPHS OF POLISHED ORE SECTIONS.

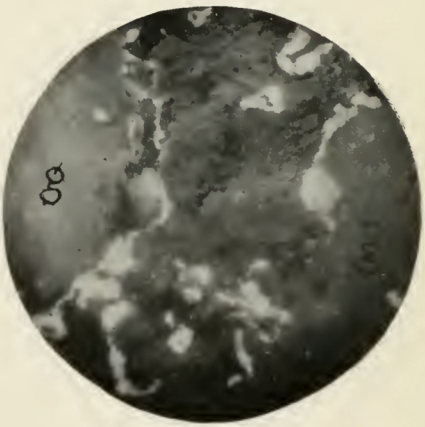
FOR EXPLANATION OF PLATE SEE PAGE 624.



1



2



3

PHOTOMICROGRAPHS OF POLISHED ORE SECTIONS.

FOR EXPLANATION OF PLATE SEE PAGE 625.

RESULTS OF THE YALE PERUVIAN EXPEDITION OF 1911. LEPIDOPTERA.

By Harrison G. Dyar,

Custodian of Lepidoptera, United States National Museum.

A large part of the species of Lepidoptera could not be found in the collection of the United States National Museum at Washington, and I accordingly enlisted the aid of Mr. William Schaus, who very kindly compared the specimens in London. He submitted certain specimens to various specialists, to all of whom my thanks are cordially extended. The collection contains 242 species, here listed.

Family PAPILIONIDÆ.

PAPILIO PÆON Boisduval.

Cotahuasi, 9,000 feet, October 11, 1911.

Machupichu, 1912.

PAPILIO MADYES MONTEBANUS, new subspecies.

Submarginal spots of hind wing above slender, incised, nearly divided, white in the male, yellow in the female, white edge of the wings very broad in the incisures between the veins. Otherwise as in *P. m. chlorodamas* Guenée.

Cotypes.—Male and female, Cat. No. 15599, U.S.N.M., San Miguel, 6,000 feet, September 1, 1911.

Family PIERIDÆ.

ACMEPTERON NEMESIS Latreille.

Paltaybamba, 5,000 feet, August 28, 1911.

ENANTIA TERESA Hewitson.

Pampaconas River, August, 1911.

CATASTICTA MODESTA Lucas.

San Miguel, 6,000 feet, September 1, 1911.

CATASTICTA MANCO Doubleday.

Tincochaca, 7,000 feet, August 9, 1911.

Mr. Schaus notes that the specimens are "very near *manco.*" From the *manco* in the collection they differ in the whiter ground color and reduced submarginal dark band of hind wings, but the differences are not marked.

CATASTICTA WATKINSI Lathy and Rosenberg.

San Miguel, 5,000 feet, September 1, 1911.

Mr. Rosenberg kindly compared the specimen with a cotype and notes "agrees in markings with that species, but is very much paler. Probably a local race of that species."

CATASTICTA PRIONERIA Hopffer.

Pampaconas River, August, 1911.

CATASTICTA STRAMINEA Butler.

Pampaconas River, August, 1911.

CATASTICTA CORCYRA Felder.

Pampaconas River, August, 1911.

Determined by Mr. Schaus. This species has departed widely from the characteristic appearance of *Catasticta*.

HESPEROCHARIS CATOGRAMMA Kollar.

Huadquina, 5,000 feet, August 1, 1911.

TATOCHILA MACRODICE Staudinger.

Cotahuasi, 9,000 feet, October, 1911.

Chuquibamba, 10,000 feet, October, 1911.

TATOCHILA THEODICE Boisduval.

Cantas, 2,000 feet, November, 1911.

Cotahuasi, 9,000 feet, October, 1911.

Chuquibamba, 10,000 feet, October, 1911.

Coropuna, 14,500 feet, October, 1911.

The borders of the veins of the hind wings below are gray, not black as usual.

PIERIS ELODIA Boisduval.

Huadquina, 5,000 feet, August 1, 1911.

San Miguel, 6,000 feet, September 10, 1911.

PIERIS TOVARIA Filder.

Pampaconas River, August, 1911.

PIERIS ELEONE Doubleday.

Huadquina, 5,000 feet, July 26, 1911.

San Miguel, 6,000 feet, September 1, 1911.

PHULIA ALTIVOLANS, new species.

Male white, a black patch at end of cell, bar along costa and veins at apex black. Female yellowish, the markings more extensive; a submarginal band on fore wing; hind wing with the veins, a row of submarginal dots and streak in cell of dark color. Beneath with the pattern of *illimani* Weymer, but more diffused, no white showing and without the terminal red line. It is close to *nympha* Staudinger[1] from the high mountains of Bolivia, but the wings are less heavily marked with black above and the shades on veins and below are very pale gray.

[1] Iris, vol. 7, 1894, p. 46.

Cotypes.—Three males, two females, Cat. No. 15600, U.S.N.M., Cotahuasi, 9,000 feet, October, 1911; Coropuna, 14,500 feet, October, 1911.

PHULIA NANNOPHYES, new species.

White; fore wing with a black patch at the end of the cell, detached from costa, short subapical stripe from costa and marginal spots to vein 3. Hind wing with minute central dot. Beneath, hind wing pale yellow, veins broadly faintly lined in brown; a black streak in humeral angle, in cell, and a double one in submedian area; a row of five square spots in submarginal row, continued by the short submedian streaks. Expanse, 19–21 mm.

Cotypes.—Two males, Cat. No. 15601, U.S.N.M., Coropuna, 14,500 feet, October, 1911.

ANDINA COROPUNÆ, new species.

Wings white; fore wing with costa and narrow wavy outer border black; a group of diffuse spots before apex above vein 5; a small spot on discal cross-vein. Beneath, tip of fore wing and all of hind wing purplish gray, the hind wing darker irrorate toward base, with very faint traces of outer dark spots. Expanse, 37 mm.

Type.—Cat. No. 15602, U.S.N.M., Coropuna, 16,000 to 17,000 feet, October, 1911.

Smaller than *A. huanaco* Staudinger, with much less of black on fore wing above, the hind wing purplish tinted, without spots and with a very strong humeral angle, more so than in *huanaco.*

COLIAS EUXANTHE Felder.

Tincochaca, 7,000 feet, August 9, 1911.
Urubamba, 9,500 feet, July 16, 1911.
Cuzco, 11,500 feet, July 10, 1911.
Coropuna, 14,500 feet, October, 1911.

COLIAS LESBIA Fabricius.

Cotahuasi, 9,000 feet, October, 1911.
Urubamba, 9,500 feet, July 16, 1911.
Cuzco, 11,500 feet, July 4, 1911.
All albino females, no males of this species in the collection.

TERIOCOLIAS PACIS Röber.

Ollantaytambo, 9,000 feet, July 21, 1911.
Urubamba, 9,500 feet, July 11, 1911.
Chuquibamba, 10,000 feet, October, 1911.

TERIOCOLIAS ATERIAS Hewitson.

Urubamba, 9,500 feet, July 17, 1911.

TERIAS MUSA Fabricius.

San Miguel, 6,000 feet, September 1, 1911.

TERIAS PLATAEA Felder.

Huadquina, 5,000 feet, August 1, 1911.
San Miguel, 6,000 feet, July 24, 1911.

TERIAS ÆQUATORIALIS Felder.

Huadquina, 5,000 feet, July 26, 1911.

Paltaybamba, 5,000 feet, August 25 and 28, 1911.

San Miguel, 6,000 feet, July 24 and September 1, 1911.

Torontoy, 7,000 feet, July 23, 1911.

TERIAS TENELLA Boisduval.

Urubamba, 9,500 feet, July 16, 1911.

TERIAS PHIALE Cramer.

Paltaybamba, 5,000 feet, August 28, 1911.

TERIAS, species.

Huadquina, 5,000 feet, August 1, 1911.

One female, which Mr. Schaus labels "Not in British Museum nor collection of Godman." The species is probably undescribed, but it seems unwise to found a new name on the female alone.

STYX INFERNALIS Staudinger.

Pampaconas River, August, 1911.

Tincochaca, 7,000 feet, August 9, 1911.

Family DANAIDÆ.

DANAIS ERIPPUS Cramer.

Cantas, 2,000 feet, November, 1911.

CERATINIA CÆNO Doubleday and Hewitson.

Huadquina, 5,000 feet, July 20 and 26, 1911.

EPISCADA CANILLA Hewitson.

Lucma, 7,000 feet, August 25, 1911.

ITHOMIA AGNOSIA Druce.

Paltaybamba, 5,000 feet, August 28, 1911.

PTERONYMIA VEIA Hewitson.

Paltaybamba, 5,000 feet, August 28, 1911.

SCADA ORTYGIA Druce.

Huadquina, 5,000 feet, July 26, 1911.

San Miguel, 6,000 feet, July 24, 1911.

Lucma, 7,000 feet, August 25, 1911.

Family ARCÆIDÆ.

ACTINOTE GRISEATA Butler.

Pampaconas River, August, 1911.

ACTINOTE CALLIANIRA Hewitson.

Pampaconas River, August, 1911.

ACTINOTE NICYLLA Hopffer.

Paltaybamba, 5,000 feet, August 28, 1911.

ACTINOTE BINGHAMÆ, new species.

