ANNALS

OF THE

CARNEGIE MUSEUM

VOLUME IX.

1913–1915

W. J. HOLLAND, *Editor*

PUBLISHED BY THE AUTHORITY OF THE
BOARD OF TRUSTEES OF THE CARNEGIE INSTITUTE
SEPTEMBER, 1914–JUNE, 1915

Press of
The New Era Printing Company
Lancaster, Pa.

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Publications of the Carnegie Museum Serial No. 85

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VOLUME IX. NO. 1–2.

Editorial Notes.

The delay in the publication of the present number of the Annals which should have appeared in November, 1913, has for various reasons been unavoidable.

Since the last issue of the Annals a number of exhibits have been placed on view in the Museum. In the Gallery of Mammals the group representing the male and the female of the African buffalo, *Bos bubalus caffer*, presented to the Museum by Mr. Childs Frick, has attracted widespread attention on the part of naturalists and the general public. Another group which may well be regarded as a masterpiece of the taxidermic art is the group of jaguars, secured for the Museum by our good friend, Mr. John M. Phillips, in the vicinity of Tampico, Mexico, several years ago. This group, mounted by Mr. R. H. Santens and his assistants, is the first group of jaguars which has ever been mounted in any museum. There is nothing like it either in the eastern or western hemisphere. On one side of the group is a huge male jaguar, standing upon a log of ebony. This brute was long the scourge of the cattle-ranches in the vicinity, where he was finally shot by Mr. Phillips, and was known by the *rancheros* as "Old One-Fang." He had lost one of the canines of the lower jaw, and the slaughter of the cattle which occurred was long correctly attributed to him by the cattlemen, who after examining the victims detected the fact that the slayer was the possessor of but a single canine. On the other side of the group is his mate, with three cubs. She is holding under her paws a large iguana, while the cubs are taking their first lessons in the art of carving. The details and accessories of the group are all worked out with the most minute fidelity, but in a most wonderfully artistic manner. Another group in process of preparation by Mr. R. H. Santens consists of six specimens of the Abyssinian Nyala, *Tragelaphus buxtoni*, collected by Mr. Childs Frick on the occasion of his last journey in Africa. The species has only comparatively recently been made known to science, and this is the first group of these magnificent animals which has been set up in any museum, and may well be the occasion of pride and admiration to all Pittsburghers as well as lovers of the beautiful in nature everywhere.

Another exhibit in the hall of mammals is the lower jaw of a sperm-whale, which is reputed to be the largest jaw ever brought to New Bedford, Massachusetts. It is 16 ft. $3\frac{1}{2}$ inches in length, and shows all the teeth in place. The specimen was long hidden in storage at New Bedford, but carefully preserved. Owing to the settlement of the estate of the gentleman who had owned it, its sale became necessary, and we were fortunate enough to secure it at a very reasonable figure.

In the gallery of birds there have been placed upon exhibition the birds of paradise belonging to the Museum, which were mounted several years ago by Mr. J. A. Santens; and also an interesting collection of penguins purchased two years ago from Umlauf, of Hamburg, and mounted by him.

In the gallery of useful arts, under the superintendence of Mr. Douglas Stewart, a great many interesting changes have been made and a great number of installations have taken place. One of the new exhibits which is attracting a great deal of attention is the collection of pistols by Mr. Otho J. Bierly, and a collection of rifles by Mr. Harry Praeger. These collections, which illustrate the evolution of modern firearms, are very interesting. Placed in close proximity to the collection of ancient Japanese weapons, loaned to the Museum by Mr. Irwin Laughlin, with which they furnish a striking contrast, these exhibits have been the center of large groups of admiring visitors.

THE collection of ivory carvings loaned by Mr. J. H. Heinz has proved most attractive to the general public. Mr. Heinz has recently presented to the Museum a magnificent eagle, life-size, done in ivory. It has been mounted in a case specially constructed for its reception, where it rivets the attention of multitudes. It is one of the largest pieces of ivory carving in existence.

WE are deeply indebted to Mr. Nathaniel Holmes and Miss Eleanor Holmes for the loan to the Museum of a magnificent collection of old Chinese procelain, upon which visitors to the Museum have constantly feasted their eyes.

THE Director, accompanied by Mr. Arthur S. Coggeshall, early in November repaired to Madrid, to instal in the National Museum of Spain a replica of *Diplodocus carnegiei.* He was received with the greatest courtesy by the officials of the Museum, and had the honor of an audience with His Majesty Alphonso XIII., and also of meeting Her Majesty Doña Maria Christina, the mother of the King. During his stay in Madrid the Director was honored by many tokens of kindness and good will not the least of which was his election as an honorary member of the Royal Spanish Society of the Natural Sciences. On the afternoon of November 28, the Director had the pleasure of giving an illustrated lecture before the Royal Society in the large audience room of the International Institute for women. It was with peculiar emotions that he arose to address his audience. Hanging on the wall of the room to his left was a portrait of the late Mrs. Alice Gordon Gulick, to whose philanthropy the Institute owes its existence. In her young life this noble woman was an acquaintance of the speaker. The sight of her features, glorified by the consecrating touch of years of self-denying labor on behalf of the womanhood of Spain, naturally awoke a flood of memories, and across the bridge of more than two-score years there came, as phantoms come in dreams, the forms of those who were her friends.

IT is with satisfaction that the Director records the publication in the MEMOIRS of his Monograph upon the Osteology of the Chalicotheroidea, which forms the final part of Volume III of that series of publications. This work, which has been in process of preparation for several years past, embodies the results of extensive study and comparison, in which the author was assisted by Mr. O. A. Peterson. It is believed that it brings within the compass of a single paper all the most important observations upon this group of mammals, which have been made since 1825.

CONCENTRATED effort has been made during the fall and winter to extract from the matrix some of the more important specimens found in the great quarry in Uinta County, Utah, where Mr. Earl Douglass and his assistants have been working for several years past. A great deal of the material is absolutely new to science, and the result of these discoveries is certain to add enormously to our knowledge of the reptilian fauna of Mesozoic times. The skeleton of *Brontosaurus* which has been recovered, probably the largest specimen representing that genus which has ever been taken up, is in many respects more complete than any other specimen which has been discovered. When assembled and mounted it will show that the figures heretofore published based upon more or less fragmentary material, have been in many respects wide of the truth so far as the proportions of the animal are concerned.

AMONG other material taken up in the Utah quarry is a remarkably well-preserved skull of a sauropod dinosaur, referable to the genus *Diplodocus*, in which even the sclerotic coat of the eye-ball has been preserved in a fossil condition, and a paper upon this remarkable skull will shortly be published by the Editor.

IMPORTANT collections of birds, collected by Mr. M. A. Carriker, Jr., in Venezuela and Colombia, have been received during the past month. Many species not hitherto represented in the Museum have come into our possession from this source. From tropical west Africa we have received a number of species of the birds of this region carefully collected by Mr. J. A. Reis. By exchange with the National Museum in Madrid we have secured a small collection of the birds of Morocco. The ornithological collections of the Museum are growing steadily, and in a few years may be expected to become one of the most important assemblages of its kind on the continent.

THE collection of fishes has been increased during the past twelve months by much valuable material obtained in South America, and also in Japan and Corea. The South American collections were made by parties collecting under the direction of Dr. C. H. Eigenmann. The Asiatic collections were obtained for the Museum through Dr. David Starr Jordan, with the generous assistance of the officials of the Japanese government in Corea and Japan, as well as through the disinterested kindness of Mr. Allan W. Owston, of Yokohama.

CAPTAIN F. E. KLEINSCHMIDT on the occasion of his visit to Alaska succeeded in obtaining for the Museum some magnificent specimens of the great Alaskan bear, *Ursus middendorfi* which it is proposed to use in the preparation of a group.

DR. O. E. JENNINGS during the summer of 1913 continued his botanical exploration of the north shore of Lake Superior. He was accompanied by Mrs. Jennings. They brought back with them to the Museum a very large collection of the plants of the region and a large number of photographs serving to throw light upon the ecological relationships which exist at various points. Dr. Jennings reports that he has ascertained a number of very interesting facts in reference to the geographical distribution of species, and that he has also discovered several species which are undoubtedly new to science.

During the summer Professor Arnold E. Ortmann made extensive investigations in the drainage areas of Virginia, Kentucky, and Tennessee. His studies upon the molluscan faunæ of these areas are calculated to throw a flood of light not only upon the distribution of species, but upon the origin and development of the river systems themselves.

FROM Mr. G. A. Steiner we have received as a loan a very large collection of Indian baskets, which has been mounted and placed upon view. It forms a most attractive exhibit in the Gallery of Ethnology.

DURING the summer we had the pleasure of a visit from Sir William M. Ramsey, who expressed himself as most highly pleased with the arrangement and contents of the Museum. Sir William is familiar with the leading museums of the world, and his approval of what he saw was a source of great pleasure to the members of the staff who had the honor of meeting him.

A LARGE collection made by Mr. José Steinbach during the past three years in eastern Bolivia has just been received. It consists principally of birds, mammals, and insects of all orders. There are about twenty-seven thousand insects in the collection, and more than six hundred birds.

FROM the United States National Museum we have received as a gift from the Smithsonian Institution fifty-four skins and skulls of African mammals collected by Col. Theodore Roosevelt on his expedition to East Africa. The collection consists principally of small rodents, but includes the skin and skull of a specimen of *Rhinoceros bicornis*. The rodents in a number of cases are cotypes of the species recently described by Mr. Edmund Heller.

I. A NEW GENUS AND SOME NEW SPECIES AND SUBSPECIES OF ABYSSINIAN RODENTS.

By Childs Frick.

(Plates I–V.)

The forms herein described were collected by members of the party during a ten months' journey, which was made by the author from Dirre Doua, Abyssinia, to Nairobi, British East Africa (1911–1912).

Stenocephalemys[1] gen. nov.

A large soft-furred, big-eared rat with white feet and tail, occurring in the Chilalo mountains at an elevation of ten thousand feet above sea-level. It shows resemblances to *Epimys*, but differs so essentially in certain features of the skull, that it seems best to place it in a separate genus, for which I propose the name *Stenocephalemys*, with reference to the characteristic narrowness of the frontals.

Characters. *Skull.*—Remarkable constriction of the interorbital region, and posterior position of the narrowest point; anterior portion of frontal broader than the posterior, which results in a peculiar pinching in of the shortened frontal portion of the brain-case, accompanied by a stretching of the squamosals, which here form an unusually large portion of the anterior lateral roof of the cranium; width and strength of malar portion of zygomatic arch together with narrowness of antorbital plates and open oval shape of suborbital foramina; elongation and marked slenderness of maxillary-premaxillary region; strongly arched postero-anterior profile of upper surface of skull; smallness of bullæ.

The form most nearly approaching the new genus in its peculiar orbital constriction is *Dasymys*, but *Dasymys* differs in the arrangement of its molar pattern and in entirely lacking the posterior narrowness of the frontals and other important characters of the skull (see Plate I, figs. 6–10 and Table of Ratios.) In the development of the maxillary-nasal region the small forest-mouse, *Epimys tulbergi endorobæ* Heller, is very similar to the new genus, the nasals of this *Epimys* being almost proportionately as long as, and the width of the anterior

[1] στενός = narrow, κεφαλή = head, and μῦς = mouse.

orbital plate and the depth of the maxillaries being even less than, those of the latter; the arrangement of the molar cusps is also similar in both forms; on the other hand *E. t. endorobæ* widely differs from the new genus in totally lacking its peculiar and characteristic development of the orbital and frontal portions of the skull (see Plate II, figs. 6–10, and the following Table of Ratios).

TABLE OF RATIOS.

	Type (No. 11).	Cotype (No. 32).	*Dasymys*[2] sp.	*Epimys tulbergi endorobæ*.[3]
Ratio of anterior width to posterior width of frontals..............	1.40	1.10	.87–.79	.50
Ratio of length of nasals to greatest length of skull................	.46	.44	.40–.38	.41
Ratio of maxillary depth at fronto-maxillary suture to greatest length of skull................	.22	.24	.27–.27	.20

Dentition.—Similar to that of *Epimys* in the proportions of the molars and in the arrangement of their cusps.

Pelage.—Of the same general character as that of some of the sylvicoline species of *Epimys*, soft, exceedingly long and thick, the color of upper and lower surfaces distinctly differentiated.

1. **Stenocephalemys albocaudata** sp. nov.

Type from Inyala Camp, Chilalo Mountains, southern Abyssinia, collected February 18, 1911. (Original field No. D. G. R. 11.)

CHARACTERS. *Skull.*—Remarkable interorbital constriction of frontal region, supra-orbital ridges approaching to within 1 mm., and posterior position of narrowest point; squamosals largely supplanting frontals in formation of brain case; excessive elongation of maxillary nasal region; unconstricted base of suborbital foramina, and comparative narrowness of spreading anterior orbital plates; markedly arched superior profile of cranium.

Dentition.—Incisors ungrooved, yellow anteriorly, upper pair recurved, lower procumbent; molars worn smooth (see No. 32 for cusps, which are arranged in three longitudinal rows as in *Epimys*); combined length of M^2 and M^3 slightly greater than M^1.

[2] *Dasymys* ♀, No. 162463 U. S. N. M. and No. 165237 U. S. N. M., the latter specimen figured on Plate I, figs. 6–10.

[3] *Epimys tulbergi endorobæ* Heller, ♀, No. 163402 U. S. N. M., figured on Plate II, figs. 6–10.

Pelage.—Exceptionally soft and long; median and posterior portions of back mottled saccardo-umber;[4] flanks pinkish buff and sharply defined from gray of underparts. Main coat bi-colored; slate-gray basal fur tipped dorsally with cinnamon to pinkish buff, and ventrally with white; grayish tone of underparts due to prominence of dark basal fur; mottled effect of upper back due to same cause together with intermixture of coarser black hair; hair of rump max. 24.5 mm.; outer portions of arms and thighs pinkish buff mixed with gray, inner portions gray; upper portions of carpus, tarsus, and feet thickly covered with white hair, which projects beyond the light-colored claws; under sides of feet flesh-colored; pollex rudimentary, with nail in place of claw; tail sub-equal or equal to combined length of head and body (14 annulations per 10 mm.) light flesh-colored, thickly covered with white hair.

Besides the type the collection of the writer contains four other specimens: No. 12, an old female, No. 13, an immature specimen taken at the Inyala Camp, and two younger specimens (Nos. 32 and 24) captured at Hora Mountain Base Camp.

MEASUREMENTS.

	No. 11 ♂, Mm.	No. 12 ♀, Mm.	No. 32 ♂, Mm.	No. 24 ♀, Mm.
Length of head and body	190	176	144	144
Length of tail	161	164	....	144
Length of pes	31.5	31.5	31	32
Greatest length of skull	41.1	....	38.4	36.3
Basilar length	33.8	....	32.3	30.2
Condylo-incisive length	38.8	....	37	34.8
Zygomatic breadth	21	....	20	18.8
Interorbital breadth	3.4	....	4.2	4.2
Squamosal breadth	15	....	15	14.1
Length and breadth of nasals	19.4×5	18×5	17×5	4.6
Length of diastema	12.4	12	11.5	10.2
Alveolar length of upper tooth-row	9.1	8.8	8.4	8
Length of palatal foramen	10.3	10	9.2	8.5
Depth of brain-case	10.7	....	10.3	10.2
Length of bullæ	6	....	6	5.8
Depth of maxillaries at fronto-nasal suture	10	10	9.6	8.5
Condylo-incisive length of mandible	25	....	23.8	21.5

Genus OTOMYS. Cuvier.

The collection contains two comparatively light-colored species of *Otomys* with the incisive grooving, molar lamination, and soft, thick

[4] Ridgway, "Color Standards and Nomenclature," 1912.

pelage characteristic of *O. jacksoni* Thomas (see P. Z. S., 1891, p. 184) from Mt. Elgon. The first, which I designate as *O. helleri* is represented by a large specimen from the Chilalo Mountains; the second, *O. malkensis*, from the village of Malka in Sidamo, by a smaller and slightly darker specimen. To avoid confusion both are described as subspecies of *O. jacksoni*. When compared with specimens in the U. S. National Museum, they come nearest in color to *O. orestes* Thomas.

Measurements.

	No. 21 ♂ (*O. helleri*), Mm.	No. 29 ♂ (*O. malkensis*), Mm.	Type of *O. jacksoni* in B.M., Mm.
Length of head and body	175	127	120
Length of tail	82	83	50
Length of pes	27.5	26	26
Greatest length of skull	....	36.5	36
Basilar length	....	31	28
Condylo-incisive length	....	35.5	....
Zygomatic breadth	....	19	18
Interorbital breadth	4.5	3.8	....
Length and breadth of nasals	19×7.5	17×7	....
Length of diastema	9.5	8.5	8.5
Alveolar length of upper row of teeth	11	9.7	....
Length of palatal foramen	8.5	6.6	6
Length of mandible	....	22	....

2. **Otomys jacksoni helleri** subsp. nov. (Plate III, figs. 1–5.)

Type from Chilalo Divide Camp, Abyssinia, altitude 9,000 feet, "heath-zone." (Original field-number E. A. M., 7531, Feb. 17, 1912.)

General Characters.—Has the excessively long, soft fur, incisive grooving, and molar lamination of *O. jacksoni* Thomas (*l. c.*), but has a larger, more massively built skull, and far greater size of body. The length of head and body of *O. j. helleri* is 175 mm. as against 120 mm. in the case of *O. jacksoni* (*typicus*).

Skull.—The posterior portion of that of the type is unfortunately broken, the molars are worn. Compared with *O. j. malkensis* (see below), *O. helleri* is heavier throughout. The greater breadth of the orbital region, the longer and wider nasals, the development of the suborbital foramen, the depth of the maxillary region, the size of the molars, and the breadth of the incisors are all particularly noticeable. The dentition of the two forms agrees in that in both the lower incisors have two deep grooves, the upper pair a deep outer and very indistinct inner groove, (see Fig. 1, p. 12) and the posterior upper molar has seven laminæ. (Lamination of the series $\frac{3-2-7}{4-2-2}$.)

Pelage.—In general character identical with, but longer, coarser, slightly lighter, and more olivaceous than, the smaller *O. j. malkensis* (see below), somewhat resembling *O. thomasi* Osgood from the Guaso Nyiro, very distinctly differing from the dark forms, *O. elgonis* Wroughton, *O. tropicalis* Thomas, and *O. irroraratus* Brants, and most like *O. orestes* Thomas (see above). Dorsal area Dresden-brown[5] in general appearance, sides lighter toned and but slightly differentiated from the drab-like under parts. Upper pelage very long and soft; fur bicolored, composed of a thick covering of comparatively short hair (24 mm. in length) intermixed with longer hair (32 mm. in length). Basal portion of entire coat slate-gray; tips of thick upper covering (1/10 of total length) vary from light buff on the sides to antimony-yellow on the back, longer scattered hair banded subterminally to terminally with broad black annulations; tips of under parts shorter and light buff-colored, general grayish appearance due to prominence of faded basal fur; outer portions of arms and legs same as sides, inner portions as under parts; end of snout, hair about eyes, and anterior ear-tufts antimony-yellow; posterior ear-patches of uniform, long, faded, light buff hair, ears large, sparsely clad; tail short, well covered with bristles, dark above, light buff below, (annulations 11 per 10 mm.); upper parts of feet gray, washed with buff; toes worn dark, claws light to translucent.

I take pleasure in naming this fine Abyssinian mountain form after Mr. Edmund Heller, who has so greatly assisted the writer in comparing his material with that at the Smithsonian Institution.

3. **Otomys jacksoni malkensis** subsp. nov. (Plate III, figs. 6–10.)

Type from vicinity of Malka, Sidamo, Abyssinia, altitude 7,000 ft. (Original field number G. D. R. 29, March 3, 1912.)

GENERAL CHARACTERS.—Lighter colored than *O. jacksoni* (*typicus*) from Mt. Elgon (by published description, *l. c.*), with which it agrees in the proportions of the skull and body. (See table of measurements under *O. j. helleri.*)

Skull.—Fully adult. Measurements agree with those of *O. jacksoni* (see measurements above).

[5] Ridgway *l. c.* (*cf.* footnote 4).

Pelage.—Upper parts dark cinnamon-brown[6] in tone, sides lighter, demarcation between same and drab-gray under parts better defined than in the larger *O. j. helleri*. Tips of hair over upper parts ochraceous to light buff; on lower parts gray washed with light buff; anterior and ocular portions of face without the light markings of the larger species; ears well clad, contrasting with the poorly clad, to much worn ears of *O. j. helleri*; light posterior orbital patches same in both subspecies; tail dark above, light below (annulations 14 to 10 mm. against 11 to 10 mm. in the larger form); covered with dark light-tipped hair, claws light to translucent.

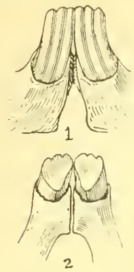


FIG. 1. Lower incisors of type (No. 29), 1. viewed from in front; 2, from above. $\times \frac{2}{1}$

Genus GERBILLUS Desmarest.