Nearest to *A. eresia leptoneura* Jordan. Body black; a sublateral orange-red stripe crossed by a fine black line; some yellow brown shading on collar. Fore wing black, tinged with brown terminally; the cell from near base to near end orange red, crossed by an oblique black line to origin of vein 2; a similar shade below cell not reaching

submedian, but more extended outwardly and crossed by vein 2, which is black; a subapical pale yellow fascia intersected by veins. Hind wing paler orange-red, the inner margin whitish yellow; a space at base, the veins, streaks on interspaces and termen black, the latter very narrowly black toward anal angle. Beneath, fore wing pale reddish to postmedial area; costa and terminal space olive yellow; veins black with similar streaks on interspaces from vein 2 to vein 8; a black median line across middle of cell and irregular black shading on discocellular; a postmedial broad black line, oblique from vein 11 to vein 3, a spot below 3 and a vertical shade from vein 2 to inner margin; subapical fascia faintly indicated. Hind wing below olive yellow, the veins and intervenal streaks black; a reddish shade at base of costa and below cell, followed by a macular black line; a fine postmedial black line, inbent and irregular; a broad terminal dull brown shade. Expanse, 47 mm.

Type.—Female, San Miguel, 5,000 feet, September 1, 1911.

Named in honor of Mrs. Alfreda Mitchell Bingham, of New Haven, Connecticut.

Family HELICONIIDÆ.

HELICONIUS TELESIPHE Hewitson.

Paltaybamba, 5,000 feet, August 28, 1911.

HELICONIUS MELPOMENE HYPERPLEA, new subspecies.

Black; fore wing with the red patch large and full, the edge rather irregular, filling out below roundedly to vein 1, which it broadly borders for some distance not squarely cut off above this vein as in most forms of melpomene. No basal marking. Hind wing below as in *melpomene*.

Cotypes.—Two specimens, No. 15606, U.S.N.M., Paltaybamba, 5,000 feet, August 6, 1911.

Family NYMPHALIDÆ.

Subfamily NYMPHALINÆ.

COLAENIS TELESIPHE Hewitson.

Paltaybamba, 5,000 feet, August 28, 1911.

AGRAULIS JUNO Felder.

Cotahuasi, 9,000 feet, October, 1911.

AGRAULIS GLYCERA Felder.

Cotahuasi, 9,000 feet, October, 1911.

AGRAULIS VANILLÆ Linnæus.

Ollantaytambo, 9,000 feet, July 20, 1911.

The specimens represent a variety, smaller and with somewhat modified markings.

PHYCIODES PEARCII Druce.

Pampaconas River, August, 1911.

Huadquina, 5,000 feet, July 26, 1911.

San Miguel, 6,000 feet, July 24, 1911.

Torontoy, 7,000 feet, July 23, 1911.

PHYCIODES ELIA Hewitson.

Pampaconas River, August, 1911.

Paltaybamba, 5,000 feet, August 28, 1911.

PHYCOIDES OMOSIS, new species.

Black, dusted with ocher scales; fore wing with a white patch across end of cell, more or less obsolete, and a more distinct spot above vein 3; a broken powdery subterminal line, looped in at the outer spot. Hind wing with three submarginal wavy ocher lines, the inner two less distinct. Beneath, fore wing with the base dull olive, disk black; the white bars more distinct than above; margin fulvous and brown with waved brown submarginal line bent in at white bar and two rounded black spots above. Hind wing pale, with purplish and brown shades; basal area mottled, with a large brown patch in the cell and wavy shaded mesial line; outer row of four heart-shaped black spots outlined in purplish; submarginal line as on fore wing, preceded by purplish, tending to form lunules; margin yellow-brown.

Cotypes.—Seven specimens, Cat. No. 15604, U.S.N.M., Pampaconas River, August, 1911.

Mr. Schaus labeled a specimen "Between *nana* Druce, *nussia* Druce and a MSS. label of Staudinger in the Godman collection."

PHYCIODES BIRIVULA, new species.

Black above, dusted with yellow; spots of fore wing yellowish white; a narrow one in cell and oblique one at end, two minute subapical, two rounded submarginal, one above vein 4 and vein 2, the latter larger and further from the margin; submarginal line wavy, broken, obsolete above. Hind wing with two submarginal lines, wavy, the inner not reaching costa. Beneath, fore wing yellowish dusted at base, disk broadly black, spots repeated; margin marbled with brown, with submarginal pale line repeated. Hind wing pale lilacine at basal half, outer half strongly blotched with brown, wavy confused brown lines, the brown forming a quadrate costal patch near middle and inclosing the outer row of six black spots, which form a dislocated row; a submarginal waved, crescentic, pale band.

Type.—Cat. No. 15605, U.S.N.M., San Miguel, 6,000 feet, July 24, 1911.

Mr. Schaus labels it "Near *P. abazia* Stgr."

PHYCIODES TELTUSA Godart.

Pampaconas River, August, 1911.

ERESIA POLINA Hewitson.

Pampaconas River, August, 1911.

ANARTIA FATIMA Fabricius.

Panama Canal Zone, June 16, 1911.

PYRAMEIS RUBIA Staudinger.

Tincochaca, 7,000 feet, August 9, 1911.

PYRAMEIS CARYE Hübner.
San Miguel, 5,000 feet, September 1, 1911.
Cotahuasi, 9,000 feet, October, 1911.
Chuquibamba, 10,000 feet, October, 1911.
Cuzco, 11,500 feet, July 4, 1911.

JUNONIA LAVINIA Cramer.
Huadquina, 5,000 feet, July 31, 1911.

JUNONIA VESTINA Felder.
Cuzco, 11,500 feet, July 4, 1911.

EUREMA ZABULINA Godart.
Huadquina, 5,000 feet, July 30, 1911.

EUREMA KEFERSTEINI Doubleday and Hewitson.
Pampaconas River, August, 1911.

CALLICORE LIDWINA Felder.
Paltaybamba, 5,000 feet, August 28, 1911.

CYBDELIS CECIDA Hewitson.
Pampaconas River, August, 1911.
Paltaybamba, 5,000 feet, August 28, 1911.

EUBAGIS SALPENSA Felder.
Huadquina, 5,000 feet, July 26, 1911.

EUBAGIS THALASSINA Hewitson.
Panama, June 17, 1911.

TEMENIS LAOTHŒ Cramer.
Pampaconas River, August, 1911.

PERIDROMIA FERONIA Linnaeus.
Panama, June 12, 1911.

TIMETES CHIRON Fabricius.
Cuzco, 11,500 feet, July 10, 1911.

ADELPHA OBERTHURI Boisduval.
Pampaconas River, August, 1911.

ADELPHA ALALA Hewitson.
Pampaconas River, August, 1911.

ADELPHA SAUNDERSI Hewitson.
Pampaconas River, August, 1911.
Tincochaca, 7,000 feet, August 9, 1911.

ANAEA CAMBYSES Druce.
Paltaybamba, 5,000 feet, August 6, 1911

ANAEA TITAN Felder.
Pampaconas River, August, 1911.

Subfamily SATYRINÆ.

ORESSINOMA TYPHLA Doubleday and Hewitson.
Paltaybamba, 5,000 feet, August 6, 1911.

LYMANOPODA EUBAGIOIDES Butler.
San Miguel, 6,000 feet, July 24, 1911.

LYMANOPODA SHEFTELI, new species.

Fore wing white, blue-gray at base, costa reddish, then black, spreading over apex, cut off squarely along vein 4, broad marginal border to vein 2, narrow to tornus, containing a white spot beyond cell and row of four before margin, the lower dot minute and farther from the margin. Hind wing with black powdering along the edge and spot between veins 5 and 6. Beneath the apex of fore wing brown. Hind wing with veins brown, the wing with many brown strigæ and three bands, one from costa to origin of vein 2, second from apex to inner margin, with a branch to above tornus, third submarginal; five white, black-ringed ocelli in a curved row from apex along the branch of second line.

Cotypes.—Two specimens, Cat. No. 15615, U.S.N.M., San Miguel, 6,000 feet, September 1, 1911; Torontoy, 7,000 feet, July 23, 1911.

Named in honor of Mr. Herbert Sheftel of New York.

LYMANOPODA ACRAEIDA Butler.

Pampaconas River, August, 1911.

Tiocochaca, 7,000 feet, August 9, 1911.

LYMANOPODA LANASSA Felder.

Pampaconas River, August, 1911.

San Miguel, 6,000 feet, July 24, 1911.

LYMANOPODA HARKNESSI, new species.

Brown-black, with red-brown reflections, no markings above. Beneath, fore wing with two parallel brown lines near the margin, wavy, containing a yellow dot above and small ocellus below; hind wing slightly purplish variegated; a curved brown inner band; two submarginal lines as on fore wing with two yellow dots either side of vein 2; marginal half paler, especially broadly about tornus.

Cotypes.—Three specimens, Cat. No. 15616, U.S.N.M., Pampaconas River, August, 1911; San Miguel, 6,000 feet, July 24, 1911.

Named in honor of Mr. Edward S. Harkness of New York.

LYMANOPODA KEITHI, new species.

Brown above, fore wing blackish in the cell; hind wing with two small red-ringed ocelli before anal angle and vein 2. Below, fore wing with two distant lines, the outer crenulate and near the margin. Hind wing with a broad straight white band beyond the cell, yellow tinged toward costa; beyond, bright brown; four black ocelli with white specks in centers, one large between veins 5 and 6, specks only between 4–5 and 3–4, large between 2–3, two before vein 2, the inner minute; a coarsely waved submarginal brown line.

Cotypes.—Three specimens, Cat. No. 15617, U.S.N.M., Pampaconas River, August, 1911.

Mr. Schaus labeled this as in the British Museum without name.

Named in honor of Mr. Minor C. Keith of New York.

LYMANOPODA FERRUGINOSA Butler.

Pampaconas River, August, 1911.

LYMANOPODA OBSOLETA Doubleday and Hewitson.

Pampaconas River, August, 1911.

Paltaybamba, 5,000 feet, August 28, 1911.

LYMANOPODA APULEIA Hopffer.

Pampaconas River, August, 1911.

PEDALIODES PANYASIS Hewitson.

Tincochaca, 7,000 feet, August 24, 1911.

PEDALIODES PORIMA Hewitson.

Paltaybamba, 5,000 feet, August 6, 1911.

San Miguel, 6,000 feet, July 24, 1911.

STEROMA BEGA Doubleday and Hewitson.

Tincochaca, 7,000 feet, August 10, 1911.

STEROMA UMBRACINA Butler.

Tincochaca, 7,000 feet, August 9, 1911.

EUPTYCHIA CAMERTA Cramer.

Panama, Canal Zone, June 16, 1911.

The small form with row of six large ocelli on hind wing below.

Paltaybamba, 5,000 feet, August 6, 1911.

Huadquina, 5,000 feet, July 30, 1911.

The large form with the ocelli on the wings below very minute, the surface dusted with yellow scales.

EUPTYCHIA HOTCHKISSI, new species.

Wings gray brown with two black wavy submarginal lines, no ocelli above. Below, fore wing with two straight parallel distinct median lines, two submarginal lines; a small ocellus before them above vein 5. Hind wing washed with bluish white to beyond cell; two parallel straight median brown lines; four large ocelli, the first and fourth with black centers and double white pupils, the two central ones grayish; two submarginal lines.

Type.—Cat. No. 15618, U.S.N.M., Pampaconas River, August, 1911.

Named in honor of Mr. H. Stuart Hotchkiss of New Haven, Connecticut.

EUPTYCHIA LEGUIA-LIMAI, new species.

Above, brown; a coarsely waved faint submarginal line. Below, wings finely strigose; fore wing with outer line shaded with lighter brown; space beyond pale, more lilaceous; a wavy submarginal line; margin beyond it browner. Hind wing with two slightly wavy median lines; space between filled with darker brown, with brighter edges; margin as on fore wing; minute points representing ocelli.

Cotypes.—Seven specimens, Cat. No. 15619, U.S.N.M., Huadquina, 5,000 feet, July 26, 1911; Paltaybamba, 5,000 feet, August 28, 1911; San Miguel, 6,000 feet, July 24, 1911.

Named in honor of Hon. A. B. Leguia-Lima, a former president of Peru.

LASIOPHILA ZAPATOZA Westwood.
San Miguel, 6,000 feet, September 1, 1911.

OXEOSCHISTUS PRONAX Hewitson.
Huadquina, 5,000 feet, July 26, 1911.

TAYGETIS CELIA Cramer.
Pampaconas River, August, 1911.

MYGONA PROCHYTA Hewitson.
San Miguel, 5,000 feet, September, 1911.
The specimen is of the form *chyprota* Grosse-Smith.

PRONOPHILA PORSENNA Hewitson.
Pampaconas River, August, 1911.

Subfamily BRASSOLINÆ.

CALIGO ILIONEUS Cramer.
Huadquina, 5,000 feet, July 26, 1911.

Family RIODINIDÆ.

ANCYLURIS MELIBŒUS Fabricius.
Pampaconas River, August, 1911.

CHARIS GYNÆA Godart.
Panama Canal Zone, June 17, 1911.

Family LYCÆNIDÆ.

THECLA CANDAR H. H. Druce.
Tincochaca, 7,000 feet, August 9, 1911.

THECLA OCRISIA Hewitson.
Pampaconas River, August, 1911.
Huadquina, 5,000 feet, August, 1911.
The specimens are of the form *peruviana* Eschscholtz.

THECLA TYLERI, new species.

Near *yojoa* Reakirt. Beneath grayer, less reddish, the lines of both wings straighter, not broken nor scalloped, rounded below, not angled, without red bordering scales; marginal ocellus small, without red; no red at anal angle.

Type.—Cat. No. 15620, U.S.N.M., Coropuna, 14,500 feet, October, 1911.

Named in honor of Mr. Victor Tyler, of New Haven, Connecticut.

THECLA BENNETTI, new species.

Bright metallic blue above; fore wing with a darker, less metallic patch on the disk; outer margin black, broadest at apex and gradually narrowing to tornus. Hind wing black on costa and apex, outer margin very narrowly so; long tail at end of vein 2, shorter one at 3, both white tipped. Beneath, blackish gray with ocher tint; fore wing with the median line straight, white, black-edged within; submarginal line fine, slightly dislocated on the veins. Hind wing with the median line colored as on fore wing, irregular, produced

outward before and after vein 2; submarginal line as on fore wing; two red ocelli between the tails and at anal angle, black centered and black edged within.

Type.—Cat. No. 15621, U.S.N.M., Pampaconas River, August, 1911.

Named in honor of Mr. Thomas G. Bennett, of New Haven, Connecticut.

THECLA BROCELA, new species.

Gray brown above, costa narrowly light red, broader at base; a black discal patch. Hind wing a little tingid with bright blue; a small red spot at anal angle. Single tail at vein 2 long, white-tipped. Below light ashen; a median brick-red band across both wings, submaculate on hind wings, narrowly white without; a small red spot above tail and at anal angle, the latter with black spot also. A faint double whitish submarginal maculate line.

Type.—Cat. No. 15622, U.S.N.M., Cotahuasi, 9,000 feet, October, 1911.

THECLA ULIA, new species.

Wing-shape as in *T. gamma* H. H. Druce. Gray, with light bluish tint, especially along inner half of hind wing; fringes and base of costa light brownish red. Below ocher brown; fore wing with inner area pale; two irregular broad brown bands across cell; a faint submarginal row of brown spots. Hind wing with two bands from costa across cell, fainter than on fore wing; a submarginal faint line, beyond which the ground color is lighter.

Type.—Cat. No. 15623, U.S.N.M., Cantas, 2,000 feet, November, 1911.

THECLA MUELA, new species.

Wing-shape of *T. bolima* Schaus, but the hind wing without the projection at vein 2, the anal angle strongly produced. Gray-brown; basal area of both wings, except toward costa, washed with light blue. Below, fore wing dark at base, shading to pale, outer line pale, straight, preceded by a dark olive gray shade stopping at vein 2; a marginal olive gray border, the subterminal space olive yellowish. Hind wing dark olive brown on basal half, limited by a line incised in cell; outer half olive yellowish, contrasted, crossed by a faint macular line and shaded border.

Cotypes.—Two specimens, Cat. No. 15624, U.S.N.M., Cotahuasi, 9,000 feet, October, 1911.

THECLA EXCISICOSTA, new species.

Blackish brown, the fore wing in some specimens reddish except costa and margin; fringe white checkered. Hind wing with the costa shallowly excised, apex roundedly prominent; three black spots, small one at anal angle, two following the short tail at vein 2; a row of faint whitish submarginal crescents. Below, fore wing orange,

costa gray; outer margin gray with two rows of checkered spots, the inner square, white-edged without, the outer row narrow, fainter toward costa. Hind wing soft gray, with shaded white submarginal streak; quadrate checkered spots in a faint row near base, a distinct row across middle, the three below vein 3 alternatingly dislocated toward base and outwardly; a spot at tornus and two beyond the tail, these gold centered.

Cotypes.—Six specimens, Cat. No. 15625, U.S.N.M., Cotahuasi, 9,000 feet, October, 1911; Chuquibamba, 10,000 feet, October, 1911.

LYCÆNA CALLANGA Staudinger.

San Miguel, 6,000 feet, July 24, 1911.

Urubamba, 9,500 feet, July 15, 1911.

Mr. Schaus notes this as possibly a manuscript name. The males are violet above, blue toward base; female with submarginal yellowish crescents on hind wing, followed by violaceous rounded spots with dark centers. Beneath, fore wing reddish; two white ringlets in cell, one below; an outer row of same; termen gray with double lunular white line. Hind wing gray; two rows of white rings and one at end of cell; submarginal white band followed by faint crescents with two metallic specks near tornus.

LYCÆNA MARINA Reakirt.

San Miguel, 6,000 feet, July 24, 1911.

LYCÆNA ZACHACINA Butler and Druce.

Cantas, 2,000 feet, November, 1911.

Urubamba, 9,500 feet, July 16, 1911.

Coropuna, 14,500 feet, October, 1911.

LYCÆNA ALTICOLA Godman and Salvin.

Cantas, 2,000 feet, November, 1911.

Coropuna, 14,500 feet, October, 1911.

LYCÆNA KOA Druce.[1]

Pampaconas River, August, 1911.

Cotahuasi, 9,000 feet, October, 1911.

Urubamba, 9,500 feet, July 16, 1911.

Chuquibamba, 10,000 feet, October, 1911.

Coropuna, 14,500 feet, October, 1911.

The specimens taken in July and August are dark above, blue over blackish. Those taken in October are bright metallic silvery blue with narrow black margin to both wings. Evidently these are seasonal forms.

Family HESPERIIDÆ.

EUDAMUS EURYCLES Hübner.

Panama Canal Zone, June 16, 1911.

EUDAMUS SIMPLICIUS Stoll.

Huadquina, 5,000 feet, August, 1911.

[1] Or *vapa* Staudinger. I have the reference to neither, so can not say which name has precedence.

EUDAMUS CATILLUS Cramer.

Huadquina, 5,000 feet, July 24, 1911.

EUDAMUS DORANTES Stoll.

Huadquina, 5,000 feet, August, 1911.

BUTLERIA CUPARIA Mabille.

Pampaconas River, August, 1911.

BUTLERIA DIMIDIATUS Felder.

Pampaconas River, August, 1911.

BUTLERIA AGATHODES Felder.

Tincochaca, 7,000 feet, August 9, 1911.

HYLEPHILA LIMA Plötz.

Tincochaca, 7,000 feet, August 9, 1911.
Urubamba, 9,500 feet, July 16, 1911.
Cuzco, 11,500 feet, July 4, 1911.

HYLEPHILA ISONIRA, new species.