4. Gerbillus bilensis sp. nov.

Type from dry plain near Bilen, Abyssinia. (Original field-number 7519, Dec. 19, 1911.)

GENERAL CHARACTERS.—In markings and coloration closely agrees with the description of the much larger *G. pyramidum* Geoffroy of Egypt (see J. Anderson, "Zoology of Egypt," 1902, p. 255) and differs from *G. pygargus* Cuvier from Suakin (*l. c.*, p. 256) and *G. pulvinatus* Rhoads from southern Abyssinia, which it more nearly resembles in size, by its pronouncedly dark median dorsal area, black eye-lids, dark postocular stripes, and strongly buff coloration of the under surface of the tail.

Skull.—The hinder portion of the skull of the type is gone; the molars are somewhat worn. Compared with the type of *G. pulvinatus* Rhoads,[7] the general proportions are the same, but the interorbital region is slightly broader.

Pelage.—Median portion of back and rump heavily marked with black, anterior and lateral portions bright ochraceous buff (*cf.* Ridgway), under parts pure white. Individual hairs of upper flanks and back light slate-gray at base and light ochraceous buff at tips, which

[6] Ridgway, *l. c.* (*cf.* footnote 4).

[7] *Proc. Acad. Nat. Sciences of Philada.*, Vol. 48, 1896, p. 537. The writer has had access to the specimens through the kindness of Mr. Witmer Stone, the Curator in charge.

Measurements.

	No. 7519, Type *bilenensis*, mm.	Rhoads' Type *pulvinatus*, mm.	No. 92, *pulvinatus* ♂, mm.	No. 91, *pulvinatus* ♀, mm.
Length of head and body	92.	....	86.	8.
Length of tail	139–151.0	137.	127–137	130–137
Length of hind foot	25.5	24.5	25.	24.5
Greatest length of skull	....	30.6	31.1	27.2
Basilar length of skull	....	22.2	22.6	19.2
Condylo-incisive length	....	26.5	....	23.5
Zygomatic breadth	....	....	16.2	14.2
Interorbital breadth	5.9	5.6	5.5	5.1
Squamosal breadth	....	13.4	13.7	12.7
Length of nasals	11.6	13.	11.8	9.8
Breadth of nasals	2.6	2.6	2.3	2.1
Length of diastema	7.2	7.8	8.	6.6
Alveolar length of upper row of molars	3.8	4.	4.1	4.
Length of palatal foramen	4.6	5.2	5.7	4.5
Length of bullæ	....	10.6	11.5	10.2
Depth of brain-case	....	9.1	....	8.8
Depth of maxillaries at fronto-nasal suture	....	7.1	....	6.3
Length of mandible	15.	15.	15.3	13.5

over the dark area of the back are surtipped with black and intermixed with long black hair; hair of lower flanks white at base, but with light ochraceous buff tips, which blend into the pelage of the upper parts, and are sharply defined from the uniformly white hair of the under parts; coloration of the outer side of the thighs continuous with that of the flanks; arms and inner sides of thighs white; sides, shoulders, and muzzle light ochraceous buff; the bright coloring of muzzle continued further down on sides of face than in *G. pulvinatus* Rhoads, where the white of the chin encroaches on the same; occiput dusky; slight markings beneath eye and half-way between corner of eye and tip of nose, distinctly backwardly prolonged superciliary line, and small post-auricular patches, white; margins of eye and oblique streak posterior to same, dusky; main portion of tail light ochraceous buff, dorsally marked with black, below paler, but without the white streaking of *G. pulvinatus*; pencilled portion well-developed, black above, white below (max. length of hair 12 mm.)

The collection of the writer contains two specimens of a *Gerbillus* collected at the Oasis of Hor, just south of the Abyssinian border, which in the proportions of the skull appears similar to Dr. A. Donaldson Smith's *Gerbillus pulvinatus* from Sheik Hussein (see description by Rhoads). The type of the latter has unfortunately been so long in alcohol that it is impossible to determine the color of the pelage, but the outlines of the markings appear to agree with those of the specimens from Hor, and a dry skin of an immature specimen in the Smith Collection, which has been referred to the type has the same markedly pinkish tone. The new subspecies from Sadi Malka differs from all of these in the darker shading of its dorsal areas, and in the ochraceous buff, instead of pinkish buff, coloration of the lateral portions of its coat.

Genus TATERA Lataste.

5. **Tatera nigricauda bodessæ** subsp. nov.

Type from Sagan River, Bodessa, Abyssinia; altitude 5,000 feet. (Original field-number 312 E. A. M., June 6, 1912.)

GENERAL CHARACTERS.—Much smaller, but in other respects somewhat strongly resembling *T. nigricauda nyama* Dollman[8] from the northern Guaso Nyiro, but the black tail is shorter-haired, the color of the body less brightly rufescent, due to the comparative lightness of the coat and the resulting greatei prominence of the slaty color of the under fur, the head is darker, and the white and black ocular markings more pronounced.

Length of pes 34.6 *versus* 36. in *T. nigricauda nyama.*

Skull.—Fully adult, but molars show scarcely any wear. Of the same type as skulls of the series of *T. n. nyama* Dollman in the U. S. N. M., but of markedly smaller size than those of the latter of equal age.

Pelage.—Dorsal pinkish area buff (*cf.* Ridgway) heavily shaded with black on head, median, and especially posterior portions of back; under parts white. Individual hairs of upper pelage light slate-gray with long whitish bases (the same being characteristic of *T. nigricauda* Peters (*typica*) in contrast with the light slate-gray of *T. vicina* Peters (*typica*) and allies)[8a] and pinkish buff tips, surtipped over darker areas with black, and mixed with usual longer black hairs; flanks less bright and pinker in tone than in *T. n. nyama*; coloration of outer sides of legs continuous with upper parts, inner sides uniform white, like under surfaces; snout and nape heavily shaded with darker; lids dusky, promi-

[8] *Cf.* Ann. & Mag. Nat. Hist., (8) Vol. 7, 1911, p. 592. Specimen No. 183937, ♀, U. S. N. M., is of the same age as the type of the new subspecies.

[8a] *Cf.* MB. Akad. Berlin, 1878, p. 200. *Nigricaudus* from Taita, greatest length of skull 49 mm., length of pes 41 mm.; *vicinus* from Kitui; greatest length of skull 42 mm.; length of pes 31 mm.

MEASUREMENTS.

	No. 312. (Type, ♂).	No. 183937 U. S. N. M. (*T. n. nyama*).
Length of head and body	127.	152.
Length of tail	182.	208.
Length of pes	34.5	36.
Greatest length of skull	39.6	41.
Basilar length of skull	29.1	30.4
Condylo-incisive length	34.6	36.
Zygomatic breadth	20.2	20.7
Interorbital breadth	7.	7.7
Squamosal breadth	17.	17.3
Length of nasals	16.5	17.8
Breadth of nasals	3.5	4.
Length of diastema	10.2	10.7
Alveolar length of upper row of molars	6.5	6.5
Length of palatal foramen	7.	7.5
Length of bullæ	11.	11.
Depth of brain-case	12.5	12.5
Depth of maxillaries at fronto-nasal suture	9.3	10.
Length of mandible	20.5	21.3

nent white of posterior portion of ocular rings passing into a grayish area behind, anterior corner of eye with black markings; ears well-developed, long, buffy haired at bases, tips dark; vibrissæ predominantly black with some white; tail well-clad, hair shorter than in *T. n. nyama*, anterior fourth of tail warm buff-colored with white markings underneath, posterior three-fourths black; top of tarsus light buff; upper surface of feet and toes covered with white hair, soles naked, under surface of toes slightly haired.

The collection includes an immature specimen from Wobok, Abyssinia.

6. Tatera vicina bodessana subsp. nov.

Type from Bodessa, southern Abyssinia; altitude 5,000 feet. (Original field-number E. A. M., 301, May 25, 1912.)

GENERAL CHARACTERS.—Resembles *T. v. pothae* Heller,[9] but is distinctly smaller (see measurements below) and is more darkly shaded over the posterior portion of the back and pinker in tone laterally.

Length of pes 31.5 mm. *versus* 35.5 in *T. v. pothæ* Heller.

Skull.—Similar to *T. v. pothæ*, but smaller throughout (greatest

[9] *Cf.* Heller, Smith. Misc. Coll., Vol. 56, 1910, p. 2. Specimen No. 163425 U. S. N. M. is a ♂ from the Ulucania Hills, British East Africa, which is of about the same size as *Tatera vicina* Peters, *l. c.*

length 36.2 *versus* 41.3 in *T. v. pothæ*) the nasals being noticeably smaller in proportion, and the incisors lighter.

MEASUREMENTS.

	No. 301 ♂, (Type), mm.	No. 302 ♂, mm.	No. 36 ♂, mm.	No. 163425 ♂, U.S.N.M., mm.
Length of head and body	140.	133.	126.	144.
Length of tail	178.	178.	178.	178.
Length of pes	31.	31.5	32.	35.5
Greatest length of skull	36.2	....	37.2	41.3
Basilar length of skull	26.8	29.	27.5	31.
Condylo-incisive length	29.2	33.2	32.4	36.9
Zygomatic breadth	17.5	18.2	18.4	....
Interorbital breadth	6.5	6.3	6.5	7.1
Squamosal breadth	15.5	15.7	15.3	17.
Length of nasals	15.	....	15.1	19.
Breadth of nasals	3.5	....	3.4	4.1
Length of diastema	8.8	9.6	9.	10.6
Alveolar length of upper-tooth row	6.	6.3	6.	6.6
Length of palatal foramen	6.	7.	6.5	7.5
Length of bullæ	10.5	10.8	10.9	11.1
Depth of brain-case	11.2	11.7	11.7	12.5
Depth of maxillaries at fronto-nasal suture	8.8	8.8	8.6	10.1
Length of mandible	18.2	19.2	18.6	21.4

Pelage.—Dorsal area pinkish buff (*cf.* Ridgway) heavily mottled with black and sharply defined from the white of the under parts. Individual hairs of upper pelage slate-gray at base and light pinkish buff at tips, which are surtipped with black over darker median area; latter portion also lightly lined with longer black hair; coloration of outer portions of legs continuous with flanks and shoulders, inner portions with white of lower coat; lids and anterior basal corners of eyes dusky; grayish markings above and behind eyes; ears buff at base, and dark at tips as in *T. v. pothæ*; tail well-clad, dark above and light buff below, with hairs at the end elongated; upper surface of feet and toes thickly covered with white hair, soles bare, under surface of toes very slightly haired; claws much weaker than in *T. v. pothæ*, translucent to dark.

Besides the type the collection of the writer contains an old adult (No. 302, ♂) and two immature specimens (Nos. 304 and 316) from the type-locality, together with a mature male from Black Abai Lake. The latter closely resembles the type, but is a trifle lighter in tone. The young are very black over the median dorsal area, the rump, and the upper surface of the tail. The skull measurements of the old adult male (No. 302) the molars of which are much worn, are comparatively small, and similar to those of the type in the foregoing table and compare with the less aged but much larger specimen of *T. n. nyama*.

Genus EPIMYS Trouessart.

(*Coucha* Group.)

The collection of the author contains specimens of the genus *Epimys* from widely separated districts of Shoa and Sidamo, which have the "blackish" eye-ring, "bright ochre-colored" hair, and darkly tinted wrists and ankles of Heuglin's description of *M.* (?) *rufidorsalis*,[10] but which differ from the same in their proportionately greater length of tail and in the white tipping of the fur of their under parts, being pure white, without the "dirty yellowish tinge." The collection also includes specimens from Addis Ababa, Black Abai, Gardula, and Tertale, which lack the dark ocular rings, dark ankles, and light ochraceous sides of *rufidorsalis*, and resemble Peters' *Mus hildebranti*[11] and certain British East African races of the same.

7. **E. rufidorsalis alettensis** subsp. nov.

Type from Aletta, Sidamo, Southern Abyssinia, altitude 6,000 feet. (Original field-number 31, D. G. R., March 6, 1912.)

GENERAL CHARACTERS.—Long soft fur, bright ochraceous buff of side-coloration, dark ocular rings and ankles.

Skull.—Badly broken; of about same size as the larger specimens of *hildebranti*, but with slightly heavier molars.

Pelage.—Upper parts bright ochraceous buff[12] thickly intermixed with black over median dorsal area; under parts grayish white to white. Deep quaker-drab hair of upper coat over median area faintly tipped with ochraceous buff and thickly intermixed with longer black-tipped hair; on shoulders and flanks strongly tipped with ochraceous buff and but very faintly lined with black; outer sides of arms and legs deep mouse-gray washed with buff; fur of under parts and inner sides of arms and legs shorter and tipped with white; dark ocular rings prominent; ears large, the distal half dark and finely covered with short hair; vibrissæ black and white; throat and chin well-covered, hairs with

[10] Heuglin, "Reise in Nordost-Afrika," Vol. II, p. 70.

[11] Peters MB. Akad. Berlin, 1878, p. 200.

[12] Ridgway, *l. c.* (*Cf.* footnote 4).

dark bases and white tips, contrasting with the tendency to uniform white in *hildebranti* Peters; tail dark brown above, lighter below; flesh and hair of wrists and ankles cinnamon-brown, becoming lighter on distal portions of feet and passing into white on the toes; claws light, translucent, or speckled with darker color.

The collection includes a very young specimen (No. 32 ♀) from the type-locality, which shows the same ocular rings and dark ankles.

8. **E. rufidorsalis ankoberensis** subsp. nov.

Type from Ankober, Shoa, Abyssinia, altitude 7,500 feet. (Original field-number 7521, E. A. M., January 23, 1912.)

GENERAL CHARACTERS.—Comparatively large size of body and skull, dark ocular rings and ankles.

Skull.—Compared with other races of *E. coucha* Smith this is longer and broader, showing greater development of the brain-case and nasals.

Pelage.—Upper dorsal area prevalently hair-brown [13] in color, slightly speckled with buff-tipped hair; sides bright buffy; under parts pallid mouse-gray; dark ocular rings prominent, tip of nose white, ears very large, with the usual fine covering; tail strongly bicolored, skin and hair dark above, and hair below thick and white; ankles hair-brown and sharply contrasted with the white-furred distal parts of feet and toes.

9. **E. hildebranti gardulensis** subsp. nov.

Type from Gardula, Southern Abyssinia; altitude 4,000 feet. (Original field-number 44, ♂, D. G. R., March 27, 1912.)

GENERAL CHARACTERS.—Slightly larger, but agreeing in the proportions of skull and body with the series of *E. neumani* Heller from the northern Guaso Nyiro, in U. S. National Museum, the general appearance of the upper parts resembling *E. neumanni*, and being almost identical with that of the slightly smaller *E. panya* Heller *l. c.*, from Juja Farm, and the lower surface differing from both *E. neumanni* and *E. panya* by the entire lack of the usual buffy over-wash.

Skull.—Proportions very similar to, but slightly larger than, those of *E. neumani* Heller.

Pelage.—Dorsal area generally avellaneous,[14] median portion dark to blackish, due to thick intermixing of longer black hair (the light-tipped fur is never surtipped with black as in *Arvicanthis* and some

[13] Ridgway, *l. c.* (*Cf.* footnote 4).

[14] Ridgway, *l. c.* (See footnote 4).

other genera); sides lighter and divided from pallid mouse-gray of under parts by a bright buffy line; slate-gray fur of ventral surface evenly tipped with pure white; tail slightly darker above than below, annulations prominent (13 per 10 mm.) and but slightly haired; feet and toes white-furred.

Color of dorsal area of series of nine specimens (Nos. 44 ♂, 86 ♂, 37 ♀, 55 ♂, 53 ♀, 313 ♂, 83 ♂, 80 ♀, and 89, *juv.*) varies from drab-gray in a specimen from Tertale to vinaceous-buff in one from Black Abai Lake.

The collection includes a specimen (No. 7520) from Addis Ababa, which differs from the specimens described above, and corresponds with Peter's description of *E. hildebranti* (*typicus*) in the strong "ochre color" of its under parts, the white of same being heavily washed with buff along the sides and mid-ventral line. This specimen also differs from *E. gardulensis* in having heavier fur and in the exceptional blackness of its dorsal area. Tails of specimens from Addis and Tertale are much the shortest of the series, and the only specimens in which tails measure less than the combined length of head and body.

MEASUREMENTS.

	No. 44 ♂ (Type), mm.	No. 37 ♀, Black Abai, mm.	No. 7520 ♂, Addis, mm.	No. 313 ♂, Tertale, mm.	No. 7521 ♂, Ankober, mm.
Length of head and body	120.	112.	131.	1 5.	133.
Length of tail	120.	113.	107.	07.	154.
Length of pes	25.	24.5	24.5	23.5	28 ?
Greatest length of skull	33.3	32.5	31.6	30.6	34.9
Basilar length	26.6	26.1	26.	23.9	28.1
Condylo-incisive length	31.4	30.4	30.1	28.5	32.5
Zygomatic breadth	....	15.5	....	14.1	16.4
Interorbital breadth	4.6	4.4	4.6	4.4	4.9
Squamosal breadth	13.	12.1	12.4	12.2	13.6
Length of nasals	12.6	12.9	12.6	12.6	14.1
Breadth of nasals	3.4	3.5	3.3	3.1	4.
Length of diastema	8.5	8.6	8.6	8.	9.4
Alveolar length of upper tooth-row	5.6	5.4	5.1	5.1	6.3
Length of palatal foramen	7.6	7.	7.7	7.1	7.5
Depth of brain-case	9.	8.5	9.3	8.5	9.1
Depth of maxillary at fronto-nasal suture	7.6	7.5	7.4	7.	7.6
Length of mandible	17.6	17.6	17.5	16.5	19.1

Genus ARVICANTHIS. Lesson.

Three distinct forms of *Arvicanthis abyssinicus* Rüppell, taken in widely separated localities, Chilalo (altitude 9,000 feet), Sadi Malka

(3,000 feet), and Gardula (4,000 feet), differ from the species represented in the U. S. National Museum and from descriptions of those in the British Museum, and are described below as new subspecies.

The first, a large form from the Chilalo Mountains, by its heavy molars and strongly built skull, together with its short tail, well defined dorsal line, and lightly lined coat, is quite distinct from the latter two, which differ from each other mainly in color and in the proportionate length of their longer tails, the specimens from Sadi Malka tending to resemble *A. testicularis jebelæ* Heller and those from Gardula *A. a. nubilans* Wroughton.

10. **Arvicanthis abyssinicus blicki** subsp. nov. (Plate IV, figs. 1–5.)

Type from Hora Mountain Base Camp, South Chilalo Mountains, Abyssinia, altitude 9,000 feet. (Original field-number 26, ♂, D. G. R., Feb. 28, 1912.)

General Characters.—A large light-colored form with short tail, prominent median dorsal line, undifferentiated lower parts, and exceptionally heavy molars.

Length of foot 33 mm.; of tail 150 mm.; alveolar length of upper tooth-row 8.5 mm.

Pelage.—The tawny olive[15] coloration of the dark median area and light-lined pinkish buff of the lateral portions of the back pass into wood-brown and drab-gray on the under parts. Black hair of scant dorsal lining long (23 mm.), main coat bi-colored, bases of hair warm sepia, tips light buff on under parts and sides to warm buff on upper and posterior portions of back; hairs of rump 9.5–11.5 mm. in length; outer portions of arms and legs same as back; throat and inner portions of limbs scantily haired and faded inner coat prominent; small post-auricular patches of soft white hair; ear-covering and sides of snout warm buff; tail well clad, buff below and on sides, black-brown above (in some specimens whole tip is black); hair of body at base of tail ochraceous tawny; feet gray, washed with warm buff; claws opaque black throughout.

Skull.—Strongly built and exceptionally broad, especially in zygomatic region (zygomatic breadth 19–21 mm. in series of eight specimens, against 18.5 in typical *A. abyssinicus* Rüppell);[16] frontals depressed between strong supra-orbital ridges, which send spurs into

[15] Ridgway, *l. c.* (*cf.* footnote 4).

[16] *Cf.* Dollman, *Ann. and Mag. Nat. Hist.* (8), Vol. 8, 1911, p. 334, *et seq.*

orbit; dorsal frontal maxillary line much curved; palatal foramina without usual mid-lateral expansion; post-palatal foramina fairly large, opposite heel of M^2; molars very broad and heavy with markedly heavy cusps, arranged in typical Arvicanthis pattern; alveolar length of upper row of teeth 8.5 mm., compared with 7 mm. in *A. abyssinicus* Rüppell (*cf.* Dollman, *l. c.*) and 8 mm. in the larger *A. niloticus* Desmarest (*cf.* Dollman, *l. c.*) and attaining in Specimen No. 15 (a very old female) a measurement of 9.4 mm. (see table below).

MEASUREMENTS.