Similar to *phylaeus* Drury; male with the black terminal marks broader and more nearly forming a dentate band, often completely so; female only a little blacker than the male, some specimens not at all so, the marks not confluent over the surface as in female phylaeus. Beneath light yellowish; fore wing as in phylaeus but lighter; hind wing light yellowish, grayish tinged, a mesial pale band edged with dull red scales, sharply bent, its lower segment straighter than in phylaeus, not dotted with black.

Cotypes.—15 specimens, Cat. No. 15627, U.S.N.M., Ollantaytambo, 9,000 feet, October, 1911; Urubamba, 9,500 feet, July 18, 1911; Chuquibamba, 10,000 feet, October, 1911; Cuzco, 11,500 feet, July 12, 1911; Coropuna, 14,500 feet, October, 1911. Three specimens from Cantas, 2,000 feet, November, 1911, have the marginal markings more pointed and smaller.

ARGOPTERON CYPSELUS Felder.

Pampaconas River, August, 1911.
San Miguel, 6,000 feet, July 24, 1911.

ARGOPTERON XICCA, new species.

Black above; inner area of hind wing broadly covered with long greenish hairs. Below, fore wing with base of costa and apex gray-brown, disk broadly black. Hind wing all gray-brown except a black streak on submedian fold, widening to a patch at tornus.

Type.—Cat. No. 15628, U.S.N.M., Vilcabamba, 10,000 feet, August 23, 1911.

ATRYTONE MELLA Godman and Salvin.

Cuzco, 11,500 feet, July 4, 1911.

Mr. Schaus labels this as possibly the female of *mella*, which is known only by males.

LERODEA GRACIA, new species.

Blackish brown, fringes white; fore wing grayish at base, with constricted spot in end of cell, three subapical and row of four below,

the upper two of these quadrate, hyaline white, the third and fourth dead white, the third small. Hind wing with yellowish shading over the disk nearly forming spots beyond the cell. Below, fore wing black at base, spots repeated, apex broadly light powdery gray. Hind wing all powdery gray with a long black ray through cell, traces of outer row of small white spots.

Cotypes.—Four specimens, Cat. No. 15629, U.S.N.M., Cotahuasi, 9,000 feet, October, 1911; Coropuna, 14,500 feet, October, 1911.

LEREMA MIQUA, new species.

Close to *L. bipunctata* Mabille (*lockius* Plötz), but wings beneath without the strigæ; hind wing with two brown bands, the inner bent at right angles to costa, the outer strongly curved. In *bipunctata* they run parallel and obliquely to costa.

Type.—Cat. No. 15630, U.S.N.M., San Miguel, 6,000 feet, July 24, 1911.

THYMELICUS ATHEMON Hübner.

Cuzco, 11,500 feet, July 4, 1911.

COBALUS CANNÆ Herrich-Schaeffer.

Urubamba, 9,500 feet, July 16, 1911.

HELIOPETES OMRINA Butler.

Huadquina, 5,000 feet, July 26, 1911.

PERICHARES CORYDON Fabricius.

San Miguel, 6,000 feet, July 29, 1911.

TELEGONUS CENTRITES Hewitson.

Pampaconas River, August, 1911.

CYCLYRIUS ALTICOLA Godman and Salvin.

Cantas, 2,000 feet, November, 1911.
Cotahuasi, 9,000 feet, October, 1911.
Chuquibamba, 10,000 feet, October, 1911.
Coropuna, 14,500 feet, October, 1911.

STAPHYLUS SCORAMUS Schaus.

San Miguel, 6,000 feet, July 24, 1911.

THANAOS FUNERALIS Scudder and Burgess.

Coropuna, 14,500 feet, October, 1911.

HESPERIA SYRICHTUS Fabricius.

Huadquina, 5,000 feet, July 24, 1911.
Urubamba, 9,500 feet, July 16, 1911.

HESPERIA NOTATA Blanchard.

Coropuna, 14,500 feet, October, 1911.

HESPERIA ARCHIA, new species.

Brown; fringes checkered brown, yellowish white; base of fore wing and submarginal area with yellowish scales; incised quadrate spot at end of cell with dash above; spot at base of vein 2 and on vein 1 at middle third; outer row of spots, three subapical, two beyond, one below above vein 3, one farther in above vein 2; two

in submarginal space a little farther out. Hind wing with yellowish bar at end of cell and pale suffusion beyond it; submarginal row of suffused spots. Below, fore wing whitish with ocher tint at base, blackish beyond; spots repeated; termen washed with pale. Hind wing ocherous white, dusted with dark atoms; blackish rounded quadrate, powdery spots, one in cell, row of three centrally, outer row of six, blurred and forming a band excurved centrally.

Cotypes.—Four specimens, Cat. No. 15631, U.S.N.M., Cantas, 2,000 feet, November, 1911; Cotahuasi, 9,000 feet, October, 1911.

Allied to *H. emma* Staudinger.

Family SPHINGIDÆ.

SESIA TITAN Cramer.

Huadquina, 5,000 feet, July 29, 1911.

SESIA FADUS Cramer.

Northwest coast of South America, on steamer, June 21, 1911.

Family SATURNIIDÆ.

SATURNIODES ORIOS, new species.

Dark gray; wings irrorated with dark ocher scales; inner line of fore wing irregularly dentate, white, narrowly edged with black without, with black lines along veins 1 and 2 to outer line; discal ocellus hyaline, black ringed, then narrowly with dark ocher; outer line waved, white, edged black on both sides, expanding over apex where is a short partly black, partly deep crimson patch; a white band following outer line, then red, black, and ocher scales; margin very narrowly dark clay-brown. Hind wing dull and little marked on costa; mesial line white to back of ocellus, black edged; ocellus with small hyaline center, its ocher rim broad; outer line as on fore wing, its outer border becoming crimson at apex, the following white area mixed with crimson scales; margin as on fore wing. Beneath, gray, with yellow scales only marginally; a mesial blackish straight band on both wings, with yellow powdering. Hind wing without mesial line, the line being toward base, black, wavy, white-bordered. No submarginal white on either wing. Expanse, 115 mm.

Type.—Male, Cat. No. 15632, U.S.N.M., Cuzco, 11,500 feet, November, 1910.

Jordan founded the genus *Saturniodes*[1] on *Saturnia medea* Maassen.[2] He describes three subspecies of *medea*. Druce described *Saturnia ockendeni*,[3] which is evidently a *Saturniodes*. The present form is apparently nearer to *ockendeni* than to *medea;* it does not appear to agree with any of the descriptions. The forms of *Saturniodes* all

[1] Novitates Zool., vol. 18, 1911, p. 132.
[2] Stübel's Reise durch Col., Ecuad., Peru, etc., 1890, p. 133, pl. 5, fig. 7.
[3] Ann. Mag. Nat. Hist. (7), vol. 17, 1906, p. 411.

inhabit the higher altitudes of the Andes, but I have not sufficient material to discuss their relations to each other.

OXYTENIS LAVERNA Druce.

Pampaconas River, August, 1911.

Family SYNTOMIDÆ.

COSMOSOMA AUGE Linnæus.

Santa Ana, 3,000 feet, August 4, 1911.

Family LITHOSIIDÆ.

ARDONISSA ADSCITINA Dognin.

Cuzco, 11,500 feet, July 9, 1911.

Family ARCTIIDÆ.

VIRBIA ELISCA, new species.

Fore wing grayish black; hind wing dull black with large orange patch on costa on outer half except apex, running down almost to termen below vein 1. Beneath, hind wing as above; fore wing with a large orange patch from close to inner margin from end of cell to near base. Expanse, 25 mm.

Type.—Cat. No. 15633, U.S.N.M., Huadquina, 5,000 feet, July 24, 1911.

Allied to *V. fluminea* Schaus, but without red on fore coxæ.

VIRBIA CATAMA, new species.

Fore wing brownish black. Hind wing orange, with narrow outer black border, widened a little at apex and submedian; a little black at base of costa. Fore wing below with the disk broadly orange; costa and base narrowly and outer margin broadly grayish black. Abdomen and legs black. Expanse, 32 mm.

Type.—Female, Cat. No. 15634, U.S.N.M., Huadquina, 5,000 feet, July 24, 1911.

Near *V. lehmanni* Rothschild, but the abdomen entirely black.

HEMIHYALEA MELAS Dognin.

Cuzco, 11,500 feet, July, 1911.

ECPANTHERIA PERUVIENSIS Hampson,

Santa Ana, 3,000 feet, August 5, 1911.

ALTIMÆNAS TAPINA, new genus and species.

Hind wing with vein 4 present; 6 and 7 from apex of cell; fore wing with veins 7 to 10 stalked, 6 from angle of cell; proboscis aborted; hind tibiæ without medial spurs; fore tibiæ without claw; eyes not hairy; vestiture of head and thorax of rough woolly hairs; eyes small, sunken in the vestiture.

Thorax with long blackish hairs. Fore wing densely powdered, blackish on pale ocherous, leaving patches in cell, on either side of incised black discal spot and an outer band, curved over cell; a terminal row of diffuse black spots; fringe pale. Hind wing pale

ocherous whitish. Below, ocherous whitish; fore wing with dark shade along costa and patch at end of cell. Expanse, 28 mm.

Type.—Male, Cat. No. 15635, U.S.N.M., Coropuna, 14,500 feet, October, 1911.

UTETHEISA ORNATRIX Linnæus.

Coropuna, 14,500 feet, October, 1911.

Family NOCTUIDÆ.

Subfamily AGROTINÆ.

MESEMBREUXOA FASICOLA, new species.

Fore wing dull rosy ocherous subcostally to reniform; outer line indicated, curved, dentate; a dark gray rounded patch on costa subapically; subterminal space of lighter color, with dashes on discal venules; termen gray, cut by pale rays at veins 2 and 3; orbicular and reniform pale, joined by a broad black bar that incloses orbicular except above; area below median vein light grayish. Hind wing semihyaline white, costa gray. Expanse, 38 mm.

Type.—Male, Cat. No. 15636, U.S.N.M., Cotahuasi, 9,000 feet, October, 1911.

POROSAGROTIS PROPRIENS, new species.

Ground color clayey ocherous suffused with grayish; orbicular large, elongate, reniform full, pale ringed, blackish filled, preceded and separated by black in the cell and followed by a black dash; claviform a large confused gray area surrounded by black and joined to outer line by a dash; a claviform mark below vein 1; inner line obscure; outer minutely crenulate, pale; termen with cuneiform black dashes; preceded by pale scales, the palest on the wing; four oblique pale dashes on costa before apex. Hind wing translucent, gray tinged especially on veins; fringe whitish outwardly. Expanse, 30 mm.

Type.—Female, Cat. No. 15637, U.S.N.M., Chuquibamba, 10,000 feet, October, 1911.

FELTIA ANNEXA Treitschke.

Pampaconas River, August, 1911

FELTIA MALEFIDA Guenée.

Pampaconas River, August, 1911.

FELTIA CLERICA Butler.

Ollantaytambo, 9,000 feet, July 23, 1911.

METALEPSIS CERPHIPHILA, new species.

Thorax blackish haired over luteous. Fore wing pale luteous, the veins narrowly white; black streaks below subcosta in cell, shading below cell, the veins beyond it from 2 to 8, intensified on margin, and a broad streak above vein 1. Hind wing shaded with blackish, fringe pale. Expanse, 29 mm.

Type.—Male, Cat. No. 15638, U.S.N.M., Coropuna, 14,500 feet, October, 1911.

LYCOPHOTIA ALBIORBIS, new species.

Dark gray, mottled with black, powdered with brassy; lines whitish, black edged on both sides; subbasal half line distinct, of two arcs; inner slightly oblique, crenulate; orbicular large, round, white; reniform brassy powdered, black in lower segment; outer line excurved over cell; subterminal line pale, angular, narrow. Hind wing white, blackish on costa and narrow marginal line. Expanse, 37 mm.

Type.—Male, Cat. No. 15639, U.S.N.M., Vilcabamba, 10,000 feet, August 23, 1911.

Subfamily HADENINÆ.

ERIOPYGA OROBA Druce.

Tincochaca, 7,000 feet, August 9, 1911.

Ollantaytambo, 9,000 feet, July, 1911.

HYSSIA ELÆOCHROA, new species.

Smooth yellowish olive gray; base and termen more yellowish powdered; lines slender, blackish; inner dentate on submedian; outer crenulate; orbicular and reniform blackish, solid, not strongly relieved; subterminal line obsolete. Hind wing blackish, whitish over cell, fringe whitish, interlined. Expanse, 35 mm.

Type.—Female, Cat. No. 15640, U.S.N.M., Cuzco, 11,500 feet, July 4, 1911.

CIRPHIS LATIUSCULA Herrich-Schaeffer.

Huadquina, 5,000 feet, July, 1911.

LASIONYCTA COMIFERA, new species.

Gray, with bronzy yellowish tint; lines powdery blackish, all forming geminate streaks on costa; four yellowish specks before apex; subbasal and inner lines geminate, powdery, broken, not strongly relieved; claviform a half circle; orbicular pale, black ringed; reniform stellate, of the ground color, with pale speck; specks in the five points, black edged; outer line geminate, segmented, pale filled; subterminal line a row of bright dots preceded by black; termen yellowish, narrowly. Hind wing whitish in cell, fuscous beyond; fringe pale. Expanse, 31 mm.

Type.—Cat. No. 15644, U.S.N.M., Cantas, 2,000 feet, November, 1911.

The eyes have long, sparse hairs instead of the usual dense ones, and are besides strongly lashed.

Subfamily ACRONYCTINÆ.

ARGYRACTIS PHRAORTES Druce.

Pampaconas River, August, 1911.

PERIGEA APAMEOIDES Guenée.

Pampaconas River, August, 1911.

Huadquina, 5,000 feet, August 1, 1911.

PERIGEA VECORS Guenée.

Pampaconas River, August, 1911.

PERIGEA ALBOLABES Guenée.

Pampaconas River, August, 1911.

PERIGEA SELENOSA Guenée.

Pampaconas River, August, 1911.

DANTONA STILLATA Guenée.

Huadquina, 5,000 feet, July 24, 1911.

Subfamily ERASTRIINÆ.

COBUBATHA RILLA, new species.

Fore wing dark gray, irrorated with metallic purplish scales; a straight, median dark brown band, narrow on costal half; subterminal line dark, distinct, in-angled subcostally and strongly at veins 2–3. Hind wing orange, fringe blackish; costa narrowly gray. Expanse, 12 mm.

Type.—Cat. No. 15645, U.S.N.M., Cotahuasi, 9,000 feet, October, 1911.

Subfamily PLUSIINÆ.

PLUSIA OU Guenée.

Pampaconas River, August, 1911.

PLUSIA MONOXYLA, new species.

Violaceous gray, shaded with bronzy; markings as in *biloba*, the sign smaller and more oblique, the silvery marking at reniform absent. Expanse, 29 mm.

Type.—Female, Cat. No. 15646, U.S.N.M., Ollantaytambo, 9,000 feet, July 24, 1911.

Subfamily NOCTUINÆ.

GONITIS EDETRIX Guenée.

Pampaconas River, August, 1911.

ANOMIS SOPHISTES, new species.

Near *cataggelus* Dyar, but with the costal fovea at base of fore wing forming no swelling above; anal tuft white; fore tibiæ not spotted with white on the sides; general color more reddish brown, dark shadings lighter, that at base of wing much restricted. Hind wing lighter fuscous. Expanse, 33 mm.

Cotypes.—Male and female, Cat. No. 15647, U.S.N.M., Pampaconas River, August, 1911.

PANGRAPTA REPUGNALIS Hübner.

Pampaconas River, August, 1911.

GABINA HOMICHLODES Hübner.

Pampaconas River, August, 1911.

DONACLEA PERUVIENSIS Dognin.

Torontoy, 7,000 feet, July 23, 1911.

HERMESIA GEMINA Maassen.

Huadquina, 5,000 feet, August 1, 1911.

HYPOGRAMMA HEMIPLAGIA Felder.

Pampaconas River, August, 1911.

COENIPETA LOBULIGERA Guenée.

Pampaconas River, August, 1911.

BOLINA FASCIOLARIS Guenée.

Off east coast of Cuba, on steamer, June 13, 1911.

Subfamily HYPENINÆ.

LASCORIA PHORMISALIS Walker.
Pampaconas River, August, 1911.

BLEPTINA CONFUSALIS Guenée.
Pampaconas River, August, 1911.

HYPENA CLAXALIS Schaus.
Pampaconas River, August, 1911.

HYPENA LEBONIA Druce.
Pampaconas River, August, 1911.
Tincochaca, 7,000 feet, August 9, 1911.

HYPENA CHAKA Dognin.
Pampaconas River, August, 1911.

HYPENA LOLLIA Druce.
Pampaconas River, August, 1911.
Mr. Schaus labeled this as like *lollia* but larger.

HYPENA INDENTATA Dognin.
Huadquina, 5,000 feet, August, 1911.

Family NOTODONTIDÆ.

CRINODES STRIOLATA Schaus.
Pampaconas River, August, 1911.

HEMICERAS NIGRIGUTTA Schaus.
Pampaconas River, August, 1911.

HIPPIA ASTUTA Schaus.
Pampaconas River, August, 1911.

Family THYATRIDÆ.

THYATIRA STAPHYLA Dognin.
Lucma, 7,000 feet, August 25, 1911.

Family GEOMETRIDÆ.

SANGALOPSIS FUGAX Dognin.
San Miguel, 6,000 feet, July 24, 1911.

SANGALA PHILODAMEA Druce.
Paltaybamba, 5,000 feet, August 28, 1911.

NELO CORYRA Druce.
Paltaybamba, 5,000 feet, August 6, 1911.

HETERUSIA SINUOSA Felder.
Ollantaytambo, 9,000 feet, July 20, 1911.

HETERUSIA STOLTZMANNARIA Oberthur.
Torontoy, 7,000 feet, July 23, 1911.

HETERUSIA HUMERARIA Walker.
San Miguel, 6,000 feet, July 24, 1911.

HETERUSIA PACIFICA Thierry-Mieg.
Pampaconas River, August, 1911.

HETERUSIA EPHESTRIS Felder and Rogenhofer.
Huadquina, 5,000 feet, July 30, 1911.

ERATEINA CYNTHIA Doubleday.
Tincochaca, 7,000 feet, August 9, 1911.

EUDULE SOMBREATA Dognin.
Huadquina, 5,000 feet, July 24, 1911.

EUDULE MALEFIDA Warren.
Huadquina, 5,000 feet, July 24, 1911.

SPARGANIA NARANGILLA Dognin.
Pampaconas River, August, 1911.
San Miguel, 5,000 feet, September 1, 1911.

CYLLOPODA ROXANA Druce.
Santa Ana, 3,000 feet, August 2, 1911.

EPIRRHOE DILTILLA, new species.
Bright yellow-green, irrorate with blackish; subbasal band broad, dark; inner space full of black atoms; inner and outer bands approximate, broad, dark, inbent in cell and submedian; a black discal mark; space between and outer space full of black dots and atoms; subterminal line fine, pale, crenulate, preceded by dark shading in patches; an oblique black line to apex; terminal black dots in groups of three. Hind wing greenish tinged, pale; outer crenulate greenish gray line followed by two other straighter ones; termen washed with greenish. Expanse, 30 mm.
Type.—Female, Cat. No. 15648, U.S.N.M., Vilcabamba, 10,000 feet, August 11, 1911.

EREBOCHLORA TIMA Thierry-Mieg.
Pampaconas River, August, 1911.