	Type 26, ♂, Mm.	401, ♀, Mm.	14, ♂, Mm.	15, ♀, Mm.	21, ♂, Mm.	28, ♂, Mm.	16, ♀, Mm.	403, ♀, Mm.	18, ♂, Mm.
Length of head and body	164	161	164	164	164	150	143	158	158
Length of tail	103	111	111	110	110	104	92	113	111
Length of pes	30	29.5	31	32	29	30.5	28	31.5	27
Greatest length of skull	35.8	35.2	....	....	....	35.7	....	33.4	32.8
Basilar length of do.	31	30.7	....	....	....	31.3	29	28.5	28.2
Condylo-incisive length of skull	35	34.5	....	....	....	35.3	....	32.5	32
Zygomatic breadth	29	19.5	20.8	....	....	19.1	19	18.6	19.6
Interorbital constriction	5	5.1	5.3	5	4.7	4.7	4.8	4.7	4.6
Squamosal breadth	14	14	....	....	....	13.9	13.5	13	14
Length of nasals	14	13.5	....	14	12	13.5	12.5	12.5	12.5
Breadth of nasals	4.5	4.4	4.6	4.5	4.4	4	4.5	4.4	4
Length of diastema	9.5	9.5	10	10.3	10	9.3	9	8.5	8.5
Alveolar length of upper tooth-row	8.5	8.5	8.7	9.4	8.5	8.5	8.5	8.5	8.1
Length of palatal foramen	7	7	7.5	7.5	7.5	7.5	7	6.5	6.5
Length of bullæ	6.5	6.5	....	....	6.7	6.5	6.6	6.5	6.5
Depth of brain-case	10	10.5	....	....	....	10.4	10	9.7	10.3
Depth of maxillaries at fronto-nasal suture	11	10.5	11	11.3	9.7	9.5	9.5	9	9.3
Length of mandible	22	22	23	24.5	23	22	21	21.5	20

The author's collection contains a series of seventeen specimens, twelve large adults, three small adults, and two immature, all taken February 24, 25, and 28, on treeless plain by Hora Mountain Base Camp, where they were seen running about in the daytime pursued by hawks. The pelage of most specimens is much worn and therefore patchy in appearance, the light tips of the dorsal hairs having been broken off over considerable areas. Specimen No. 18 shows the widest variation in color, tending toward buffy brown in contrast with the tawny olive of the type.

Named after my companion, Mr. J. C. Blick.

11. **Arvicanthis abyssinicus mearnsi** subsp. nov. (Plate IV, figs. 6–10.)

Type from Sadi Malka, Hawash River, Abyssinia, altitude 2800 ft. (Original field number 7522 E. A. M., January 29, 1912.)

GENERAL CHARACTERS.—Length of tail equal to, or greater than, combined length of head and body, and grayish olive tone of body coloration.

Skull.—Generally very similar to *A. a. raffertyi* (see description below), but viewed laterally shows less depth in the maxillary region, and a more flattened brain-case; all suggesting *A. testicularis jebelæ* Heller (see comparative table of measurements below). The posterior portion of the incisive foramina, however, is shorter and not narrowed down as in the latter and the breadth of the skull is greater.

Pelage.—Black-lined dorsal area deep grayish olive to brownish olive[17] posteriorly, median line absent; under parts whitish, sharply differentiated from sides, and washed with buff along mid-ventral line and at sides. Individual hairs of main coat dark at base, dorsally with terminal to sub-terminal bands of cartilage or cream-buff, and ventrally with white to light buff tips; hairs of rump 1.15 mm.–18.5 mm. in length; flanks, sides of face, outer portions of arms and legs deep to dark olive-buff; ocular rings, sides of muzzle, and hairs of ear cream-buff; skin of throat and inner arms bare; vibrissæ black; tail buff below, dark above; hairs of rump at base of tail sagal-brown;[18] feet gray, strongly washed with buff, claws brown with horny tips. In general external appearance this new subspecies somewhat resembles *A. a. jebelæ* Heller, but its upper parts are much darker, due to the black lining, which is less distinct in *A. a. jebelæ*. The size of the body is less than that of the latter, and its tail is proportionally longer.

The writer's collection contains four specimens, all taken at Sadi Malka on January 29, 1912. No. 7523 shows a slight variation in color from the type, being lighter and more brownish olive in tone.

I have named this new sub-species after Dr. Mearns, collector of the type, and ornithologist of the expedition.

[17] Ridgway, *l. c.* (*cf.* footnote 4).

[18] Measurements from specimen in United States National Museum.

MEASUREMENTS.

	No. 7522, ♂, (Type), Mm.	No. 7523, ♂, Mm.	No. 7524, ♂, Mm.	No. 38, ♂, Mm.	*A. testicularis jebelæ* Mm.
Length of body and head	141	136	132	132	153
Length of tail	138	145	137	143.5	143
Length of pes	29	28.5	27	27	28–29
Greatest length of skull	34	34.2	33.3	32.2	34
Basilar length of skull	27.5	27.7	27	26.5	28
Condylo-incisive length of skull	32	32.1	31.3	30.5	32
Zygomatic breadth	...	17.1	17	16.6	16.1
Interorbital constriction	5.4	5.2	5.2	5	5
Squamosal breadth	13.2	13.4	13.2	13	12.7
Nasals, length and breadth	13 × 4	12.3 × 4.3	12.3 × 4.2	11.8 × 4	13.2 × 3.7
Length of diastema	8.2	8.2	8.1	7.6	8.5
Alveolar length of upper tooth-row	7	7	6.6	6.5	6.8
Length of palatal foramen	7	7	6.7	6.7	7.1
Depth of brain-case	9.8	9.6	9.5	9.3	9.5
Depth of maxillary region at fronto-nasal suture	8.5	8.6	8.6	8.3	8.7
Length of mandible	18.7	18.7	17.8	17.6	19

12. **Arvicanthis abyssinicus raffertyi** subsp. nov. (Plate V.)

Type from Gardula, Southern Abyssinia, altitude 4,000 feet. (Original field number D. G. R. 59. Collected March 29, 1912.)

GENERAL CHARACTERS.—Rufescent, with tail of medium length, and neither dorsal stripe nor white post-auricular patches. Very similar in color to certain specimens of *A. a. nubilans* Wroughton in the U. S. National Museum, and also appearing to resemble Mr. Dollman's description of *A. a. zaphiri*, but lacks the broad brain-case and large pes of the latter.

Squamosal breadth of brain-case 13.8 against 15.2 of *A. a. zaphiri* Dollman[19] and 14.2 of *A. a. nubilans* Wroughton; average length of pes 27.5–28.5 *versus* 31 of *A. a. zaphiri.*

Skull.—General proportions very similar to those of *A. a. nubilans* Wroughton from Kisumu in the U. S. National Museum. A series of specimens shows great variations in size. (See measurements below.)

Pelage.—Dorsal area cinnamon-brown[20] to ochraceous tawny, heavily lined with black and sharply differentiated from the gray of under parts. Black lined main pelage of upper parts with broad light-colored terminal

[19] Dollman on "*Arvicanthis abyssinicus* and allied East-African Species, with Descriptions of Four New Forms," *Ann. and Mag. Nat. Hist.* (8), Vol. 8, 1911, p. 334.

[20] Ridgway, *l. c.* (*cf.* footnote 4).

MEASUREMENTS.

	No. 59 ♂ (Type), Mm.	No. 55 ♂, Mm.	No. 61 ♀, Mm.	No. 38 ♀, Mm.	No. 65 ♂, Mm.	No. 56 ♀, Mm.	No. 7548 ♂, Mm.	No. 60 ♀, Mm.	No. 40 ♂, Mm.	No. 88 ♂, Mm.	No. 64 ♀, Mm.
Length of head and body	149	145	132	129	176	144	143	132	113	148	134
Length of tail	128	129	....	114	123	107	113	112	105	114	106
Length of hind foot	27.8	28.5	27.5	27.5	28.5	27.5	29.5	28	27	28.5	24.5
Greatest length of skull	35.3	36.5	....	35.6	34.7	34.4	33.8	33.7	33.7	32.5	....
Basilar length	28.3	29.7	29.4	....	29	27.5	27.5	28.3	27.3	26	26
Condylo-incisive length	33	34.5	33.4	....	33.5	....	32.5	32.1	32	30	30
Zygomatic breadth	17.9	18.3	17.8	18.4	18	17.8	17.6	16.5	17.5	16.5	16.5
Interorbital breadth	5.3	5.8	5.8	5.3	5.8	5.5	5.1	5.3	5.4	5	4.9
Squamosal breadth	13.8	13.7	13.3	13.9	13.2	13.7	13	13	13.5	13.5	13
Length of nasals	13	13.3	....	14.	12.5	12.5	12.5	13	12.6	12.5	....
Breadth of do.	4.2	4.7	....	4.6	4.8	4.5	4.4	4	4	4	....
Length of diastema	9	9.5	8.7	9.2	9	8.7	8.5	8.8	9	7.5	8.2
Alveolar length of upper-tooth-row	7.1	6.7	7	7.1	7.5	7.5	6.7	7	6.5	7	6.5
Length palatal foramen	6.5	7	6.7	7	7	7	6.5	7	6.1	5.5	6.1
Depth of brain-case	10.7	10.7	10.1	....	10.5	10.5	10	10.3	10.2	....	10
Depth of maxillaries	10	10	9.6	10.1	10	9.5	9.7	9.2	9.4	8.5	9
Length of mandible	19.05	20.7	20	20.1	19.5	20	....	....	....	18.5	18

to subterminal rings of light ochraceous to ochraceous-buff; hair of rump 11.5–20 mm. in length; under parts gray with three indistinct longitudinal buffy lines, *i. e.*, two lateral, bordering dark coloration of the sides and a single median line; outer covering of arms and legs continuous with ochraceous tawny flanks and shoulders; throat and undersides of arms and legs sparsely covered with hair; ocular rings, sides of snout, scant short covering of ears, and anterior basal tuft ochraceous-buff; lower side of tail ochraceous buff, upper side black· hair of rump at base ochraceous buff; anal region of the same color mixed with white; feet ochraceous buff with toes tending to become dark through wear; claws brown with horny tips.

The author's collection contains twenty-three specimens of different ages taken March 27–April 25, 1912, in the vicinity of Gato Camp, Gardula, and one specimen from South Abai Lake, taken March 19 (No. 7548 ♀), which differs from the rest of the series in the length of the pes, the maximum length of the pes in the series being 28.5 mm., as against 30 mm. in No. 7548, but the coloration and characters of the skull indicate that it belongs to the same species.

Individuals show considerable variation in color:[21]

1. In the distinctness of the demarcation between the sides and under parts;

2. In the tone of the under surface, which runs from white, either lightly or strongly washed with buff, to dark mouse-gray; and

3. In dorsal shading, which is partly due to age, *i. e.*, specimens with unworn to slightly worn molars average darkest and more olivescent than rufescent.

The size (by measurement of skulls and dried skins) is not dependent upon age, *i. e.*, the molars of two of six specimens (including the type) measuring in length of head and body 150 mm. and over, together with those of nine specimens averaging 135 mm. in length, show scarcely any wear, while the molars of one specimen of ten measuring under 125 mm. are well worn (No. 40).

Average length of tail 105 mm.; tail of type and Nos. 51 and 41 longest, 130 mm.; latter short-bodied and only specimen with tail exceeding combined length of head and body.

The species is named after its collector, Dr. Rafferty.

[21] Upper pelage of No. 61 ♀ in writer's collection is identical in color with a specimen of *nubilans* Wroughton in the U. S. National Museum, No. 183050, but *A. nubilans* as a series runs lighter and the tails average less than in the new subspecies.

Genus ACOMYS Geoffroy.

13. **Acomys hawashensis** sp. nov.

Type from Sadi Malka, Abyssinia; altitude 3,500 feet. (Original field-number D. G. R., No. "A," ♀, Jan. 31, 1912.)

In the size of tail and body this form approaches *A. dimidiatus* Cretzschmar from Egypt,[22] and differs greatly from a series of *A. kempi* Dollman[23] in the author's collection in the greater length and breadth of body, tail, and feet, the larger size of ears, brighter coloration of sides, lack of subocular white patches (has tendency to the same postorbital patches) and heavier dorsal spines. In the latter feature it approaches *A. percivali*[24] Dollman.

Pelage.—The fawn-color of the anterior dorsal region darkens into benzo-brown on spiny rump and passes into light pinkish cinnamon on flanks and shoulders; underparts white. Hair of dorsal area stiff, modified into spines over the posterior part of same. (Maximum length of hairs 14.5 mm. *versus* 12.5 mm. in *A. kempi* and 15.5 in *A. percivali*.) Individual hairs mouse-gray in color, with whitish bases and tips of light cinnamon-drab to benzo-drab (*cf.* Ridgway *l. c.*) on upper parts, and pinkish cinnamon on sides and flanks; outer portions of arms and thighs marked with light pinkish cinnamon like shoulders and flanks, inner portions white like the under parts; head and snout fawn-colored, sides of face light like the sides of the body; no white subocular patches as in *A. kempi*; ears much larger than those of the latter species, but similarly covered with fine down, brownish and darkest towards tips; tail, which is equal to head and body in length, darkest dorsally, where the fine bristles are stouter and darkest (annulations 14 per 10 mm.). Bristle-like covering of upper surface and sides of feet white, washed with benzo-brown.

NOTES.

It is worthy of remark that the nine specimens of *A. kempi* in the collection of the author (three adults and one immature from Tertale, three from Mt. Indunumara, one from Endoto, and one from Yebo) cannot be differentiated by skull-measurements or external characters from a series of the same species in the U. S. National Museum, taken at the Northern Guaso Nyiro. Mature individuals vary slightly in

[22] *Cf.* Rüppell, Atlas, 1826, p. 37; and Anderson, "Mammals of Egypt," 1902, p. 234.

[23] Annals & Mag. Nat. Hist., (8) Vol. 8, p. 125.

[24] Annals & Mag. Nat. Hist., (8) Vol. 8, p. 126.

the color of the back, which becomes lighter and more pronouncedly fawn with age. The very young are mouse-gray, with only a slight suggestion of drab on lower flanks. The spines are also undeveloped in the young, and the tails are smooth and mouse-gray above, contrasting with the roughened and fawn-colored tails of adults.

The nineteen specimens of a blue form taken at Gardula and the Abai Lakes, which agree in coloration and measurements with the series of *A. percivali* Dollman, in the U. S. National Museum, especially that part of the series from the Lololokui Hills (north of the Northern Guaso Nyiro River), appear to be identical with Dr. A. Donaldson Smith's alcoholic specimens from Lake Abai and eastward,[25] and differ from *A. kempi* Dollman:

1. By the blue instead of strongly fawn tone of the dorsal coloration;

2. By the coarser and less brilliant under parts, with a tendency to gray at the throat;

3. By the less distinct demarcation between the sides and upper parts;

4. By the longer spines (maximum length 15.5 mm. *versus* 12.5 mm.);

5. By the fact that skulls with well-worn molars average slightly larger than skulls of *A. kempi* of the same age. But both forms are somewhat variable.

EXPLANATION OF PLATES.

PLATE I.

FIG. 1. *Stenocephalemys albocaudata* Frick. Adult. (Type No. 11.) Lateral view of skull and mandible. $\frac{1}{1}$.

FIG. 2. Do. Superior view of skull.

FIG. 3. Do. Inferior view of mandible.

FIG. 4. Do. Inferior view of skull.

FIG. 5. Do. Superior view of mandible.

FIG. 6. *Dasymys sp.* (U. S. Nat. Mus., No. 165237.) Lateral view of skull and mandible. $\frac{1}{1}$.

FIG. 7. Do. Superior view of skull.

FIG. 8. Do. Inferior view of mandible.

FIG. 9. Do. Inferior view of skull.

FIG. 10. Do. Superior view of mandible.

[25] In the collection of the Academy of Natural Sciences of Philadelphia marked "*spinosissimus* Peters," for the privilege of examining which the author is indebted to Mr. Witmer Stone, the Curator in charge.

PLATE II.

FIG. 1. *Stenocephalemys albocaudata* Frick. Less mature. (Cotype, No. 32.) Lateral view of skull and mandible. $\frac{1}{1}$.

FIG. 2. Do. Superior view of skull.

FIG. 3. Do. Inferior view of mandible.

FIG. 4. Do. Inferior view of skull.

FIG. 5. Do. Superior view of mandible.

FIG. 6. *Epimys tulbergi endorobæ.* (U. S. Nat. Mus., No. 163402, ♀.) Lateral view of skull and mandible. $\frac{1}{1}$.

FIG. 7. Do. Superior view of skull.

FIG. 8. Do. Inferior view of mandible.

FIG. 9. Do. Inferior view of skull.

FIG. 10. Do. Superior view of mandible.

PLATE III.

FIG. 1. *Otomys jacksoni helleri* Frick. (Field No. E. A. M. 7531.) Lateral view of skull and mandible. $\frac{1}{1}$.

FIG. 2. Do. Superior view of skull.

FIG. 3. Do. Inferior view of mandible.

FIG. 4. Do. Inferior view of skull.

FIG. 5. Do. Superior view of mandible.

FIG. 6. *Otomys jacksoni malkensis* Frick. (Type, Field No. D. G. R. 29.) Lateral view of skull and mandible. $\frac{1}{1}$.

FIG. 7. Do. Superior view of skull.

FIG. 8. Do. Inferior view of mandible.

FIG. 9. Do. Inferior view of skull.

FIG. 10. Do. Superior view of mandible.

PLATE IV.

FIG. 1. *Arvicanthis abyssinicus blicki* Frick. (Type, Field No. D. G. R. 26, ♂.) Lateral view of skull and mandible. $\frac{1}{1}$.

FIG. 2. Do. Superior view of skull.

FIG. 3. Do. Inferior view of mandible.

FIG. 4. Do. Inferior view of skull.

FIG. 5. Do. Superior view of mandible.

FIG. 6. *Arvicanthis abyssinicus mearnsi* Frick. (Type, Field No. E. A. M. 7522, ♂.) Lateral view of skull and mandible. $\frac{1}{1}$.

FIG. 7. Do. Superior view of skull.

FIG. 8. Do. Inferior view of mandible.

FIG. 9. Do. Inferior view of skull.

FIG. 10. Do. Superior view of mandible.

PLATE V.

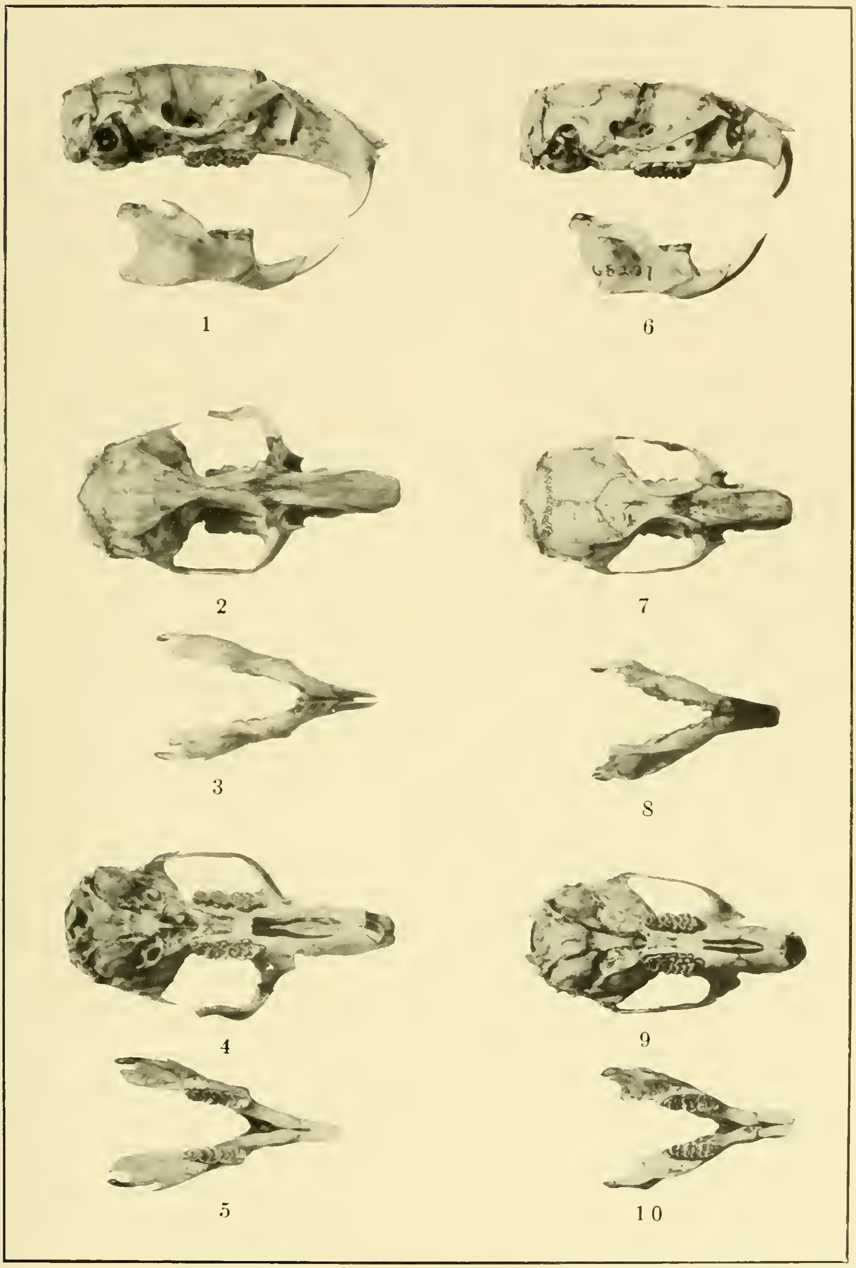
FIG. 1. *Arvicanthis abyssinicus raffertyi* Frick. (Type, Field No. D. G. R. 59, ♂.) Lateral view of skull and mandible. $\frac{1}{1}$.

FIG. 2. Do. Superior view of skull.

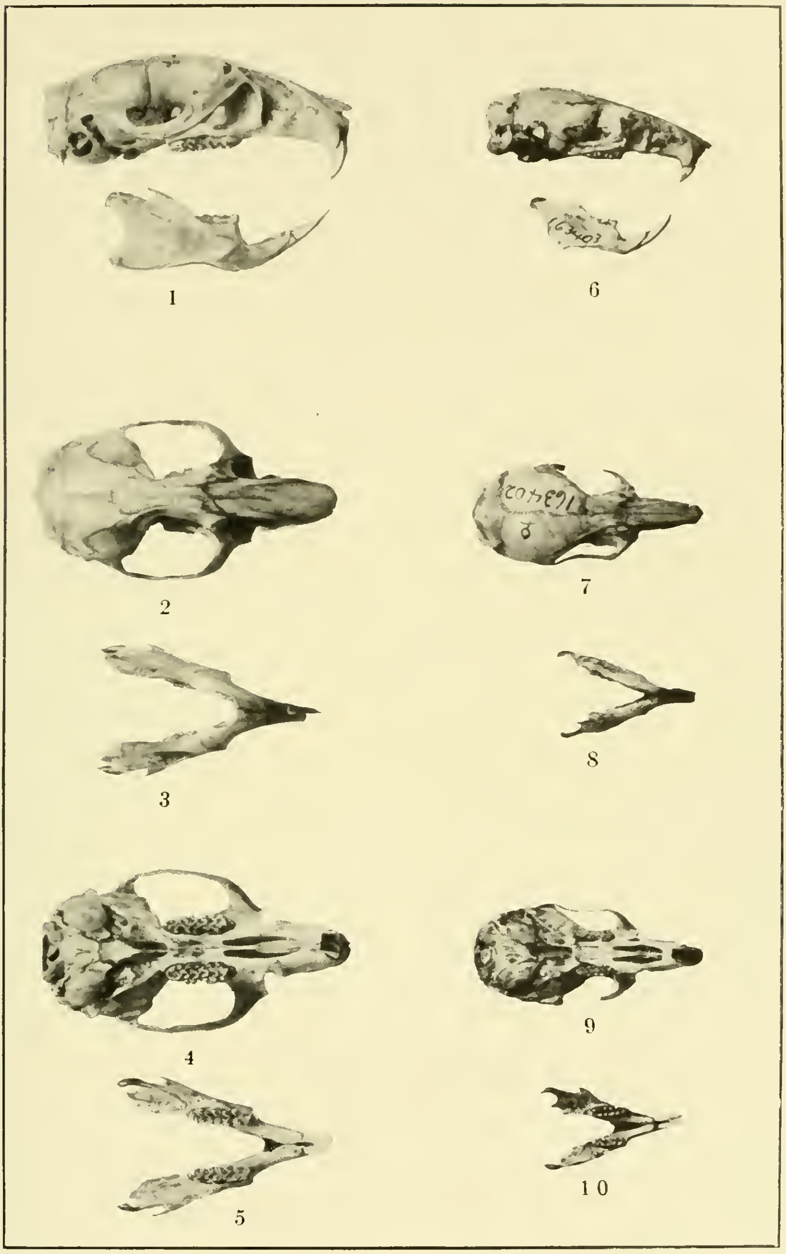
FIG. 3. Inferior view of mandible.

FIG. 4. Inferior view of skull.

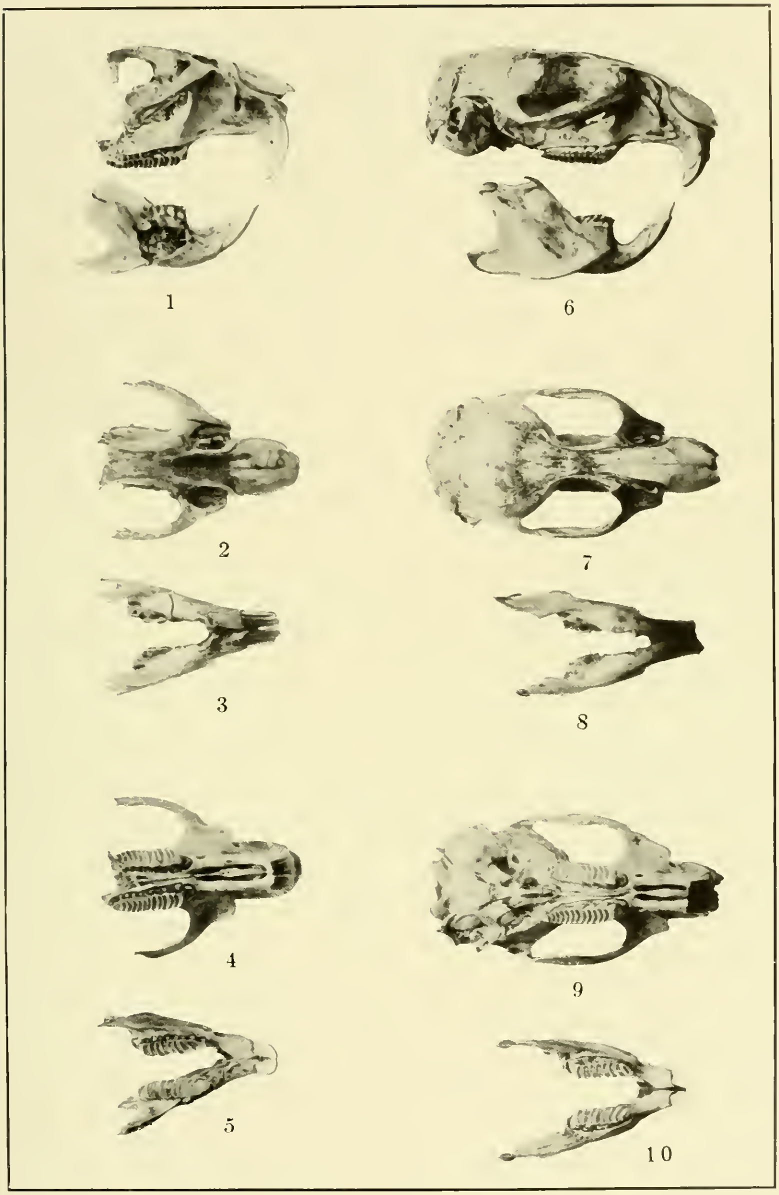
FIG. 5. Superior view of mandible.



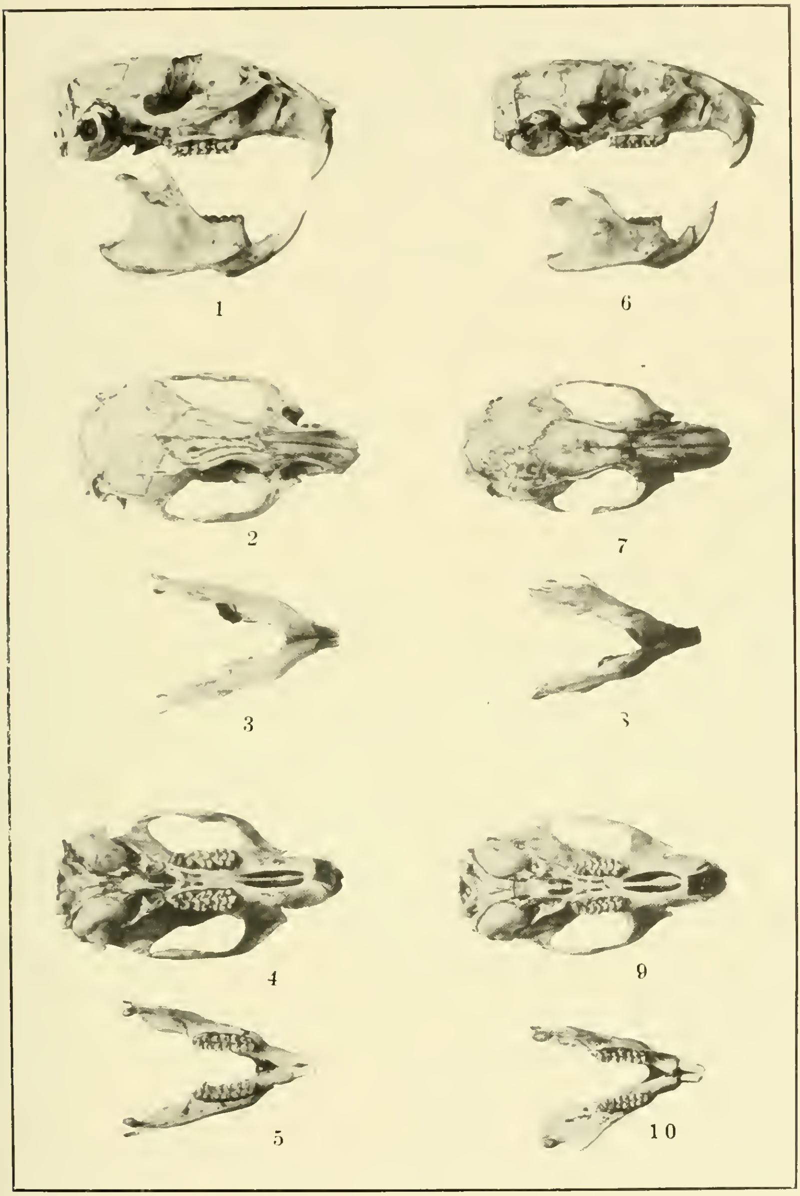
Figs. 1–5. *S. albocaudata* Frick. (Type. No. 11.) $\frac{1}{1}$.
Figs. 6–10. *Dasymys* sp. (No. 165237 U. S. N. M.) $\frac{1}{1}$.



Figs. 1–5. *S. albocaudata* Frick, juv. (Cotype. No. 32.) $\frac{1}{1}$.
Figs. 6–10. *Epimys tulbergi endorobæ* Heller. (No. 163402, U. S. N. M.) $\frac{1}{1}$.

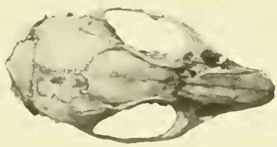


Figs. 1–5. *Otomys jacksoni mearnsi* Frick. (Type. No. 7531). $\frac{1}{1}$.
Figs. 6–10. *Otomys jacksoni malkensis* Frick. (Type. No. 29). $\frac{1}{1}$.



Figs. 1–5. *Arvicanthis abyssinicus blicki* Frick. (Type. No. 26). $\frac{1}{1}$.
Figs. 6–10. *Arvicanthis abyssinicus mearnsi* Frick. (Type. No. 7522). $\frac{1}{1}$.

1



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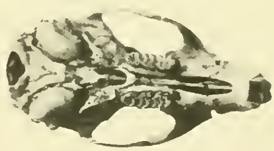

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5

Figs. 1–5. *Arvicanthis abyssinicus raffertyi* Frick. (Type. No. 59). $\frac{1}{1}$.

II. A NEW TITANOTHERE FROM THE UINTA EOCENE.

By O. A. Peterson.

During the summer of 1912, while collecting fossils for the Carnegie Museum and seeking for data bearing upon the geology of the Uinta Basin, the writer was so fortunate as to find in the upper portion of Horizon B, near Myton, on the Duchesne River, Uinta County, Utah. a number of specimens pertaining to a phylum of the true Titanotheres, The material is new to science, and bears directly upon important questions discussed in his Memoir upon the Titanotheriidæ by Professor Henry Fairfield Osborn, now, as we are informed, nearing completion. In order that these additional data may be published early enough to be incorporated in Professor Osborn's work, it has been decided, at his suggestion, to print this paper in the Annals without waiting foı the fuller account of the fauna of the Uinta which is in contemplation.

In the December issue of the *American Naturalist*, 1895, the late J. B. Hatcher published a new species of Diplacodon (*D. emarginatum*, suggesting for his species a new generic name (*Protitanotherium*) "should futuıe discoveries show that there are hornless forms with the same dental character as *Diplacodon*." Whether or not the true *Diplacodon elatum* Marsh[1] has horns, is still, I believe, an open question. Professor Osborn in his "New and Little Known Titanotheres from the Eocene and Oligocene,"[2] has accepted Hatcher's proposed genus *Protitanotherium* without much comment.[3] We anticipate that in his forthcoming work he will give his reasons for accepting the genus.

From the studies of Osborn, Earl, Hatcher, Douglass, and Riggs, we see that the Titanotheres of the Upper Eocene were already well differentiated. In fact it appears that the family had at this time reached its highest polyphyletic development, the survivors in the lower Oligocene being restricted to only those with true horns already developed. As was foreshadowed by Hatcher from the remains which he found in Horizon B ("cornutum beds"), it is now apparently

[1] Marsh, O. C., *Amer. Jour. Sci.* (3), IX, 1875, p. 247.

[2] *Bull. Amer. Mus. Nat. Hist.*, Vol. XXIV, 1908, p. 615.

[3] In a letter from Professor Osborn, dated November 20, 1912, he stated that the true *Diplacodon* is a slender form, while *Protitanotherium* is a robust animal.

well-established that the types with true horns and truly titanotheroid cranial structure are of earlier origin than has been hitherto believed. At the same time it appears that the structure of the limbs and feet of these predecessors is more nearly identical with that of the contemporary genera *Telmatherium*, *Metarhinus*, *Dolichorhinus*, etc., and undoubtedly further removed from *Titanotherium* than are *Diplacodon elatum*, *Protitanotherium emarginatum*, etc., from a later horizon of the Uinta sediments. We learn from the material collected in the Uinta Eocene by the Princeton Expedition of 1886[4] that the remains referred to *Diplacodon* are much further advanced in the direction of the Oligocene titanotheres. Comparisons made will be referred to in their proper places in the following description.

I desire to thank Dr. W. J. Holland for his kindness in allowing me to work up the material on which this paper is based, and for his revision of the manuscript for publication. I am also under obligation to Professor Charles Schuchert and the staff of the Peabody Museum of Natural History for much assistance in connection with the study of Professor Marsh's type of *Diplacodon elatum*. Mr. Sydney Prentice of the Staff of the Carnegie Museum made the drawings reproduced in this paper, and the photographs were made by Mr. Arthur S. Coggeshall.

Diploceras osborni[5] gen. et sp. nov.

Type:—Front of skull, lower jaws, portion of pelvis, atlas, portion of axis, fragments of scapula and foot-bones, No. 2859.

Paratypes:—Front of skull No. 2858; vertebral column, fragments of ribs, limb- and foot-bones, No. 2860; crowns of two upper molars, No. 2860a; humerus, No. 2861; tibiæ No. 2862.

Horizon:—Upper B, Uinta Eocene.

Locality:—On Duchesne River, near Myton, Uinta County, Utah.

GENERIC CHARACTERS:—Dentition: $I\frac{3}{3}$ $C\frac{1}{1}$ $P\frac{4}{4}$ $M\frac{3}{3}$; *Premolar series proportionally long;* $P^{\underline{3}}$ *with two distinct internal tubercles; horn-cores well developed; limbs relatively long and slender; tibial trochlea not extended back on the calcaneum. Astragalus high, with long neck, calcaneal and cuboidal facets laterally located.*

Specific Characters:—*Alveolar borders of the premaxillaries extending well in front of the canines; nasals long and relatively thin, their anterior*

[4] Scott, W. B., and Osborn, H. F., "The Mammalia of the Uinta Formation," *Trans. Amer. Philos. Soc.*, Vol. XVI, 1889, pp. 512–518, pls. IX–X.

[5] In honor of my early teacher, Professor Henry Fairfield Osborn.

portion abruptly turned downwards and convex on the anterior border; incisors well in front of the canines and relatively subequal in size; canines proportionally small.

SKULL.

Plates VI–VIII.

In comparing the recently discovered material with the best preserved remains of *Protitanotherium* (*P. emarginatum* Hatcher) a number of important differences are at once observed. The nasals of the new species are longer, thinner, somewhat narrower (especially in specimen No. 2859); furthermore the lateral borders of the nasals are much less thickened, and instead of the broadly emarginated area at the free end of the nasals in *P. emarginatum*, the termination of the nasal of the present form has an abrupt downward turn, resembling that of *Megacerops coloradensis* Leidy, and its anterior margin is very convex transversely, instead of concave, as is the case in *P. emarginatum*. Upon the whole the nasals of the species we are describing extend further forward. There seems to be a considerable variation in the development of the horn-cores; thus, in skull No. 2858 this protuberance appears to have a development comparable to that of some of the titanotheres found in the Oligocene, while in specimen No. 2859 these osseous bosses are very much smaller, more conical, and in proportion more like those of *P. emarginatum*, in spite of the fact that the skull we are considering pertains to an old individual (see Pl. VII). This varied development of the horn-cores is no doubt due to sexual differences, or possibly to individual variation. The premaxillaries extend well in front of the maxillaries, and are separated in front, forming a deep median notch, as in *P. emarginatum*, so that the median pair of incisors are wide apart, while further back they are firmly coössified and also solidly fused with the maxillaries. The infraorbital foramen is also of large size as in *P. emarginatum* and located above $P^{\underline{4}}$ as in the latter species. The maxillary is on the whole very robust, and shows that it had advanced well towards the condition found in *Diplacodon* and *Titanotherium*. This is also true of the jugal, the prominent lower border of which has the downward and backward sweep in front of and under the orbit, which is characteristic of Titanotherium. The zygomatic arch, though widely expanded behind, is, however, less robust than in the Oligocene genus, and agrees better with the type of *Diplacodon elatum* described by

Marsh. The postorbital processes on the frontal and jugal are of large size, in this respect unlike *Titanotherium*. The postorbital process on the frontal of the latter genus is usually located further back and is much smaller in proportion. The external portion of the glenoid cavity is preserved in No. 2858, and is somewhat less convex in the antero-posterior direction than in the latter genus. As in *Titanotherium* the anterior palatine foramina are small round openings, which in the present genus are situated further back from the alveolar border of the incisors. The palate is of the deep concave form usually met with in the Titanotheres, and the posterior narial opening extends approximately as far forward as in the Oligocene genus, reaching to the posterior portion of M^2.

That the type of the skull was saddle-shaped is very evident from the material under study, but whether or not the characteristically broad superior aspect of the parietals and the heavy and broad occiput seen in *Titanotherium* had been attained to the same degree as the similarity of the anterior region in the two genera suggests might have been the case, will not be completely known until the posterior region of the skull of the Uinta representatives of this phylum is found. It is highly probable that the similarity presented by the anterior region will be preserved throughout the cranium, which will then reveal more exactly the features of a true titanothere than was anticipated. From the type of *Protitanotherium emarginatum* at Princeton University, Hatcher[6] was apparently able to determine that the sagittal crest is absent, and that the dorsal surface of the skull is probably slightly concave antero-posteriorly.

MANDIBLE.

Plate VII.

The lower jaw is somewhat depressed by crushing, but allowing for this fact, it appears that the horizontal ramus of *Diploceras osborni* is shallower than in *P. emarginatum*. Characteristics which may further be noted, are: the more rounded under surface of the symphysis, and the constriction of the lower jaws in the area between the canine and the premolars which is greater than in *P. emarginatum*. As in the latter, the symphysis is strong and the mental foramen is large, located well down on the ramus, directly below $P_{\overline{2}}$. The lower jaw is broken off back of M .

[6] *The American Naturalist*, Vol. XXIX, 1895, p. 1085.

MEASUREMENTS.

Skull.

	No. 2858, Mm.	No. 2859, Mm.
Diameter from incisors to posterior border of glenoid cavity..	470	
Diameter from incisors to anterior border of orbit..........	180[7]	179[7]
Antero-posterior diameter of orbit..................	67	67[7]
Vertical diameter of orbit..................	55	
Diameter from incisors to anterior border of posterior nares..	260	256
Transverse diameter at the canines..................	93[7]	86
Transverse diameter at diastema between the canines and the premolars..................	67[7]	67
Transverse diameter across the horn-cores..................	290[7]	136

Lower Jaw.

	No. 2858, Mm.	No. 2859, Mm.
Total length of jaw fragment..................		380
Diameter from incisor to $P_{\overline{1}}$..................		67
Vertical diameter of ramus at $P_{\overline{1}}$..................		70[7]
Vertical diameter of ramus at $M_{\overline{2}}$..................		80[7]
Vertical diameter of ramus at $M_{\overline{3}}$..................		92

DENTITION.

Plates VI–VII.

The upper incisors and canines are well preserved, though much worn in the two crania under description. The molar-premolar series is less completely preserved in No. 2858, while in 2859 the superior dentition is completely represented. The lateral incisor and the canine of the right mandible and the complete molar-premolar series of the left ramus are also present in the latter individual.