DARNA VULTURATA Warren.
Torontoy, 7,000 feet, July 10, 1911.

ANAPALTA ACERBATA Felder and Rogenhofer.
Pampaconas River, August, 1911.

COPHOCEROTIS CINEREA Warren.
Tincochaca, 7,000 feet, August 8, 1911.

EUCOSMIA AFFIRMATA Guenée.
Urubamba, 9,500 feet, July 16, 1911.

TRIPHOSA QUASIPLAGA, new species.
Similar to *T. uniplaga* Warren, the lines more distinct, crisply crenulate, the subterminal white scales not forming rounded patches, but lines or pointed dots; instead of the large spot between veins 3 and 4, a slender crescent.
Type.—Male, Cat. No. 15649, U.S.N.M., Tincochaca, 7,000 feet, August 9, 1911.

CALLIPIA PARRHASIATA Guenée.
Pampaconas River, August, 1911.

CALLIPIA ROSETTA Thierry-Mieg.
Torontoy, 7,000 feet, July 23, 1911.

SEMIOTHISA CARDINEA Druce.
Huadquina, 5,000 feet, July 24, 1911.

PERGAMA SPECIOSATA Guenée.
Pampaconas River, August, 1911.

NEPHELOLEUCA POLITIA Cramer.
Pampaconas River, August, 1911.

CERTIMA MIMA Thierry-Mieg.
Pampaconas River, August, 1911.

TRICHROMATOPODIA CALAVERA Dognin.
Pampaconas River, August, 1911.

OPISTHOXIA MELAE Druce.
Huadquina, 5,000 feet, July 24, 1911.

BYSSODES QUADRIFILATA Felder.
Pampaconas River, August, 1911.

SEMIOTHISA RADIATA Maassen.
Pampaconas River, August, 1911.

OXYDIA CROCALLINARIA Oberthur.
Pampaconas River, August, 1911.

AZELINA VARIARIA Walker.
Pampaconas River, August, 1911.

AZELINA MARCARIA Oberthur.
Pampaconas River, August, 1911.

AZELINA SPECTRATA Felder.
Pampaconas River, August, 1911.

PERO MACULICOSTA Warren.
Pampaconas River, August, 1911.

PERO CERIATA Walker.
Pampaconas River, August, 1911.

SABULODES AEGROTATA Guenée.
Pampaconas River, August, 1911.

SABULODES EXHONORATA Guenée.
Pampaconas River, August, 1911.

SABULODES TAMBILLARIA Oberthur.
Pampaconas River, August, 1911.

SABULODES GLAUCULARIA Snellen.
Pampaconas River, August, 1911.

SPODODES UNIFACTA, new species.

Dark reddish brown, finely irrorate, marks obscure; both wings with minute black discal dot and outer row of spots on the veins, the latter connected by a vague gray shade.

Type.—Female, Cat. No. 15651, U.S.N.M., Pampaconas River, August, 1911.

Mr. Paul Dognin has labeled the specimen "Seems close to *Spododes adumbrata* Warren, mais je n'en ai aucune d'aussi foncé."

EPIONE POLYDORA Thierry-Mieg.
Pampaconas River, August, 1911.

EPIONE THERMIDORA Thierry-Mieg.
Pampaconas River, August, 1911.

STENALCIDIA CONSTIPATA Dognin.
Pampaconas River, August, 1911.

ALCIS SALMONEARIA Oberthur.
Pampaconas River, August, 1911.

EUCTENECTROPIS COMMOTARIA Warren.
Huadquina, 5,000 feet, July 28, 1911.

CATORIA UNIPENNARIA Guenée.
Pampaconas River, August, 1911.

NIPTERIA FLEBILIS Warren.
San Miguel, 6,000 feet, July 24, 1911.
Mr. Schaus labels the specimen "Above equal to *Nipteria flebilis* Warren. Hind wings below paler."

Family DIOPTIDÆ.

POLYPOETES MARGINIFER, new species.
Black; fore wing semitranslucent black with broad longitudinal white streaks, one beyond cell, slightly cleft at end, the other below cell to outer three-fourths of submedian space. Hind wing white, with black border along costa and outer margin. Expanse, 22 mm.
Type.—Male, Cat. No. 15650, U.S.N.M., Tincochaca, 7,000 feet, August 10, 1911.

Family COSSIDÆ.

LANGSDORFIA MALINA Dognin.
San Miguel, 6,000 feet, July 24, 1911.

Family PYRALIDÆ.

NACOLEIA EBULEALIS Guenée.
Tincochaca, 7,000 feet, August 9, 1911.

TRITHYRIS LATIFASCIALIS Snellen.
Pampaconas River, August 1911.

STERICTA OBLIQUALIS Hampson.
Pampaconas River, August, 1911.

JOCARA SUIFERENS, new species.
Fore wing gray, tinged with green, especially on costal half; a large rounded white patch on inner margin between the lines; inner line as two black dashes in the edge of the white spot, obsolete above; small lunate black discal mark; outer line far out, dentate, excurved in middle third; a row of terminal short dashes. Hind wing whitish, gray on costa, narrowly so on outer margin; a wavy outer gray line, obsolete submedianly. Expanse, 29 mm.
Type.—Male, Cat. No. 15652, U.S.N.M., Pampaconas River, August, 1911.

Family TINEIDÆ.

TINEOLA (?) CULMINICOLA Staudinger.
Coropuna, 14,500 feet, October, 1911.
Mr. August Busck kindly examined the specimen.

DESCRIPTION OF MESOPLODON MIRUM, A BEAKED WHALE RECENTLY DISCOVERED ON THE COAST OF NORTH CAROLINA.

By Frederick W. True,

Assistant Secretary, Smithsonian Institution.

On July 29, 1912, the United States Bureau of Fisheries transmitted to the United States National Museum a barrel containing the head, tail, and pectoral of an adult female beaked whale of the genus *Mesoplodon* which stranded on the outer bank of Bird Island Shoal in Beaufort Harbor, North Carolina, three days earlier. On examination the specimen was found to represent a new species, a diagnosis of which was published under the name of *Mesoplodon mirum* in the Smithsonian Miscellaneous Collections.[1]

The director of the Fisheries Laboratory at Beaufort, Mr. Lewis Radcliffe, furnished the following data regarding the whale, together with a photograph, which is reproduced in Plate 52:

Apparently the whale had been swimming about among the shallow channels on Bird Island Shoal and was caught just inside the outer edge of the shoal by the falling tide. It was first sighted by launch No. 316 about 10 a. m. and the report brought back to the laboratory about noon. At 1.30 p. m., when visited, it had been badly mutilated by visitors (see photograph). The following data were obtained at this time:

	Ft.	in.
Total length	16	0
Width of tail (flukes) about	4	8
Tip of snout to origin of dorsal	9	0
Tip of snout to origin of pectoral	3	8
Tip of snout to vent	11	0
Length of pectoral	1	8
Greatest depth of body	3	5

Color: Back, slate-black; lower sides, yellow-purple, flecked with black; median line of belly somewhat darker; a grayish area in front of vent; fins the color of the back.

Body covered with a thick layer of fat; flesh beneath this layer very dark red, of loose texture, coarse and stringy.

Walls of all the chambers of the heart comparatively thin. Weight of heart, 10.5 pounds; length from base of atria to tip of ventricles, 14.5 inches; width at base of ventricles, 11 inches.

[1] Smiths. Misc. Coll., vol. 60, No. 25, March 14, 1913.

Stomach divided into three chambers; first chamber large and empty; second and third chambers smaller and filled with whitish fluid. The nature of the food could not be determined. Length of intestines, 68 feet; no cæcum present.

Kidneys made up of many small lobules, each of which resembles a miniature mammalian kidney, showing distinct pelvis, calyces, and renal pyramids. These lobules are loosely aggregated and held together by connective tissue. Left kidney: Length, 15.5 inches; width, 7.5 inches; thickness, 1 to 1.75 inches.

I believe this form is not uncommon here. Large cetaceans which answer its description are not infrequently seen swimming about the laboratory, three being sighted at one time. In swimming, the dorsal fin is seen above the water, and at times it resorts to the bounding motion not unlike the porpoise.

Mr. Russel J. Coles reported harpooning a large porpoise early in July. He cut out a small piece of flesh to try its edible qualities and let it go adrift. Later, when decay has gone far enough to permit, an attempt will be made to secure at least a part of the skeleton.

Local name: Cowfish.

The head and other parts were received at the Museum during my absence from Washington. Upon my return, with the aid of Messrs. J. W. Scollick and A. B. Thorne, measurements were made of the head, and afterwards some photographs (Plate 53) and a mold were prepared. The skull and the bones of the tail were then extracted and cleaned. The following measurements were made of the head:

	Inches.	*mm.*
Tip of upper jaw to angle of mouth	14.5	368
Tip of upper jaw to center of eye	24.5	622
Tip of upper jaw to left angle of blowhole	23.0	584
Tip of upper jaw to center of anterior border of blowhole	24.25	616
Breadth of blowhole	4.25	108
Length of beak	7.5	191
Breadth of beak at the base	4.0	102
Length of throat furrows	7.75	197
Distance between furrows anteriorly	0.75	19
Distance between furrows posteriorly	4.75	121
Length of eye	1.38	35
Girth at eye	48.5	1,232
Breadth of flukes	44.0	1,118
Depth of caudal peduncle at junction with flukes	10.75	273

The lower jaw was only a very little shorter than the upper, and its superior border was concave. There was no appearance of teeth in either upper or lower jaw, and it was not until the integuments were removed that two small teeth were discovered, lying close to the extremity of the mandible. These teeth are small, conical, and acute, and are strongly inclined forward and a little outward. The presence of teeth in this position at once suggested that the species was either an undescribed one, or else *M. hectori* Flower, of New Zealand. An examination of the skull showed, however, that the proportions and general conformation were quite unlike those of *hectori*. On the other hand, it presented a very close resemblance to *M. europæus* in many particulars. It might be supposed that the peculiar position of the

teeth was characteristic of the female of that species, but both sexes of the latter are known, and both have the teeth near the posterior end of the symphysis. There seems to be sufficient reason, therefore, to regard the Beaufort specimen as representing a new species. It was therefore described under the name of

MESOPLODON MIRUM True.