As stated above, the median upper incisors are widely separated by the deeply excavated median notch of the premaxillaries. As seen in the illustration, the incisor series is placed well in front of the canine and the arc of the circle, which their arrangement represents, is more convex than in *P. emarginatum*. Their crowns are nearly circular in outline, covered with a heavy coat of enamel, bluntly conical, with a prominent cingulum at their posterior bases. They perhaps increase in size more gradually from $I^{\underline{1}}$ to $I^{\underline{3}}$ than in *P. emarginatum*. The canine is relatively smaller than in the latter genus, which imparts a much lighter looking aspect not only to this region of the dentition, but also to the entire outline of the anterior portion of the muzzle in the paratype No. 2858, as well as in the type, No. 2859. Furthermore the crown of the canine (especially in No. 2859) is shorter,

[7] Approximate measurements.

blunter, and the lateral ridges are less developed in the present species than in either *P. emarginatum* or *Diplacodon elatum*. *D. elatum* has the canine more nearly of the same proportion as in *P. emarginatum*. The diastema back of the canine is relatively longer and its border much thinner than in *P. emarginatum*, in which respect it is more nearly like *Diplacodon elatum*.

The crown of $P^{\underline{1}}$ is so much worn that its characters cannot be made out. It is, however, of greater antero-posterior than transverse diameter, and undoubtedly had a simple structure like that of *P. emarginatum*. $P^{\underline{2}}$ is also much worn especially along the external portion. The external face of the ectoloph is subdivided by a deep vertical groove and is much convex both antero-posteriorly and supero-inferiorly. This deep groove adds greatly to the antero-posterior convexity of the proto- and tritocones. The general outlines of the tooth are less quadrate than in *Titanotherium*, which is apparently due to the lack of development of the antero-internal angle in the species under consideration. In the type of *Diplacodon elatum* $P^{\underline{1}}$ is lost, while the external portion of $P^{\underline{2}}$ is broken off. In the present species, the deuterocone of $P^{\underline{2}}$ is less ridge-like than in *D. elatum*, the two internal tubercles being somewhat better indicated and the ridge between them distinctly less developed. $P^{\underline{3}}$ is more quadrate in outline than the preceding tooth, and has two distinct internal tubercles on the crown, which are separated by a shallow groove, while in *Diplacodon elatum* these tubercles are united into a solid internal ridge, revealing a distinct differentiation from what is seen in the present species (compare Pls. VI, VII, and IX). On the other hand $P^{\underline{4}}$ both in the type we are describing and in *D. elatum*, are similar, there being two internal tubercles, deutero- and tetartocones, the former considerably the larger.[8] The more important differences in the dentition of the two forms, so far as they can now be compared, seems to be in the proportion of the canines, the difference in the length of the premolar series, and the detailed structure of $P^{\underline{3}}$. The greater length of the premolar series is naturally to be expected in a form from a lower geological level.

The detailed characters of the molar series of the genera here com-

[8] In No. 2858, the paratype, there is only one internal tubercle, the deuterocone, which may by some be regarded as of sufficient importance to constitute a specific difference. For the present I prefer to regard this character as possibly representing a reversion.

pared present no differences of importance. The two Uinta forms agree in the obscure or feeble development of the cusp-like elevations on the anterior face of the molars near the inner angle, more conspicuously developed in *Titanotherium*. At the postero-internal angle of the cingulum of $M^{\underline{3}}$ in the Oligocene forms there is sometimes a distinct tubercle, which is indicated in the Uinta forms by only a slight swelling of the cingulum.

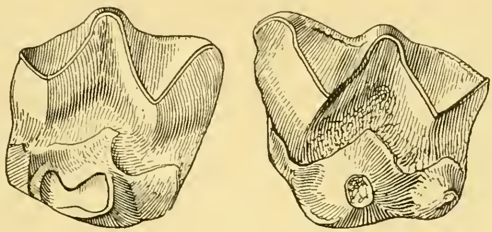


FIG. 1. Crown view of two upper molars *Diploceras osborni* Peterson. (Paratype. No. 2860*a*.) $\times \frac{1}{2}$. These isolated teeth were found with the Paratype, No. 2860.

In proportion the inferior incisor dentition is further in advance of the canine than in *P. emarginatum*. $I_{\overline{1}}$ and $I_{\overline{2}}$ are represented only by a portion of their roots buried in the symphysis. $I_{\overline{3}}$ has a very prominent cingulum posteriorly. Notwithstanding the much smaller size of the specimen, its crown has very nearly the same diameter as in *P. emarginatum*, which would indicate that the inferior incisors were possibly larger in proportion, and more nearly equal in size. The crown of the canine is injured, but its diameters appear to be equal to those in the superior series, though relatively smaller than in *P. emarginatum*. $P_{\overline{1}}$ has a single root and a simple conical crown, which has not received any wear due to its somewhat inferior position. $P_{\overline{2}}$ is submolariform and in its general characters does not differ from the same tooth in *P. emarginatum*. $P_{\overline{3}}$ is quite molariform, while $P_{\overline{4}}$ has a complete molar pattern.

There is no difference in the general features of the lower molars in the two genera here compared, and in turn the molars of *Diplacodon* are on the whole quite similar in their detailed structure to those of the Oligocene genus.

The proportion of the alveolar border occupied by the lower premolars of this species is in accord with the upper series, i. e. of a greater antero-posterior diameter than in *P. emarginatum* and *D. elatum.*[9] Judging from the type (lower jaw) of *Protitanotherium superbum* Osborn, recently described,[10] that species also has the same proportion of the molar-premolar series as the two latter, while *Telmatherium? altidens* of the same publication has a longer premolar series and more nearly agrees with the present genus.

MEASUREMENTS.

	No. 2859, Mm.	No. 2858, Mm.
Length of superior incisor series	34	33
I^1. Antero-posterior diameter	11	11
I^1. Transverse diameter	10	10
I^2. Antero-posterior diameter	12	12
I^2. Transverse diameter	12	12
I^3. Antero-posterior diameter	15	15
I^3. Transverse diameter	14	14
Canine. Antero-posterior diameter at the base	19	20
Canine. Transverse diameter at the base	18	18
Length of molar-premolar series	246	
Length of superior premolar series	101	
P^1. Antero-posterior diameter	19	
P^1. Transverse diameter	12	
P^2. Antero-posterior diameter	22	23
P^2. Transverse diameter	25	26
P^3. Antero-posterior diameter	30	
P^3. Transverse diameter	31	
P^4. Antero-posterior diameter	33	31
P^4. Transverse diameter	38	36
Extent of superior molar series	146[11]	
M^1. Antero-posterior diameter	38	
M^1. Transverse diameter	45	
M^2. Antero-posterior diameter	52	
M^2. Transverse diameter	54	
M^3. Antero-posterior diameter	57	
M^3. Transverse diameter	51	
I_3. Antero-posterior diameter	14	
I_3. Transverse diameter	12	
Canine. Antero-posterior diameter, approximately	17	
Transverse diameter, approximately	14	

[9] In remeasuring the molar series of Prof. Marsh's type of *Diplacodon elatum* it would seem that he was in error in regard to the measurement, which should read 167 instead of 152 mm.

[10] Osborn, Henry F., "New and Little Known Titanotheres from the Eocene and Oligocene," *Bull. Amer. Mus.*, Vol. XXIV, 1908, p. 615.

[11] Professor Marsh's measurement of the molar series of the type of *D. elatum* is an error.

	No. 2859, Mm.
Length of inferior molar-premolar series	255
Length of inferior premolar series	94
Length of inferior molar series	160
$P_{\overline{1}}$. Antero-posterior diameter	14
$P_{\overline{1}}$. Transverse diameter	10
$P_{\overline{2}}$. Antero-posterior diameter	24
$P_{\overline{2}}$. Transverse diameter	14
$P_{\overline{3}}$. Antero-posterior diameter	28
$P_{\overline{3}}$. Transverse diameter	18
$P_{\overline{4}}$. Antero-posterior diameter	29
$P_{\overline{4}}$. Transverse diameter	20
$M_{\overline{1}}$. Antero-posterior diameter	38
$M_{\overline{1}}$. Transverse diameter	26
$M_{\overline{2}}$. Antero-posterior diameter	49
$M_{\overline{2}}$. Transverse diameter	30
$M_{\overline{3}}$. Antero-posterior diameter	78
$M_{\overline{3}}$. Transverse diameter	32

VERTEBRAL COLUMN.

The atlas of the type (No. 2859) is quite complete. There is also the greater portion of an atlas with the paratype No. 2860.

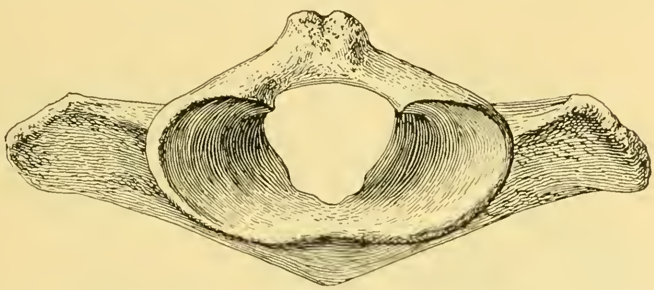


FIG. 2. *Diploceras osborni* Peterson. (Type. No. 2859) × $\frac{1}{3}$. Anterior view of atlas.

With regard to the posterior division of the arterial canal it may be said that there appears to be some variation in the Uinta species. Thus it is seen that in the type the base of the transverse process is pierced by a small foramen, see Fig. 3, while in the paratype there is no evidence of this foramen on the posterior face of the transverse process. Of the later Uinta forms there is apparently no atlas known. In comparing the Oligocene Titanotheres, with the Uinta specimens before us, there is a corresponding variation. The atlas of the Oligocene types further varies in the antero-posterior diameter, and in the prominence of the neural spine and the transverse processes.

In *Diploceras osborni* the antero-posterior diameter of the atlas is rather small, while transversely it is proportionally greater than in the Oligocene forms. This is due in a great measure to the longer

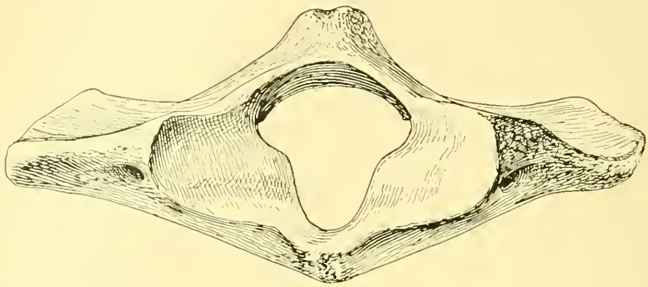


FIG. 3. *Diploceras osborni* Peterson. (Type. No. 2859.) × $\frac{1}{3}$. Posterior view of atlas.

transverse process of the Uinta form. The cotyle for the occipital condyle is also deeper and the groove for the odontoid process of the axis extends further forward on the inferior arch due probably to the proportionally longer odontoid in *Diploceras osborni*.

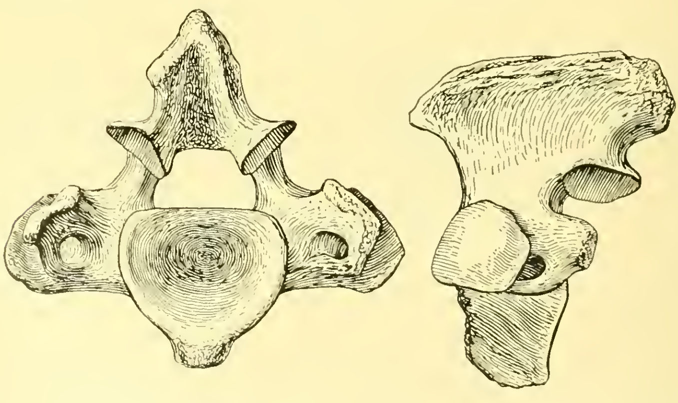


FIG. 4. *Diploceras osborni* Peterson. (Type. No. 2859.) × $\frac{1}{3}$. Posterior and lateral views of axis.

Axis.—The axis of the type is represented by a portion of the centrum, the complete neural arches, and the spinous process. The arch is somewhat depressed by crushing, but it is evidently of rather large size. The vertebra as a whole possibly has a smaller antero-posterior diameter than is the case in most of the Titanotheres of the

Oligocene; the articulating surface for the atlas is located more laterally, and the postzygapophysis has a greater vertical obliquity and a more nearly rounded outline than in the latter. In the Princeton specimen[12] it is seen that the arterial canal is located back of the posterior edge of the articulation for the atlas, while in *Diploceras osborni* the foramen is, on a direct side view, partially hidden by the backwardly extended process of the articulation. I judge that the axis, as a whole, in the present form is relatively shorter than in the Princeton specimen. In more minute details the description of Scott and Osborn (*l. c.*, p. 514) agrees well with the parts preserved, in the specimen before me, *i. e.*, the heavy spine overhanging the postzygapophyses, the inner turn of the transverse process, and a prominent inferior keel.

The succeeding four cervical vertebræ in the paratype, No. 2860, are represented only by fragments. They appear to have short opisthocœlian centra, as in *Diplacodon*, described by Marsh and Osborn, and a prominent ventral keel.

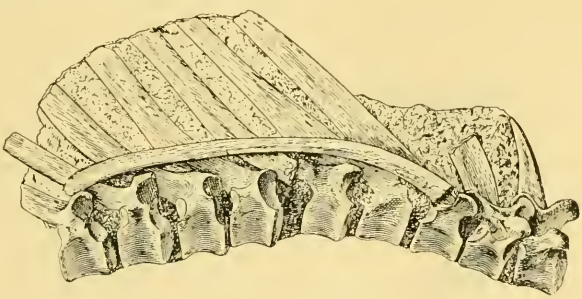


FIG. 5. *Diploceras osborni* Peterson. (Paratype. No. 2860.) $\times \frac{1}{9}$. Last cervical and dorsal vertebræ.

The seventh cervical vertebra is completely worked out in half relief and shows the chief characteristic features, Fig. 5. The long and pointed spinous process is well shown, as is also the neural arch and the centrum. The pre- and post-zygapophyses are, as in the axis, located quite laterally and face directly upward and downward as in *Titanotherium*. The transverse process shows a tendency to develop the broad round termination found in *T. validum* of the Oligocene.

There are eight dorsal vertebræ which are worked out in half

[12] Scott, W. B., and Osborn, H. F., "The Mammalia of the Uinta Formation," *Trans. Amer. Philos. Soc.*, Vol. XVI, Part III, 1889, p. 514, Pl. IX, Fig. 15.

relief and rest on the original block of sandstone on which they were found. The neural spine of the first dorsal is broken off about ten centimeters above the neural arch, but judging from the size of the fracture, the spinous process attained a length equal, and perhaps even proportionally greater, than was the case in *T. validum*, with which the Uinta remains have been compared. The second, third, fourth, and fifth dorsals have their spines very nearly complete. In proportion they agree quite well with those of the Oligocene genus, but are more strongly inclined backward. As in *Titanotherium* the transverse processes are not extremely heavy and the capitular facets for the ribs are of large size, while the sides of the centra are deeply concave. The latter are deeper than broad and the inferior borders, especially the posterior ones, are distinctly more keeled than in *Titanotherium*.

Back of the eighth dorsal there is a break in the vertebral column and a number of bones are lost. A second block, which was found, together with the one just described, contains portions of six posterior dorsals and three lumbar vertebræ (see Fig. 6). The neural spines of

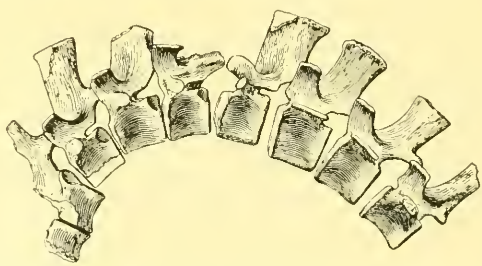


FIG. 6. *Diploceras osborni* Peterson. (Paratype. No. 2860.) × $\frac{1}{9}$. Posterior dorsals and the lumbar vertebræ.

the dorsal series are prominent and quite lumbar-like in their general character. The zygapophyses are also of the interlocking lumbar type and there are prominent metapophyses. The centra are somewhat mutilated, but enough is preserved to indicate that they are deep and of comparatively small transverse diameter.

There are, as stated, three lumbar vertebræ present in the paratype, No. 2860. These bones are fortunately found in position succeeding the last dorsal vertebra, and for the first time apparently furnish data as to the correct number of the lumbar vertebræ of the Titanotheriidæ.

That the last one of this series is the last lumbar vertebra, there is but little or no doubt, inasmuch as the neural spine is very suddenly reduced in its fore-and-aft dimension, and also shows the presence of the very heavy transverse process and the well-expanded postzygapophysis to meet the correspondingly broad surfaces of the sacrum. Unfortunately the greater portion of the centrum is weathered away, but from what remains it appears that it was more depressed than are those in front of it. Of the first and second lumbars the centra are large, sharply keeled, and the transverse processes, though generally broken off, are seen to have been prominent, though attenuated. There are large metapophyses, and the neural spines are high and of great antero-posterior diameter.

MEASUREMENTS.

Atlas.

	No. 2859, Mm.	No, 2860, Mm.
Greatest antero-posterior diameter	90	95
Greatest transverse diameter	250	250
Greatest transverse diameter of articulation for occipital condyle	140	138
Vertical diameter of articulation for occipital condyle	60	60

Axis.

Greatest height	138[13]	
Greatest transverse diameter	158	
Transverse diameter of postzygapophyses	70	
Length of centrum of a median cervical vertebra		37
Depth of centrum including inferior keel, approximately		45
Seventh cervical. Greatest height when vertebra is in position		195
Seventh cervical. Length of spine		120
Seventh cervical. Antero-posterior diameter of centrum		70
Second dorsal. Greatest height when vertebra is in position		300
Second dorsal Length of spine		325[13]
Seventh dorsal. Greatest height when in position		200
Seventh dorsal. Length of spine		165
Last dorsal. Greatest height when in position		165
Last dorsal. Length of spine		90
Second lumbar vertebra. Greatest height when in position		165
Second lumbar vertebra. Length of spine		95[13]
Caudal belonging to middle region of tail, length		29

[13] Approximate measurements.

The sacrum is not represented. The caudals appear to be short and heavy and in other respects like those of the Oligocene forms.

The ribs are represented only by a few fragments and there are no sternebræ.

FORE LIMB.

The greater portion of the scapula is represented with No. 2859. The upper and lower ends were found separately imbedded in the sandstone ledge, but in working out the two portions it is seen that they pertain to the same side of two individuals. The bone as a whole, so far as comparison may be made, presents characters not unlike those in the Princeton specimen referred to *Diplacodon*. However, in the specimen under description (possibly a female) the coracoid is seen to be relatively smaller than in the latter. The groove between the base of the coracoid and the border of the glenoid cavity is larger in proportion than in *Titanotherium*, and the excavation on the coracoid border, immediately above the coracoid, has a less abrupt curvature. This is due to the smaller development of this angle in *Diploceras*. The coracoid border is otherwise quite straight, as in *Titanotherium*. The superior portion of the glenoid border is broken off, but in the region of the break there is a similar broad extent of the superior portion of the blade. The spine is damaged, but it was apparently overhanging like that in *Diplacodon* described by Osborn, and thus less extended over the postscapular fossa than in *Titanotherium*.

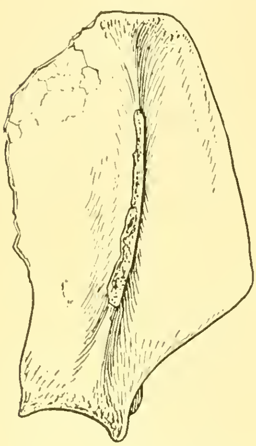
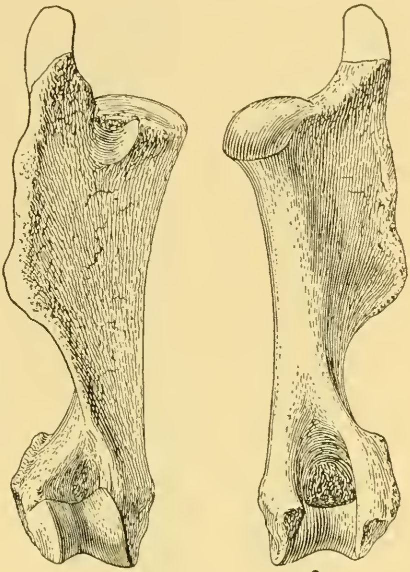


FIG. 7. Scapula of *Diploceras osborni* Peterson. (Type. No. 2859.) $\times \frac{1}{6}$.

In comparing the humerus of the present form with that of *Titanotherium validum*, the difference most noticeable is the relative robustness and the length. In the Oligocene form the bone is short and very heavy, while in the present genus the bone is longer in proportion and also lighter. Superiorly the greater tuberosity extends higher above the head than in *Titanotherium*, but is not so robust, the proximal end as a whole being more delicately proportioned. The deltoid groove is deep and well defined, as in the Oligocene genus. On the other hand the deltoid ridge, though very prominent, does not terminate in the heavy recurved process as in *T. validum*, but descends much more gently towards the supratrochlear fossa. Distally there is less variation between the two forms here compared. The anconeal fossa in the species under description is relatively broader and the supinator ridge is less rugose. The trochlea is slightly deeper, but not more oblique than in *T. validum*.

The humerus as described and figured by Osborn holds an intermediate position between the Oligocene genus and the present form. This is especially shown in the development of the deltoid ridge, which in the Princeton specimen is considerably more developed than in the genus under description.



1 2

FIG. 8. *Diploceras osborni* Peterson. (Paratype. No. 2860.) × $\frac{1}{3}$. Humerus. 1, anterior view; 2, posterior view.

MEASUREMENTS.

Humerus.

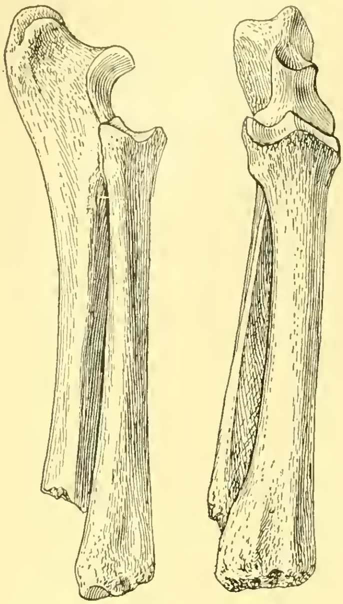
	No. 2860, Mm.	No. 2861, Mm.
Length from head to distal end	365	365
Transverse diameter of lower part of deltoid ridge	108[14]	110[14]
Transverse diameter at broadest portion of supinator ridge	115	113
Transverse diameter of distal trochlea		78

Both radii and ulnæ are represented in No. 2860. A third radius was also found in the same sandstone ledge in close proximity to the spot where Nos. 2858 and 2859 were found.

The radius and ulna are long and relatively slender, when compared with those of the Princeton specimen of *Diplacodon* and the Oligocene

[14] The shafts of the two bones are more or less crushed and the measurement is only approximately correct.

genus *T. validum.* Thus the fore arm of the new genus is actually a little longer than in *Diplacodon* and is very nearly as long as that of *T. validum*, notwithstanding the much smaller size of the Uinta form of which we are speaking. Another striking difference between the forms here compared is the lateral expansion of the proximal and distal ends of the radius. In the Oligocene form the shaft of the radius is more rounded in the middle region, while more proximally and distally a sudden expansion takes place, which is also well displayed in the Uinta specimen described and illustrated by Scott and Osborn. In *Diploceras osborni* the shaft is flatter, more uniform throughout, and the proximal and distal ends comparatively little expanded.



1 2

FIG. 9. *Diploceras osborni* Peterson. (Paratype. No. 2860. × $\frac{1}{6}$.) 1, lateral; 2, anterior views of radius and ulna.

The proportions of the ulna conform to the radius and it is consequently slenderer and proportionally longer than in *Diplacodon* and *Titanotherium*. In detail the bone is otherwise quite similar to that in the two latter genera, including the well defined tendinal groove on the anterior superior angle of the olecranon process so characteristic of the ulna of *Titanotherium validum*, but apparently less developed in the Princeton specimen, judging from the illustration Pl. IX, Figs. 10–10*c*, (*l. c.*).

MEASUREMENTS.

Radius.

	No. 2862, Mm.
Greatest length	380
Transverse diameter at middle of shaft	40
Transverse diameter of head	78
Transverse diameter of distal end	77

Ulna.

Length of olecranon process	100

The forefoot of No. 2860 is represented by the scaphoid, pisiform, trapezoid, Mc. II, IV, and V, and one or two phalanges. No. 2859 has also Mc. IV and V represented.

As might be anticipated from the description of the limb, it is found that the foot is higher than in *T. validum* of the Oligocene. Thus the scaphoid is higher in proportion, and narrower than in the latter species, but is of considerable fore-and-aft diameter. In detail there are only such differences as one might expect from the general outlines described, *i. e.*, the different articulating surfaces of the distal face are narrow and long, while the articulation for the radius is less concave antero-posteriorly than in the Oligocene form. The pisiform has a similar long attenuated shaft terminating in an obtuse tuberosity of considerable vertical diameter, but transversely rather thin.

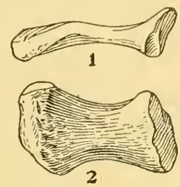


FIG. 10. *Diploceras osborni* Peterson. (Paratype. No. 2860.) × ⅓. Pisiform. 1, superior view; 2, lateral view.

Besides the greater height of the trapezoid, the small posterior superior facet for the magnum, which is characteristic of *Titanotherium*, is practically wanting in the present form. Judging from the facet on the postero-radial angle there is present in the new Uinta genus a trapezium of considerably larger size.

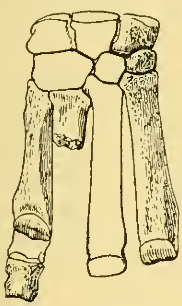


FIG. 11. *Diploceras osborni* Peterson. (Paratype. No. 2860.) × ¼. Dorsal view of manus.

Mc. II is long, quite broad, but of small antero-posterior diameter, which is in part due to crushing. The proximal end is partly broken off, so that the different facets cannot be accurately compared. The shaft is of quite uniform width until the distal articulating surface is reached, where there is on the radial face a sudden expansion. This character is less apparent in the Oligocene forms and also apparently less than in the metacarpus of the Princeton specimen from the Uinta, as figured by Scott and Osborn. Mc. IV is, as stated, represented by fragments in both type and paratype, and displays no features of especial importance.

Mc. V is longer and slenderer than the same element in *T. validum* and that referred to *Diplacodon* (*l. c.*, Pl. IX, Fig. 13). Proximally and distally the bone is expanded much as in *Titanotherium*, and the shaft, though relatively longer, is of a similar cylindroid character. The facet for Mc. IV is located more laterally than in the Oligocene genus and the dorsal and ulnar faces are less deeply grooved for muscular attachments. Near the distal end is a flange on the postero-ulnar angle, which is similar to that already described on Mc. II and is not generally present in the Oligocene Titanotheres.

There is apparently more inequality in size between Mc. II and Mc. V than represented in the figure of the manus of *Diplacodon* by Scott & Osborn. This is very probably due, to some extent, to the crushing of Mc. II of the specimen in the Carnegie Museum. In the specimen at Princeton the complete length of Mc. V is apparently represented. Its measurements appear to be only about 13 mm. longer, though nearly one-third broader, than that of the specimen before us.

The phalanges are short, broad, and in every respect titanotheroid.

MEASUREMENTS.

	No. 2860, Mm.
Scaphoid. Vertical diameter	35
Scaphoid. Transverse diameter	33
Scaphoid. Antero-posterior diameter	53
Pisiform. Total length	60
Trapezoid. Vertical diameter	20
Trapezoid. Transverse diameter	26
Trapezoid. Antero-posterior diameter	36
Mc. II. Greatest length	153
Mc. II. Transverse diameter of head, approximate	37
Mc. II. Transverse diameter of middle of shaft, approximate	30
Mc. II. Transverse diameter of near distal end, approximate	42
Mc. V. Greatest length	125
Mc. V. Greatest transverse diameter of head	36
Mc. V. Greatest transverse diameter of middle of shaft	20
Mc. V. Greatest transverse diameter of near distal end	33
Proximal phalanx, length	31
Proximal phalanx, transverse diameter of proximal end	29
Proximal phalanx, transverse diameter of distal end	26

HIND LIMB.

The pelvis of No. 2859 is represented by the greater portion of the ilium. It is quite broad across the gluteal surface, but the point of the ilium probably did not project laterally as much as in *T. validum*. The constricted portion of the neck is actually longer than in the latter species, and also longer than in the Princeton specimen of *Diplacodon* as represented on Pl. VIII in Scott and Osborn's work. The pelvis as a whole was consequently proportionally longer and probably narrower than in the Oligocene genus. The ischium and pubis are not represented.

In No. 2860 the lower half of the femur is present. The tibial and dorsal faces of the shaft are convex, while posteriorly it presents a flat surface. On the fibular angle may be seen the lower portion of the prominent ridge below the third trochanter, which decreases in prominence in its downward course. Near the distal end the fibular border presents a roughened area for muscular attachment, back and below which is the rather shallow supracondylan fossa. Distally the condyles are rather well separated by the deep and broad intercondylar fossa. The lateral sides of the distal end (especially the fibular) is well marked by the rugose attachment for muscles. The rotular trochlea is proportionally deeper and narrower than in *Titanotherium* and the fossa immediately above it is much deeper and better defined. In this respect the present genus agrees better with Fig. 5 on Plate VIII of Scott and Osborn's publication.

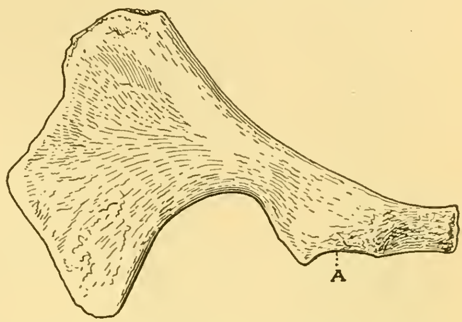


FIG. 12. *Diploceras osborni* Peterson. (Type. No. 2859.) × 1/6. Lateral view of pelvis.

MEASUREMENTS.

Femur.

	No. 2860 Mm.
Total length of the fragment	280
Transverse diameter of shaft about the middle region of the fragment	60
Transverse diameter of distal end	108
Antero-posterior diameter of distal end	110

The greater part of the tibia is represented in the paratype No. 2860, but it is badly crushed. Another individual No. 2862 has both tibiæ present and is approximately of the same size as the individuals we are describing. The bone is very nearly as long as in *T. validum.* The ends are not expanded as in the latter form, while the shaft is flatter, due in part to crushing. The superior end carries a heavy and bifid spine, while the upper anterior extremity displays the broad groove for the patellar ligament as in *Titanotherium.* The cnemial crest, though prominent, does not descend low on the shaft, another feature recalling what may be observed in *T. validum* and in the Uinta specimen figured by Scott and Osborn.[15] The anterior border of the distal trochlea was found weathered off, but the posterior surface is complete and presents a very prominent descending process on the median ridge of the articulating trochlea very similar to what is seen in the later Uinta form and in *Titanotherium.*

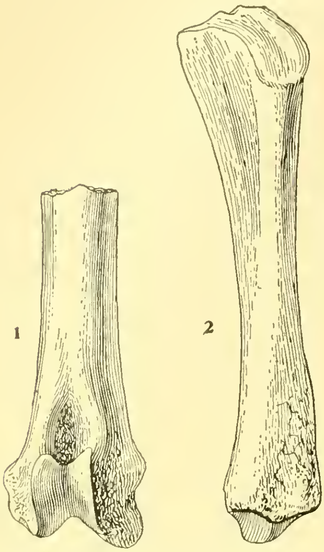


FIG. 13. *Diploceras osborni* Peterson. 1, Distal end of femur. (Paratype. No. 2860.) × 1/6. 2, Dorsal view of tibia. (Paratype. No. 2862.) × 1/6.

From the material at hand it is shown that the hind limb of *Diploceras osborni* corresponds well in length with the fore limb.

MEASUREMENTS.

Tibia.

	No. 2862, Mm.
Greatest length, approximate	415
Transverse diameter of head	100
Transverse diameter of shaft, middle region	48
Transverse diameter of distal end, approximate	75

The hind foot of No. 2860 is represented by the calcaneum, the astragalus, and the second and fourth metatarsals.

When compared with the Princeton specimen from a higher Uinta level and also with the Oligocene genera, the tuber of the calcaneum in

[15] If the illustration on Pl. VIII, Fig. 6, in Scott and Osborn's publication is 1/5 of nature, as is that of the femur in the same plate, the tibia of that form is actually shorter than that in the genus here described.

the present form is seen to be as long in proportion and compressed laterally to the same extent, while that portion carrying the sustentacular facets is longer. The fibula also apparently articulates with the calcaneum, but the posterior portion of the tibial trochlea did not touch the calcaneum as in *Diplacodon* and *Titanotherium*. The astragalus is higher and narrower, and the metatarsals are longer and much slenderer than in the latter genera.

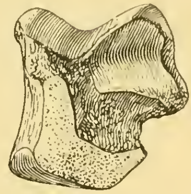


FIG. 14. *Diploceras osborni* Peterson. (Paratype. No. 2860.) × ⅓. Posterior view of astragalus.

When compared in more detail there are a number of differences between the genera here compared. On the calcaneum of the genus under description the proximal astragalar facet is not raised as high above the surface as in *Titanotherium*. The greater process of the distal end extends lower down and the facet for the cuboid is more oblique than in *Titanotherium*. As already stated, the astragalus is higher and narrower, the trochlear groove is deeper with the articular surfaces of the two condyles steeper, and the neck separating the distal end from the trochlea longer than in the astragalus of the Oligocene form, and also somewhat longer than in *Diplacodon* as figured by Scott and Osborn. Furthermore, the distal end of the astragalus of the present form is more unequally divided by the navicular and cuboid facets than in the Oligocene genus. These facets of the astragalus in *Titanotherium* are more nearly subequal in size, the cuboid facet having increased in size, as well as being located more distally on the bone, while in *Diploceras* this facet occupies a comparatively narrow area on the fibular angle and is placed laterally.

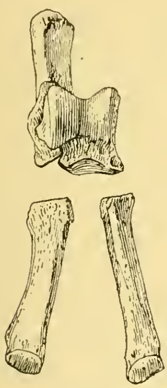


FIG. 15. *Diploceras osborni* Peterson. (Paratype. No. 2860.) × ¼. Dorsal view of pes.

The most noticeable difference of the astragalus of *Diploceras osborni* and that of the Princeton specimen as figured (*l. c.*, Pl. VIII, Fig. 8*b*) seems to be in the three distinct astragalar facets (viz. ectal, sustentacular, and cuboidal) of the latter, while in the present form the ectal, besides extending higher, unites with the cuboidal facet without distinct separation, the two forming a perfect right angle apparently similar to that in *Mesatirhinus*.[16]

Aside from the greater proportionate length, the metatarsals differ from those in *Titanotherium* by being arched forward to a greater degree. The shaft of Mt. IV is more cylindrical and the facet for the cuboid more oblique.

MEASUREMENTS.

Astragalus.

	No. 2860, Mm.
Total length	71
From lower end of external condyle to distal end	26
Greatest transverse diameter	68
Transverse diameter of trochlea	56
Calcaneum.	
Greatest length	124
Length of tuber	64
Vertical diameter of tuber	45
Transverse diameter of tuber	22
Transverse diameter at sustentaculum	70
Mt. II.	
Length	150
Transverse diameter at head	28
Transverse diameter of shaft, median region	21
Transverse diameter of distal end	26
Mt. IV.	
Length	41
Transverse diameter of head	38
Transverse diameter of shaft, median region	22
Transverse diameter of distal end	34

RESTORATION OF *Diploceras osborni*.

Plate X.

The restoration here attempted is obtained from the material described in the preceding pages and it is chiefly based on two individuals. As previously stated, the front of the skull, the lower jaws, atlas, axis, pelvis, and a few fragments of the feet pertain to one individual, the type, while the rest of the vertebral column, a few ribs and limb-bones, as well as a number of foot-bones belong to a second individual, one of the paratypes.[17] The dotted lines represent

[16] Osborn, H. F., *Bull. Amer. Mus. Nat. Hist.*, Vol. XXIV, 1908, p. 68.

[17] There was no other material found with the remains of *Diploceras* described in the preceding pages, except a few fragments of turtles. All the material was found within a radius of about 20 feet.

estimated diameters and are consequently conjectural as to proper contour outlines. This is especially true of the posterior portion of the skull, the sacrum, the ischium, the upper half of the femur, and the caudal region. There are inserted two cervicals, two dorsals, the sacrum, and the greater part of the caudal region. The vertebral formula as represented in the illustration is the same as that of the articulated skeleton of *Titanotherium* from the Oligocene now in the Carnegie Museum. The vertebral formula of *Diploceras osborni* is in part therefore tentative and is as follows: Cervicals seven, dorsals seventeen, lumbars three, sacrals four, caudals eighteen. The ribs are conjectural.

The illustration is effected for the purpose of ascertaining, at a glance, the general proportions of the animal. Each part represented by the solid lines is drawn directly from the bones themselves, by the assistance of the pantograph, and the illustration as a whole is fairly reliable.

MEASUREMENTS.

	Cm.
Total length of the vertebral column from the premaxillary to the end of the sacrum, all curves of the backbone included	252
Height of skeleton at fore limb	138
Height of skeleton at hind limb	114

TAXONOMIC POSITION OF *Diploceras osborni*.

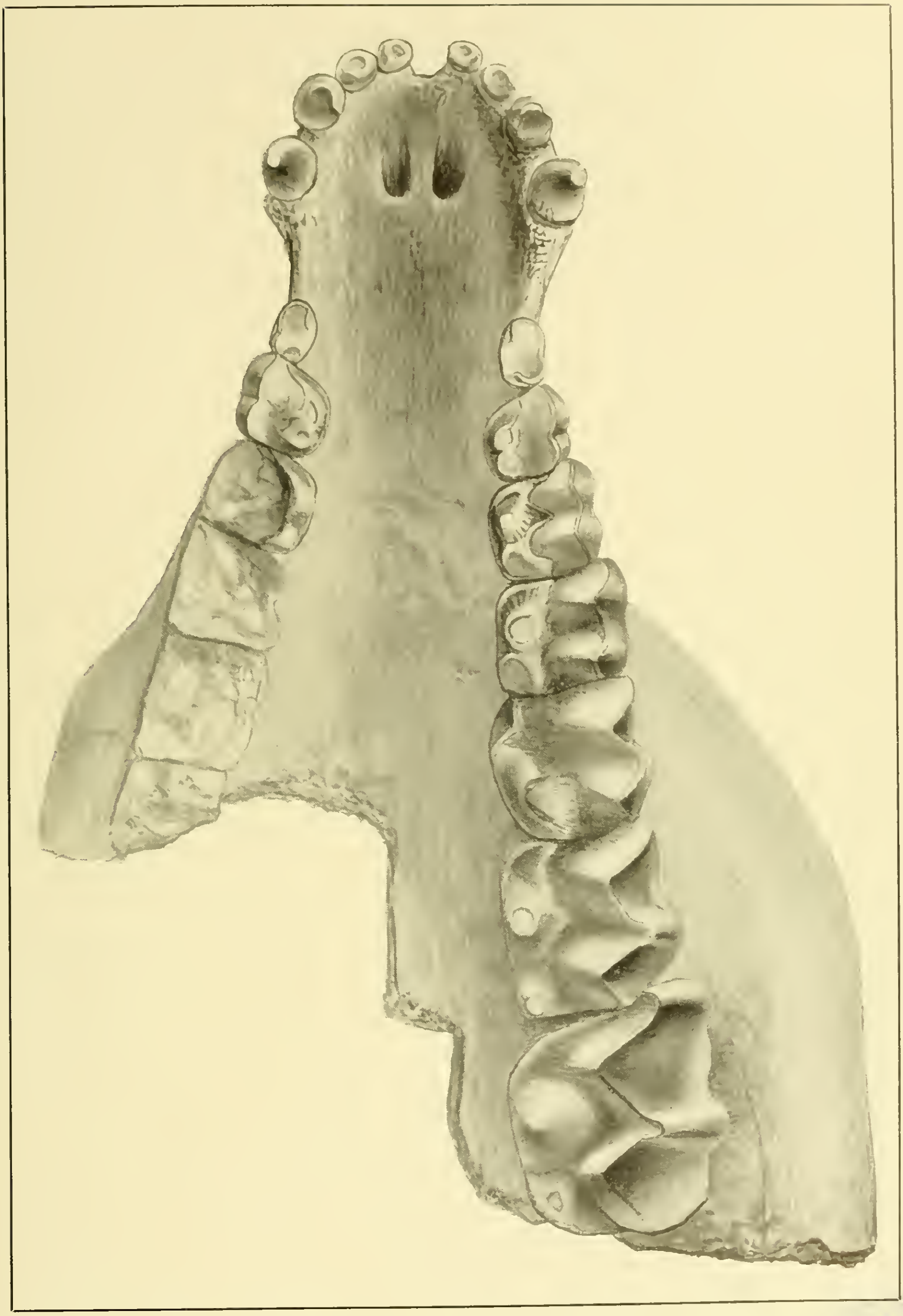
From the foregoing introduction and description it appears that *Diploceras osborni* should be placed in a phylum leading to the long-limbed animals of the Oligocene, which Osborn refers to typical *Titanotherium* Leidy.[18] Moreover, we are now more certain that true horned forms of this family were already well established in horizon B, and possibly also in the preceding horizon A of the Uinta Eocene formation. As had been anticipated by some and conclusively shown by Osborn and staff[19] the Washakie and the Uinta sediments were formed contemporaneously. No remains of these true horned types have as yet been found in the upper Washakie sediment, though they undoubtedly existed at that time. Characters of the foot-structure available for comparison, show that *Diploceras* of the Uinta B is quite similar to *Mesatirhinus* from the base of the Washakie, namely, the astragalus with neck elongated, ectal and cuboidal facets continuous,

[18] *Bull. Amer. Mus. Nat. Hist.*, Vol. XXIV, 1908, p. 611–613.
[19] *Bull. Amer. Mus.*, Vol. XVI, 1902, p. 92.