Mesoplodon mirum True, Smiths. Misc. Coll., vol. 60, No. 25, p. 1, March 14, 1913.

Type-locality.—Bird Island Shoal, Beaufort Harbor, North Carolina.

Type-specimen.—Cat. No. 175019, U.S.N.M. A skull with mandible and partial skeleton from an adult female 16 feet long which stranded in Beaufort Harbor, North Carolina, July 26, 1912. Obtained by the United States Bureau of Fisheries Laboratory, Mr. Lewis Radcliffe, director.

Diagnosis.—Teeth at the extremity of the mandible, small, entirely concealed by the integuments (in the adult female). Mandibular symphysis one-fourth the length of the mandible. No basirostral groove. External free border of the lachrymal bone one-half the length of the orbit; its anterior end curved upward and appearing on the superior surface of the skull where it joins the antero-external angle of the frontal plate of the maxilla. Maxillary prominences short and directed obliquely outward anteriorly, the extremity close to the maxillary notch. Maxillary foramina behind the premaxillary foramina. Frontal plates of the maxillæ approximately one-half as broad as long.

SKULL.

Plates 54–56.

Superior aspect.—Apex of the supraoccipital at the vertex rounded, extending forward about one-half as far as the recurved internal borders of the frontal plates of the maxillæ. The frontals form an irregular area of small extent at the vertex. Nasals elongated, wedge-shaped, with the truncated apices directed forward. Frontal plates of maxillæ about half as broad as long, their supero-internal recurved borders behind the proximal ends of the premaxillæ directed outward, rather than forward or backward. Proximal ends of premaxillæ short and thick, directed outward; portion at the sides of and in front of the nares as in *M. europæus*. Maxillary prominences large, short, and directed obliquely outward rather than forward as in *M. europæus*. On account of their relatively slight projection anteriorly, their apices are not as far from the bases of the anteorbital notches as in *M. europæus*, *M. hectori*, etc. The base of the notches is occupied by the maxilla, malar and lachrymal in about equal proportions. External free border of the rostrum strongly emarginate at the proximal end but straight more anteriorly, the beak tapering

gradually to the apex, without the convexity at the middle of its length which is characteristic of *M. europæus*. In the basal half of the beak the upper surface of the maxillæ is horizontal, but in the distal half beveled, or inclined outward. Internal free borders of premaxillæ widely separated opposite the base of the beak, more closely approximated anteriorly, but again diverging at the apex. The mesirostral bone occupies the proximal two-thirds of the vomerine trough. It is depressed below the upper surface of the premaxillæ and divided unsymmetrically into two flat portions the surfaces of which are inclined toward each other.

Lateral aspect.—Outline of occipital moderately convex. Condyles strongly projecting. Superior border of frontal plates of maxillæ nearly horizontal and nearly as long as the temporal fossæ. The latter pyriform, with the superior border only moderately concave.

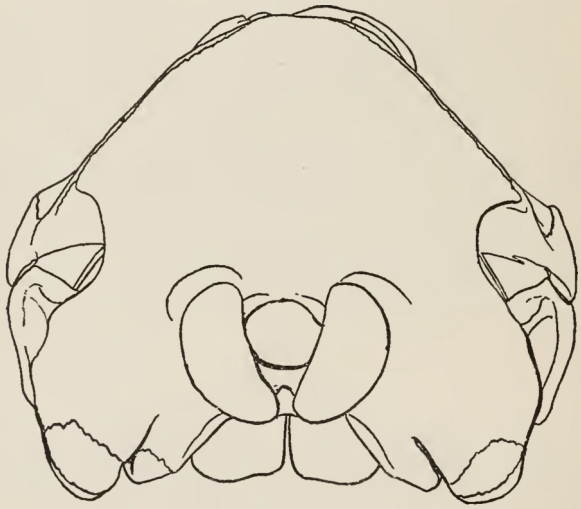


FIG. 1.—POSTERIOR ASPECT OF SKULL.

External angle of the exoccipital, which articulates with the zygomatic, truncated. Zygomatic processes large, thick, and truncated both anteriorly and posteriorly. The postglenoid process large and strongly projecting. Orbit large, with the superior border slightly convex. Free margin of the lachrymal nearly one-half as long as the orbit. Maxillary prominences high and angular, appearing as if truncated anteriorly. Lateral free border of rostrum curved upward at the proximal end.

Pterygoids large and strongly projecting outward and downward. The posterior notch longer and narrower than in *M. europæus*. Inferior outline of the rostrum straight, continuous at the base with that of the pterygoids. In *M. europæus* the inferior outline is convex and cut off at the base by that of the pterygoids, which meets it at an angle.

Inferior aspect.—Wings of the basisphenoid very thick. Posterior end of vomer terminating in an irregular angular projection, notched in the median line. Lateral portion of the pterygoids very wide; median portion narrow with the external borders concave and the inferior surface convex and devoid of the oblique ridge seen in *M. europæus*; the anterior convex extremity broad. Palatines almost concealed anteriorly by the pterygoids, but appearing on the median side of the latter as a narrow triangular area with the apex directed backward. External to the pterygoids the palatines occupy an elongated pyriform area, as in *M. europæus*.

The maxillaries extend backward along the median line so far that they prevent the palatines from meeting as they do in *M. europæus*. Only a very small area of the vomer is visible between the closely approximated pterygoids. Anterior expanded end of malar bone large and nearly as broad as long. It extends into and occupies the base of the anteorbital notch. Lachrymal with a broad truncated free margin; irregularly strap-shaped proximally and overlapped by a broad posterior extension of the maxillary bone. Its anterior free margin forms the outer half of the external boundary of the anteorbital notch.

Beak slightly and evenly convex at the base. The vomer appears as an elongated, fusiform ridge in the middle of the beak, the length of the visible portion more than one-third the length of the beak. Anterior to it the premaxillæ are convex along the median line and concave on either side, thus forming two long, moderately deep grooves. At the apex of the jaw the premaxillæ diverge from the median line and are not in contact.

MANDIBLE.

Plate 57, fig. 1.

The mandible is thick and heavy. Viewed from the side, the inferior border is concave at the middle and convex at either end. The symphysis is strongly bent upward. The angle is broad and rounded and projects backward much beyond the condyle. The coronoid process is very obtuse and is not separated from the condyle by an emargination. Anterior to it the superior border of the ramus is very convex, while it is concave opposite the posterior end of the symphysis.

The symphysis occupies one-fourth the length of the jaw. The upper surface is flat, but the two halves are inclined toward the median line. It is rounded anteriorly.

TEETH.

Plate 57, fig. 2.

The two mandibular teeth are remarkable for their small size, anterior position, and strong forward inclination. They were entirely

concealed by the integuments and their position could not be definitely determined until the latter were removed. The distance from the alveolus of each tooth to the apex of the jaw, obliquely, is 12 mm.; from the alveolus to the median line, 7 mm. As already mentioned, the teeth are inclined forward at an angle of 45° and also slightly outward. They project 4 mm. above the upper margin of the jaw.

The teeth are fusiform and slightly curved, and compressed. Their length is about 30 mm. and their greatest diameter about 9 mm. The tips are very acute and appear to be devoid of enamel.[1]

Dimensions of the type-skull of Mesoplodon mirum, Cat. No. 175019, U.S.N.M.

	mm.
Total length	810
Length of rostrum	496
Length from tip of rostrum to posterior end of pterygoids in median line	618
Greatest height from vertex to inferior border of pterygoids	301
Breadth across centers of orbits	325
Breadth between zygomatic processes	345
Breadth between bases of anteorbital notches	210
Breadth at middle of beak	60
Breadth across occipital condyles	125
Breadth of expanded proximal ends of premaxillæ behind anterior nares	142
Least breadth of premaxillæ opposite anterior nares	118
Breadth of premaxillæ opposite premaxillary foramina	68
Greatest breadth of anterior nares	56
Least distance between maxillary foramina	92
Distance from posterior border of maxillary foramen to end of maxillary protuberance	63
Length of portion of vomer visible on palate	162
Length of mandible	668
Length of symphysis	193
Greatest height of mandible opposite coronoid process	117

The skull of *Mesoplodon mirum* presents a close general resemblance to that of *M. europæus*, except in the position of the teeth. The species belongs to that section of the genus which is characterized by the absence of the basirostral groove, and comprises the species *mirum, bidens, europæus, hectori*, and *stejnegeri*. From *bidens* the present species differs in possessing a shorter and broader rostrum, more closely approximated premaxillæ, more prominent maxillary ridges and deeper anteorbital notch, broader maxillary frontal plates, a smaller anterior projection of the palatines, larger temporal fossæ, differently shaped lachrymal and pterygoid bones, and many other characters.

From *europæus* it differs in the form of the rostrum, lachrymal and pterygoid bones, and other characters as indicated in the foregoing description.

[1] The teeth have been fixed in their natural position in the jaw, and it seems undesirable to extract them. On that account it is not possible to give exact dimensions.

From *hectori* it differs in the greater breadth of the cranium, the size and shape of the maxillary ridges and anteorbital notches, the concavity of the superior margin of the temporal fossæ, the much shorter vertex, etc. It bears no close resemblance to *stejnegeri.*

The shape of the mandible is similar to that of the last-named species, but the symphysis is somewhat longer, and the position and size and form of the teeth are entirely different. *M. hectori* is the only known species besides *mirum* that has the teeth at the extremity of the mandible, but the skull of the former, as already remarked, presents quite different characters from that of *mirum.*

EXPLANATION OF PLATES.