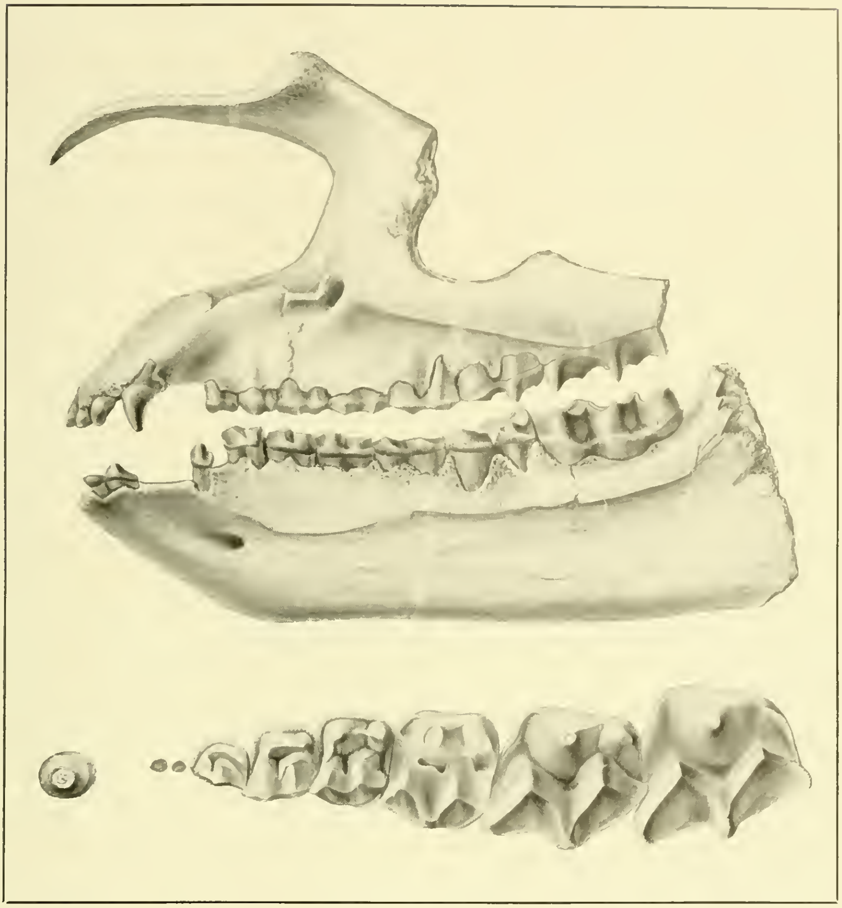
the two forming a perfect right angle; metapodials slender. Although *Palæosyops laticeps* from the Bridger, and *Telmatherium validum* from the Washakie appear, as Hatcher thought, to be the most likely ancestors of the true horned types of the Uinta and the Oligocene, it is rather questionable whether or not we may accept these as the true ancestors of this line of the Titanotheriidæ. The constant progress of new discoveries in paleontology tends to make it more and more apparent that the branches of the "phyletic trees" seem to extend further and further back through the Tertiary strata in an independent manner.

Note.—The malar bone in the restoration, Plate X, has at the post-orbital process been slightly increased in its relative perpendicular diameter, because of the crushing sustained by the original.

CARNEGIE MUSEUM,
June 19, 1913.

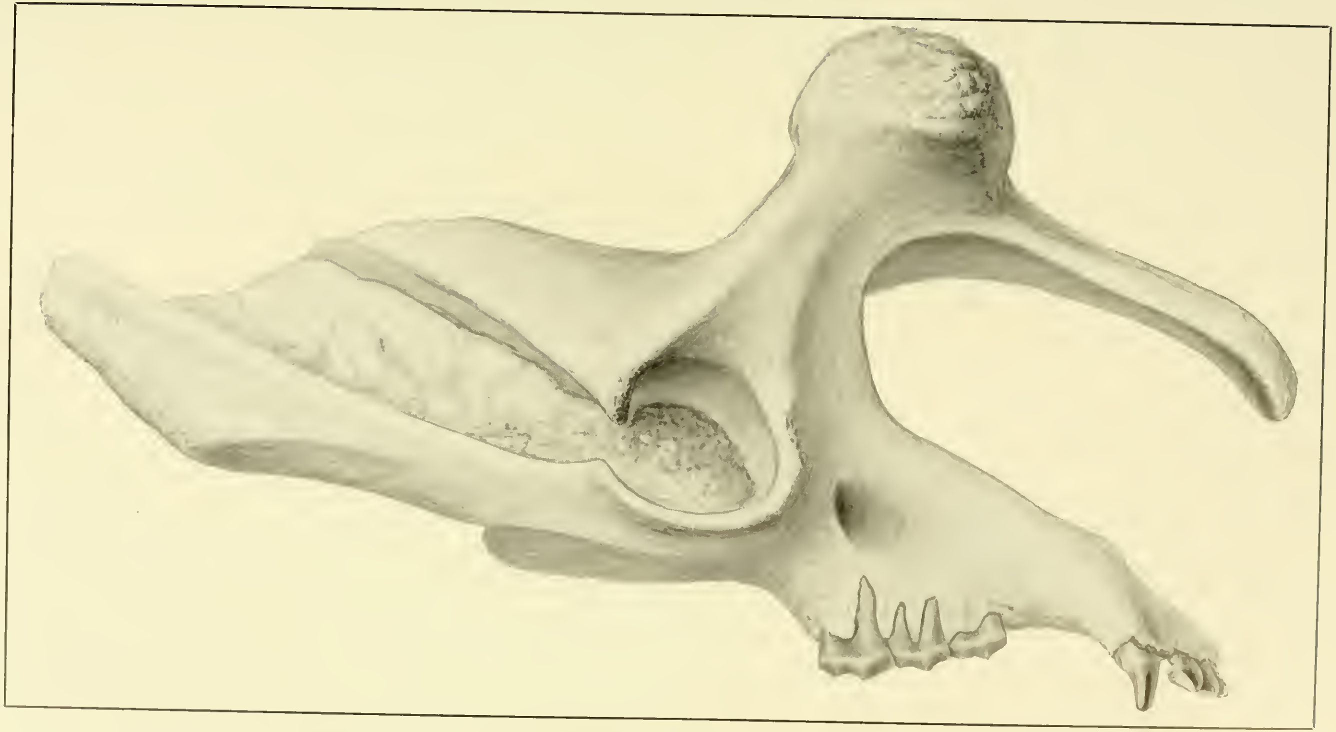


Diploceras osborni Peterson. Type. No. 2859 C. M. Cat. Vert. Foss. $\times \frac{1}{2}$.

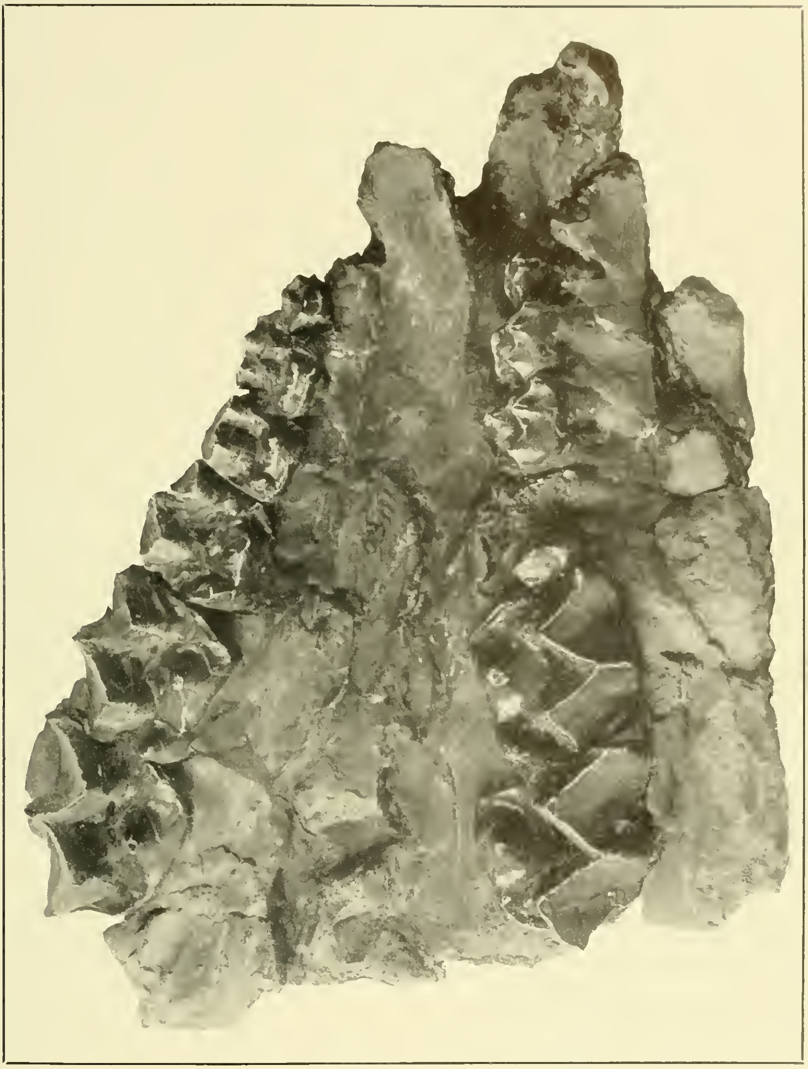


Diploceras osborni Peterson. Type. No. 2859. C. M. Cat. Vert. Foss. $\times \frac{1}{4}$.

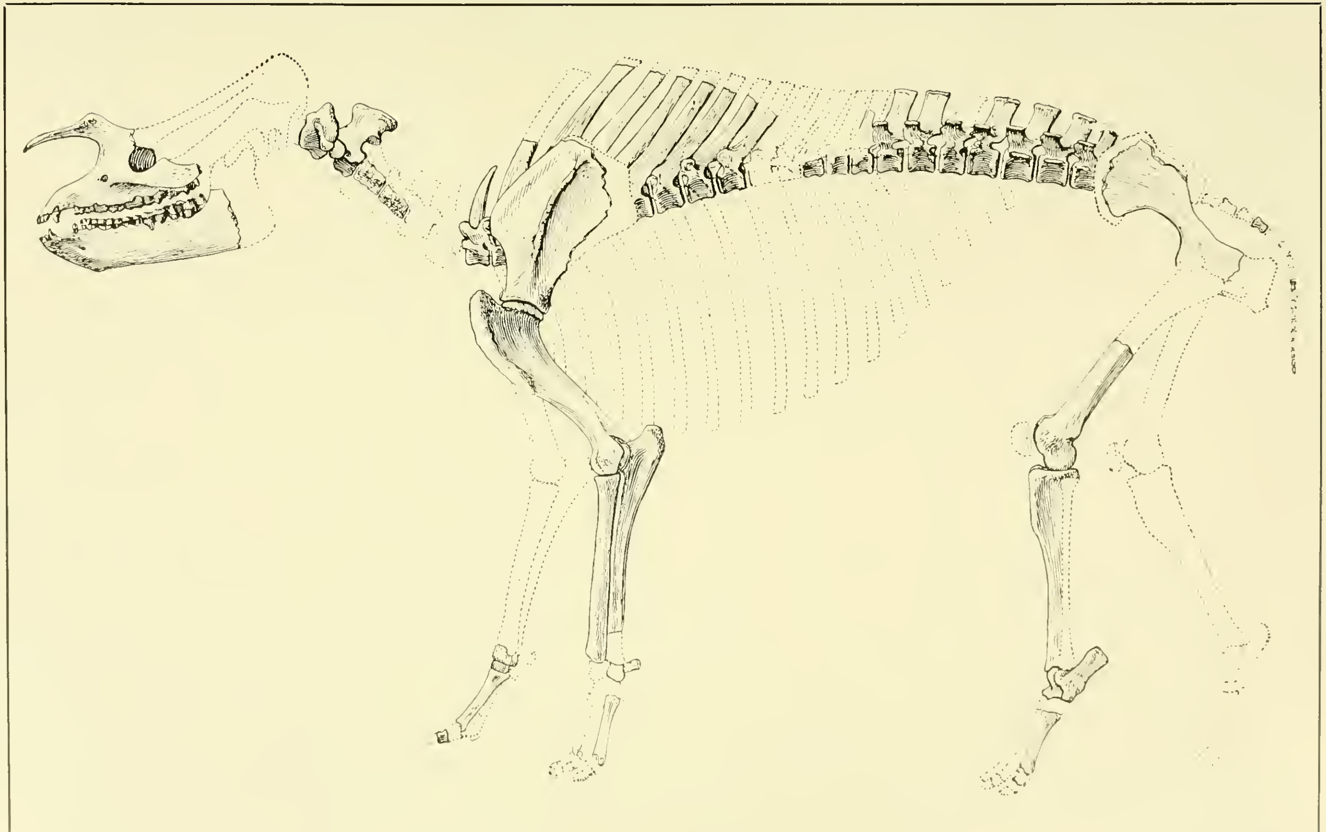
Superior dentition of *Diplacodon elatum* Marsh. Type. Peabody Museum, Yale University, No. 11,180. $\times \frac{1}{3}$.



Diploceras osborni Peterson. Paratype. No. 2858 C. M. Cat. Vert. Foss. $\times \frac{1}{3}$. Back of the horn-core and lachrymal region perhaps too far back on account of crushing undergone by the specimen.



Type of *Diplacodon elatum* Marsh. Peabody Museum, Yale University. No. 11180.
About $\frac{2}{5}$ nat. size.



Restoration of skeleton of *Diploceras osborni* Peterson. $\times \frac{1}{16}$. (Representing type and paratype).

III. A SMALL TITANOTHERE FROM THE LOWER UINTA BEDS.

By O. A. Peterson.

Heterotitanops parvus gen. and sp. nov.

Plate XI.

Type.—Skull, lower jaws, vertebral column, ribs, limb-bones, calcaneum, and astragalus of young individual. No. 2909.

Horizon.—Upper A., Uinta Eocene.

Locality.—White River, Uinta County, Utah.

The specimen on which this genus is proposed is unfortunately a very young individual, the only material representing this form in the entire collection. It was found articulated in hard sandstone concretion, and lower down in horizon A of the Uinta sediment than any mammalian remains heretofore described from that formation.

Generic Characters.—Dentition: $I\frac{3}{3}$? $C\frac{1}{1}$? $P\frac{3}{3}$? $M\frac{3}{3}$. Deciduous dentition: $I\frac{3}{3}$? $C\frac{1}{1}$ $M\frac{3}{3}$?. *Rapid increase in size of the deciduous upper cheek teeth from first to last tooth. $D^{\underline{4}}$ with perfectly formed internal tubercles (proto- and hypocones) and the antero-external angle very greatly developed. Molars hypsodont. $M^{\underline{1}}$ with large conical proto- and hypocones, the external faces of the ectoloph less emarginated antero-posteriorly than in the Titanotheres generally and the median vertical ridge of the ectoloph projecting forward to a greater degree.*

General Description.—The skull and lower jaws were found in the talus and separated from the rest of the skeleton. The front of the nasals, the premaxillaries, and symphysis of the lower jaws were broken off and were not recovered. The vertebral column and the ribs were, as stated, found in position, but all of the feet, except the left calcaneum and astragalus, are lacking. The skeleton pertains to a very young individual, so that the characters here presented may not in all cases compare well with those in fully adult specimens.

The facial region is rather short, the large orbit being placed well forward. The latter is bounded posteriorly by a postorbital process of the frontal which is considerably developed. The infraorbital foramen is of large size and placed well above the alveolar border.

The maxillary is deep and the palatine plate is located high, so as to give to that region a great transverse convexity. There is a considerable diastema between the canine and the cheek-teeth. The frontals are well elevated over the orbits as in the Titanotheres generally, but whether or not there were nasal protuberances, or horn-cores, cannot be determined from the specimen. The parietals are evenly rounded and considerably inflated laterally due to the large brain-case. There is no sagittal crest and the lambdoidal ridges are extremely

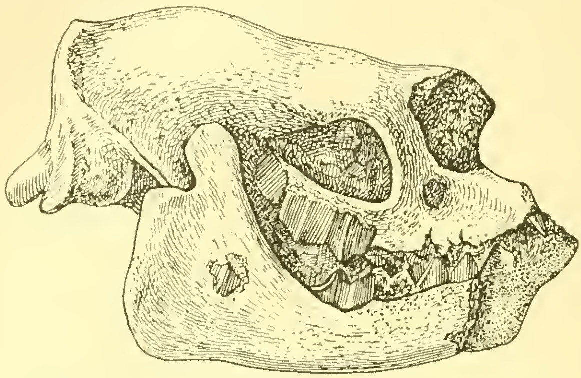


FIG. 1. *Heterotitanops parvus* Peterson. Right lateral view of skull. (Type. No. 2909.) $\times \frac{1}{2}$.

faintly indicated. The occipital plate, though well outlined, is not defined by such sharp angles as is usually the case in the Titanotheres. This is no doubt due to the immature condition of the skull. The great projection of the condyle back of the vertical plate of the occiput is also no doubt a juvenile character.

The under border of the lower jaw has not the fore-and-aft curvature usually seen in very young specimens of other vertebrates. Judging from the impression left by the specimen in the rock the ramus continued of a uniform depth from $M_{\overline{3}}$ to the symphysis. The latter is apparently quite heavy. The vertical ramus is of well-proportioned diameter antero-posteriorly. The coronoid process is broad, extends well backward as well as upward, and has a broad and rather attenuated termination.

As already stated both upper and lower incisors are wanting. The upper canine is just protruding through the alveolar border. Its crown is damaged, but it appears to possess the shape and proportions found generally in the Eocene Titanotheres. The deciduous cheek-teeth are three in number and their increase from first to last is unusually rapid. The crowns of the first and second deciduous cheek-teeth are broken off, but the greater part of the last tooth is preserved. The principal feature of this tooth is the presence of two large internal tubercles which are conical in shape and covered with a heavy coating of enamel. The antero-external angle of the tooth is extensively developed, so that the antero-posterior diameter is considerably greater than the transverse. M^1 is just appearing through the alveolar border and has been freed for the purpose of study. The proto- and hypocones usually found in the Titanotheres are present, and well developed, while the external face of the ectoloph is less concave fore-and-aft and the median vertical ridge has a somewhat greater forward projection than is generally the case in the Titanotheres. The germ of M^2 is quite well advanced, while that of M^3 has apparently not yet been formed.

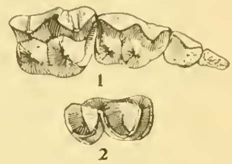


FIG. 2. *Heterotitanops parvus* Peterson. (Type. No. 2909.) $\times \frac{1}{2}$.
1, Deciduous dentition and permanent M^1; 2, Permanent M_1.

The first lower cheek-tooth is seen buried in the ramus, but is not represented in the illustrations. D_2 and D are injured while M_1 is well preserved. Its crown is like that of the typical Eocene Titanotheres and needs no description. M_2 is well advanced towards maturity while M_3 is not yet indicated.

MEASUREMENTS.

	Mm.
Total length of skull from canine to and including the occipital condyle....	142
Transverse diameter of skull at the parietal region........................	46
Greatest transverse diameters of frontals..............................	54
Length of alveolar border, canine to and including M^1..................	67
Length of deciduous cheek dentition....................................	38
Antero-posterior diameter of D^3..	21
Transverse diameter of D^3..	15
Antero-posterior diameter of M^1..	24
Transverse diameter of M^1, approximately...............................	20
Antero-posterior diameter of M_1..	25
Transverse diameter of M_1..	12

The axial and appendicular parts rest on the concretionary sandstone block in the position in which they were found imbedded.

(See Plate XI.) In the posterior dorsal and the lumbar region the ribs are distorted over the vertebræ in such a mannei that an exact count of them cannot now be made with entire certainty. The vertebral formula is, however, approximately as follows: Cervicals seven, dorsals 16 or 17, lumbars 3(?), sacrals 4 or 5, caudals 14 or 15. The cervical region is short and quite robust, the anterior dorsal vertebræ, though possessing well-proportioned neural spines, do not have the heavy and high processes seen in the true Titanotheres. The lumbar region is certainly very short and this space could hardly have been occupied by more than three or possibly four centra. The anterior face of the sacrum is quite even with the supra-iliac border of the pelvis, which is characteristic of the Titanotheres generally. Four or five short and broad centra, which represent the sacrum, aie visible. The end of the caudal region is represented by eight centra and in the space between this series and the sacrum there is room for six or seven more.

The thoracic cavity was of large size judging from the rather long ribs. There are apparently six elements in the sternum.