Mesoplodon mirum True. Type-specimen, Cat. No. 175019, U.S.N.M., Beaufort Harbor, North Carolina. Adult female, 16 feet long.

PLATE 52.

The type-specimen lying in Beaufort Harbor. Head dissevered and fins somewhat mutilated.

PLATE 53.

Fig. 1. Head, superior aspect.
2. Head, lateral aspect.
3. Head, inferior aspect. About $\frac{2}{15}$ natural size.

PLATE 54.

Skull, superior aspect. About one-fifth natural size.

PLATE 55.

Skull, inferior aspect. About one-fifth natural size.

PLATE 56.

Skull, lateral aspect. About one-fifth natural size.

PLATE 57.

Fig. 1. Mandible, left side. About one-fourth natural size.
2. Symphysis of mandible, showing the teeth in position. About seven-tenths natural size.



BEAKED WHALE, MESOPLODON MIRUM.

FOR EXPLANATION OF PLATE SEE PAGE 657.

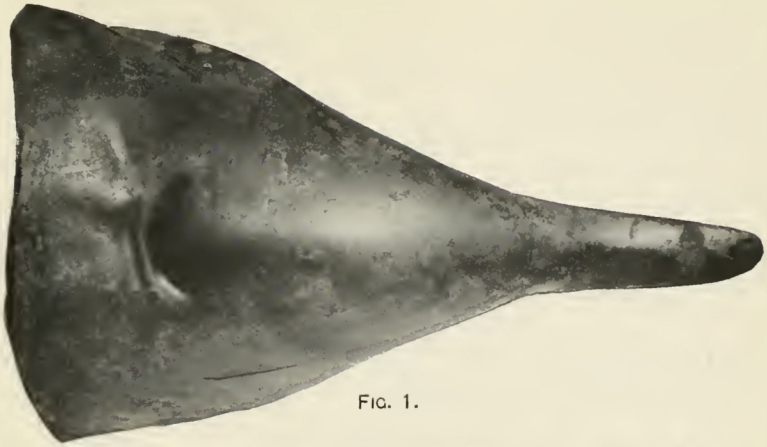


FIG. 1.

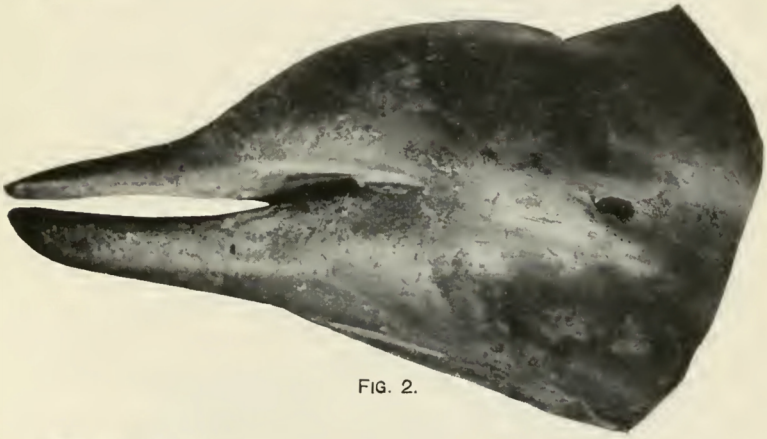


FIG. 2.

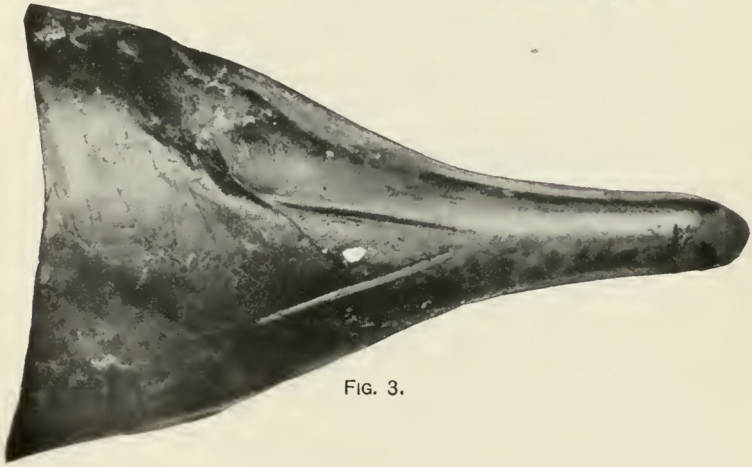
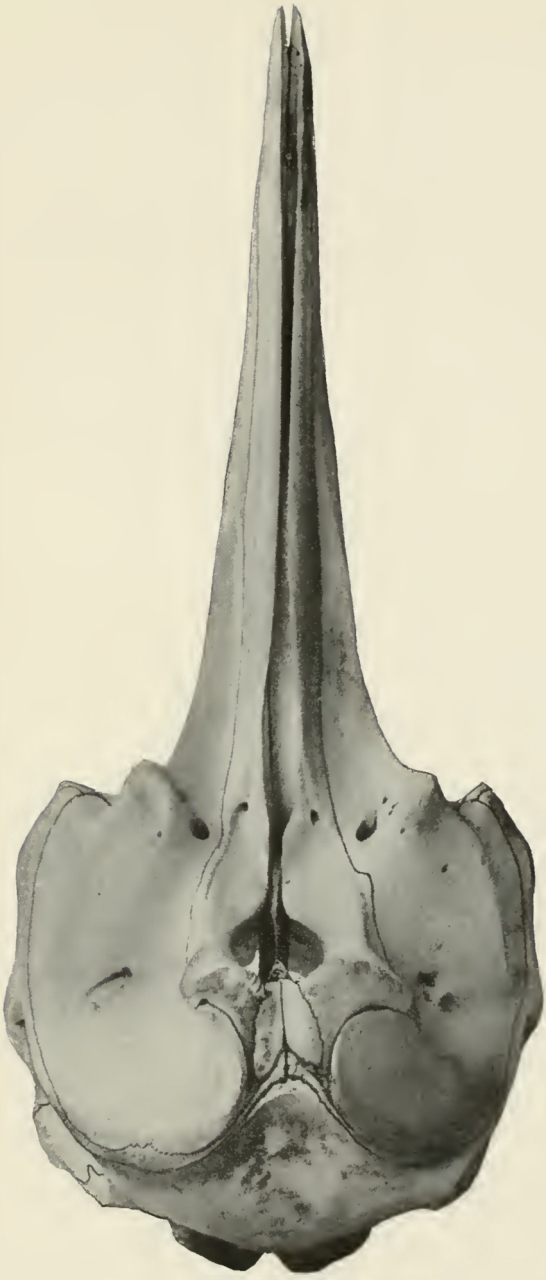


FIG. 3.

VIEWS OF HEAD OF BEAKED WHALE.

FOR EXPLANATION OF PLATE SEE PAGE 657.



SUPERIOR VIEW OF SKULL OF BEAKED WHALE.

FOR EXPLANATION OF PLATE SEE PAGE 657.



INFERIOR VIEW OF SKULL OF BEAKED WHALE.

FOR EXPLANATION OF PLATE SEE PAGE 657.



LATERAL VIEW OF SKULL OF BEAKED WHALE.

FOR EXPLANATION OF PLATE SEE PAGE 657.



FIG. 1.

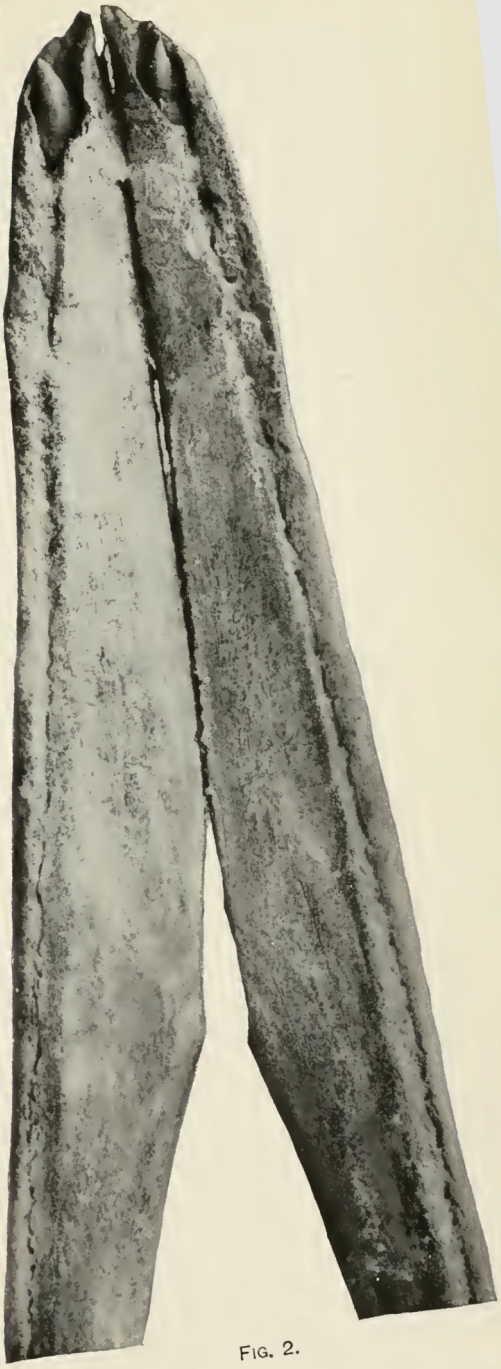


FIG. 2.

VIEWS OF MANDIBLE OF BEAKED WHALE.

FOR EXPLANATION OF PLATE SEE PAGE 657.

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