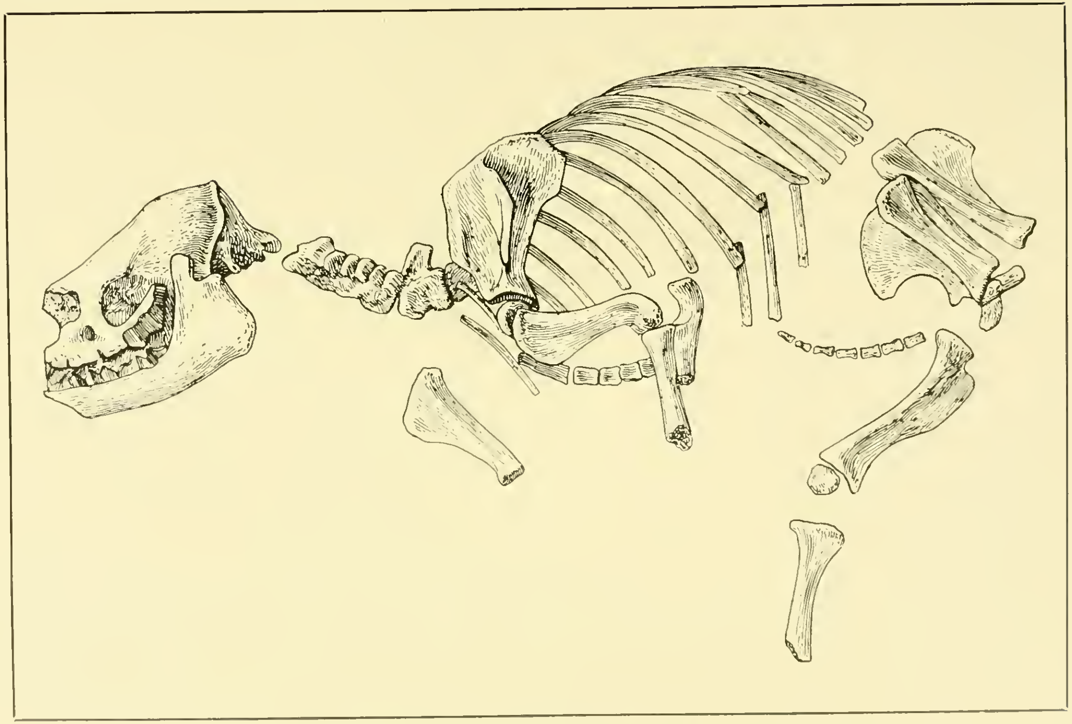
The scapula is quite titanotheroid in its general outline, the spine being less overhanging than usual, which is probably a juvenile character. The general proportion of the limb-bones is not unlike that in the Uinta Titanotheies, if one may judge from the immature condition of the specimen.

MEASUREMENTS.

	Mm.
Length of vertebral column from altas to tip of tail, measurement along the curves, approximately	655
Scapula. Greatest height	90
Scapula. Greatest transverse diameter of blade	64
Humerus. Greatest length, approximate	90
Radius. Greatest length, approximate	70
Femur. Greatest length, approximate	114
Tibia. Greatest length, approximate	85

SYSTEMATIC POSITION.

That the above described form belongs to the Titanotheriidæ can hardly be questioned. From the fact that there are only three premolars one might be led to regard it as closely related to *Lambdotherium* from the Wind River formation, but on a closer survey of the material it is clear that the upper and lower first molars are more



Heterotitanops parvus Peterson. Type. No. 2909. C. M. Cat. Vert. Foss. $\times \frac{1}{4}$.

closely allied to such forms as *Titanops borealis* (Cope) and *Limnohyops*. It is possibly a form which paralleled *Lambdotherium*, which lived in the Wind River epoch, and may be regarded as a second aberrant form of the Titanotheriidæ, with closer affinities to the latter than to *Lambdotherium*.

CARNEGIE MUSEUM,
September 16, 1913.

IV. ON THE OSTEOLOGY OF THE GENERA LASIOPYGA AND CALLITHRIX WITH NOTES UPON THE OSTEOLOGY OF THE GENERA SENIOCEBUS AND AOTUS.

By R. W. Shufeldt, C.M.Z.S.

(Plates XII–XXI.)

Not long since I had occasion to examine into the osteology of some of the Old World apes and New World tamarins and marmosets, and I soon discovered, that, although in times past much had been published on this subject, there yet remained in the matter of detail a great deal, which up to the present day has not been touched upon. To be sure we have the works of Blainville, Owen, Flower, Giebel, Huxley, Mivart, Vrolik, and many others, who have given us their time-honored contributions in this important field, but in the main these are mostly of a general nature and not especially devoted to detailed descriptions and comparisons.

Recently we have had placed before us, however, the epoch-making work of Dr. D. G. Elliot,[1] who has long been engaged upon the biology and taxonomy of the entire group of primates, for which sumptuous production he has examined an enormous body of material, including nearly all the principal types and material contained in private collections and in the great museums of the world, not to speak of what he has gathered during his personal investigations in Africa and elsewhere. Dr. Elliot with great generosity has presented a copy of this work to me, and in reply to a recent letter of inquiry states that "*Callithrix* is the proper genus in which to place *Hapale jacchus*," and that 'he places *Lasiopyga* between the genera *Rhinostigma* and *Miopithecus*, the tooth-formula of *Callithrix* being $\frac{2-2}{2-2}, \frac{1-1}{1-1}, \frac{3-3}{3-3}, \frac{2-2}{2-2} = 32$.'

It will be remembered that Mivart also states that "In the whole

[1] Three years have elapsed since the present paper was written, and it was only a few months ago that I obtained the skeleton of *Seniocebus meticulosus*. The brief description of the latter will therefore be given at the end of this article under "Closing Remarks." In the same place I will also make reference to the osteological data given by Dr. D. G. Elliot in his work, "A Review of the Primates" (Monographs A. M. N. H., Vols. I–III, 1912), with respect to the skeletons of the forms touched upon in this paper, including *Aotus miriquouina*, a skeleton of which (no. 103,917) I have examined in the U. S. National Museum.

series of Old World apes we find the same number of different kinds of teeth as in man," that is, sixteen in each jaw, or thirty-two in all; but that "*Cebidæ* have an additional premolar on each side of each jaw, and the *Hapalinæ*, besides this, have a true molar the less." These, as we know, are New World representatives of the group. (*cf.* Mivart, Article "Ape," Encyclopedia Britannica, 9th Ed., p. 164).

Recently upon going over some of the osteological material representing the primates at the United States National Museum, a privilege for which I have pleasure in thanking the curator of the Division of Mammals, Mr. Gerrit S. Miller, Jr., and his assistant curator, Mr. Ned Hollister, I found that within recent years this collection has been greatly increased; that long and varied series of skulls and skeletons of many Old and New World primates are now to be found in it; and that these are daily being augmented by accessions of a similar kind from all parts of the world, where these animals find their habitats. Much of this material still remains undescribed, although Mr. Hollister has given us something upon it which has appeared in the Proceedings of the Museum and elsewhere. I have to thank him for his kindness in looking up for me the synonymy of the species referred to in this paper.

Some years ago Mr. Edward S. Schmid of Washington presented me with three monkeys in the flesh, one of these being a male *Lasiopyga griseoviridis* (Desmarest) from northeastern Africa, and two adult specimens of *Callithrix jacchus* (Linnæus). Several years afterwards Mr. Schmid very generously added to this list a specimen of the very rare tamarin, *Seniocebus meticulosus* Elliot, of which I made a negative and preserved the skin and skeleton. From all of the first-named three I likewise obtained complete skeletons,[2] and from them all photographs of the various parts of the same, which photographs are herewith reproduced. For comparision I have had the use of a complete skeleton of a male *Lasiopyga callitrichus* from the U. S. National Museum (No. 16365).

CRANIUM AND MANDIBLE.

(Plates XII–XVII, figs. 1–19; Plate XX, fig. 24; Plate XXI, fig. 26.)

It has long been known that the skeleton in the *Simiina* is formed upon the same general plan as *Homo*. Comparative osteology more-

[2] The author has generously donated the skeletons of *L. griseoviridis*, *C. jacchus*, and *S. meticulosus* to the Carnegie Museum. (Accession 5103). *Editor.*

over teaches us that in the apes, as in man, we often meet with very marked variation in the matter of form, when we come to compare the skulls of individuals belonging to the same species, and that there are very wide variations to be noted among the skulls of the various genera of apes, as in the various races of men. In long series of the skulls of apes we would also probably find more or less constant differences distinguishing the skulls of the two sexes.

In its general appearance, the skull in *Lasiopyga griseoviridis* has a far more brutish aspect than in *Lasiopyga callitrichus;* this is well shown in figures 1–8 of the plates, and the reason is very evident; for, in the first-named ape, the supra-orbital ridges are very prominent with rounded borders, and, as they lie entirely in the horizontal plane, they merge indistinguishably with each other in the middle line, lending to the entire skull a very forbidding aspect. This is further enhanced by the prominence of the remainder of the orbital peripheries, and the extreme flatness of the vault of the cranium, as compared with the more human-like rounded dome of the calvarium in *L. callitrichus.* Furthermore all the muscular lines, depressions, processes, and other osseous characters in *L. griseoviridis* are more pronounced, more prominent, sharper, and more distinct than in *L. callitrichus;* to which must be added the feature of the upper canine teeth, which in *L. griseoviridis* are much longer in proportion, more curved, and in front exhibit deep grooves running their entire length, these grooves being more internal and by no means prominent in the upper canines of the other ape. In fact the skull of *L. callitrichus* has all these characters very much reduced in prominence, and the existing differences are very much as we find them upon comparing the skull of a highbred, intelligent Caucasian with the skull of a low, savage Ethiopian, such as I have elsewhere figured in my works upon that race. These characters of the crania are also evident when we come to compare the mandibles of these two apes; for the angle at the posterior termination of the symphysis is far more rounded in *L. callitrichus* than it is in *L. griseoviridis*, and again there are the differences in the canine teeth, though these are not grooved as they are in the upper jaw. For the rest, the dental armature is well known and has been frequently described, as it likewise has been for *Callithrix jacchus*, rendering it needless to repeat here. This marmoset also has a skull which is entirely lacking in all those characters which lend such a savage and brutish aspect to the skull of the Green Guenon as just described; in fact, the skull of *Callithrix* somewhat reminds us, especially when viewed laterally, of the skull in some of the *Mustelidæ*, *e. g.*, *Spilogale putorius*, in the posterior elongation of the cranium, and the aspect of the canines. Viewed anteriorly, the facial aspect of the skull in *Callithrix* is, however, entirely Simian in all of its essential characters, with its large, cavernous, globular orbits, with their circular, unbroken peripheries, and their inner walls entirely completed in bone excepting the usual foramina. This is the case in both the species of *Lasiopyga* before me, wherein all the diameters of either orbital cavity, save the antero-posterior, are longer than the diameters measured from the peripheral borders by several millimeters. The usual foramina in either orbit are the same as they are in man. Confining ourselves for the present to the characters of the face, we note the marked transverse narrowness of the superior nasal region in *L. callitrichus*, as compared with the much broader and more rounded area in *L. griseoviridis* (Pl. XII, Figs. 1 and 2); while the anterior narial aperture is about the same in either species, being only slightly larger in the last-named form. As in most apes in this and related genera, the maxillary portion of the face is prominent and rounded, though not nearly as much so as in some of the higher Simians, as the orangs and chimpanzees. The premaxillaries form a distinctive feature, together forming the facial area, and being carried up to articulate with the nasals above, the sutural traces being more evident in *L. griseoviridis*.

In the specimen of *L. callitrichus* before me, there is neither notch nor foramen for the supraorbital nerve, while in the Green Guenon there is a minute foramen for the exit of that branch on the left side. In both skulls there are present upon either side from four to five foramina for the exit of the infra-orbital nerve. On the other hand in *Callithrix* the foramen is single. In this genus also the malar foramen is single, which is likewise the case in *L. callitrichus;* while in *L. griseoviridis* there are two upon either side. A peculiar character in the face of this last-named species is the deep transverse notch between the nasals and the supra-orbital ridge (Plate XIII, Fig. 4). In both skulls the anterior nasal spine is entirely absent; the lachrymal groove is well marked; and the canine eminence most prominent in *L. griseoviridis*.

These apes have the vomer moderately well developed, being weakest in *L. callitrichus*, in the skull of which at hand I find no turbinated bones, although at least two on either side are well developed both in *L. griseoviridis* and in the marmoset. There are in these apes no supra-orbital ridges beyond the ones formed by the superior peripheries of the orbits, as we find in most human skulls, even among the lower races of men, where such ridges are present on the frontal bone above the orbits. These latter are sometimes absent in negroes of pure strain.

With regard to the lateral aspect of these skulls (Pl. XIII, figs. 3 and 4; Pl. XVI, fig. 10) it may be observed that in all of them the extent of the cranial capacity is far greater than might be inferred from the facial view alone. This is especially true in the case of the marmosets and *L. callitrichus*. In *L. griseoviridis* the cranial dome is more depressed anteriorly. In *C. jacchus* and in *L. griseoviridis* the superior border of the zygoma is produced backward and upward, to be lost as a prominent ridge on the lamboidal suture. This feature is best seen in *L. griseoviridis*, and is wholly absent in *L. callitrichus*. As in man, the temporal fossa is deepest opposite the middle third of the zygoma, while anteriorly the space is occupied by the outward bulging of the external wall of the corresponding orbit, especially in *C. jacchus*.

The zygoma is nearly horizontal, presenting a gentle sigmoid curve, with the tubercle at its posterior extremity very much aborted, practically absent in *C. jacchus* and *L. callitrichus*. The mastoid process, likewise, does not constitute a prominent feature in these skulls, and is only faintly indicated in the marmoset, in which conspicuous auditory bullæ are developed, a character which is entirely absent in *Lasiopyga*. The mastoid foramen is above the aural opening in *C. jacchus*, while it is found posterior to it, and at the base of the skull, in *Lasiopyga* (*Cf.* Pl. XV, fig. 7, to the right). Extensive, shallow, and flat, the glenoid fossa is hardly deserving of the name, and it is only in *L. callitrichus* that it presents any concavity at all. However, the post-glenoid apophysis is strong and pointed in all of these apes, and materially contributes to the articulatory surface for the mandible and to keeping it in place.

Apparently absent in *C. jacchus*, the styloid process is very small in *L. callitrichus*, though better developed in *L. griseoviridis*.

In the temporal fossa, the wing of the sphenoid always appears to articulate by suture with the parietal of the same side. This fact is mentioned for the reason that Owen, in his Anatomy of Vertebrates

(Vol. II. p. 533) stated that "In the still smaller monkeys (*Cercopithecus*) the cranial cavity forms a larger portion of the skull. In *C. ruber*, the alisphenoid joins the parietal on the left side, not on the right. The postglenoid process is pointed, and in some (*Cerc. albogularis*) the mastoid also." He gives a figure (Fig. 353) showing this joining of the alisphenoid with the parietal on the left side, and in stating that it did not do so in *C. ruber* on the right, he evidently considered the character constant in that species, in which I am forced to believe that he was mistaken. Mivart states that "In *Nyctipithecus* the alisphenoid is almost shut out from the parietal by the close approximation of the squamosal to the malar," which is doubtless true.[3] Low down in the temporal fossa in *C. jacchus*, the shortened wing of the sphenoid makes quite extensive contact with the parietal, and the malar bone here may be pierced by one or two large perforating foramina, which lead into the back of the orbit. There may be only one of these, or they may be absent. No such foramina are to be found in *Lasiopyga*. All these apes possess an osseous *meatus auditorius externus*, leading directly into the auditory bulla in *Callithrix*, where no auditory process is present, the latter only being conspicuously developed in *Lasiopyga*.

Viewed from above, it will be observed that there are some very striking differences in the skulls of *Lasiopyga callitrichus* and *L. griseoviridis* (Pl. XIV, figs. 5 and 6). In *L. griseoviridis* the prominent orbital arch almost conceals the orbits from view; which is not the case in *L. callitrichus*. Again, in *L. griseoviridis*, the temporal ridges are conspicuously developed, but are practically absent in *L. callitrichus*. In both these apes, no parietal foramina are met with, though I have never as yet failed to find them in the skull of man.[4]

[3] On the left side in the skull of a *Pongo*, collected by Dr. W. L. Abbott on August 11, 1907 (West Borneo, Bayu, Sempang River), and now in the collection of mammalian skeletons in the U. S. National Museum (No. 145,322), there is a temporo-frontal articulation, which separates the alisphenoid from the parietal by several millimeters; while on the left side of the skull of *Simia* (No. 142,202, Coll. U. S. Nat. Mus.), collected by Dr. W. L. Abbott in West Borneo in 1905 (Sakaiam River), the arrangement is the same as in the vast majority of human skulls, that is to say, the alisphenoid articulates with the temporal, the parietal, the frontal, and the malar.

[4] Since this was written I have undertaken the examination of some seven thousand human skulls in the collection of the U. S. National Museum, with a view to obtaining certain data from them. These skulls are of both sexes and all

The frontal bone extends far backward, while the occipital is shut out from view in this aspect of the skull in these two monkeys. The marmosets have the temporal ridges also but very faintly indicated; the parietal foramina absent, and the form of the skull much elongated in some individuals, shorter in others.

There is little demanding special description in the cranial cavity of these monkeys which is not already known to anatomists. The 'sella turcica' is well marked, with its posterior clinoid process, and the usual foramina exist for the entrance and exit of vessels and nerves. The tentorium is not ossified in *Lasiopyga*, though the cerebellar fossæ are fairly well differentiated.

Upon basal view these skulls are all interesting when studied in connection with an average human skull viewed in the same manner. In *Lasiopyga callitrichus* and *L. griseoviridis* the characters are much alike, while very decided differences are found to exist when we come to compare these with the corresponding characters in the skull of *Callithrix jacchus*. In the latter the auditory bullæ occupy much of the space, being large and elongated, and directed forwards and inwards to a point about the middle of the cranial base, where their apices are separated by a distance of several millimeters. For the rest, the surfaces are singularly smooth; the sutures nearly obliterated; the pterygoidal plates of the sphenoid prominent, with the hamular processes conspicuous; two very distinct and circumscribed foramina are present upon either side, one just external to either condyle, and the other somewhat larger, immediately external to the anterior apex of either auditory bulla. The palatal root is short antero-posteriorly, with the sutures nearly obliterated. The plane of the occiput and foramen magnum makes an angle of about 45° with the *basis cranii*.

In *Lasiopyga* the anterior palatine fossa is mesially and longitudinally divided by the vomer (Pls. XIV and XV, figs. 5–8). The palate is twice as long as it is wide, and markedly concave from side to side. Traces of the sutures between the bones are persistent until late in life. The posterior palatal grooves are very deep in *L. callitrichus*, the foramen occupying its usual site posteriorly.

ages, representing all the known races of the world, both recent and prehistoric. The opportunity to study them is due to the kindness of Dr. Ales Hrdlicka, Curator of the Division of Physical Anthropology, the work having been undertaken for a certain purpose. It is more than likely that I may now meet with human skulls in which the parietal foramina will be found to be absent, as many of these skulls appear to reveal remarkable anomalies.

The external pterygoidal plates of the sphenoid are very prominent, quadrilateral in outline, and turned outwardly; the internal plates are not more than one-fifth the size of these; but each supports a distinct hamular process. Either pterygoidal fossa is deep and has from two to twenty minute foramina at its base. The basilar process of the occipital is broad and elongated, but does not extend as far forward as the petrous portion of the temporal upon either side. The carotid foramen is very distinct and circular, and I find no posterior condyloid foramen present. The foramen ovale is of fair size, and located as in the cranium of man. Other small cranial foramina and openings are also present. The vomer is bifurcated posteriorly, the bifurcations receiving the sharp palatal process of the sphenoid. This is a striking feature of the base of both of these skulls (*Cf.* Plate XV, figs. 7 and 8).

In *L. callitrichus* the occipital surface is very smooth and lacking in depressions; while in *L. griseoviridis* it is decidedly roughened for muscular attachment two-thirds of the way up to the lamboidal suture, and in this area presents mesially a raised, longitudinal crest, the internal occipital crest, which merges into the general surface of the bone at its extremities.

The foramen magnum is subcircular in outline, and rather large for the size of the animal in either species. The condyles are elongated and narrow, and occupy half the periphery of the anterior margin of the foramen. Mesially they are separated by a very shallow notch. The occiput makes an angle with the *basis cranii* of about 45°, that of the plane of the foramen magnum being considerably less. Another well-marked character, present on either side in both species, is the Glaserian fissure, occupying a position similar to what we find in anthropotomy.

Lasiopyga has a strong and powerful mandible, with its two parts in the adult thoroughly and indistinguishably fused at the symphysis; *Callithrix* has the ramal portion very thin, broad and quadrilateral in outline; while the body is not as strong in proportion as it is in some of the higher apes. The infradental and mental foramina are minute and single. Internally at the symphysis neither tubercles nor fossa are found in *Callithrix;* while in *Lasiopyga* a deep fossa is always present where the "genial tubercles" are found in man, and at the base of this fossa we find a circular foramen piercing the bone in the median line, to appear externally at the center of the bone, half-way between the alveolar process and the inferior border. The infradental and mental foramina are generally single in *Lasiopyga* as in *Callithrix;* but there are two foramina on either side in the jaw of *L. callitrichus* before me. In this last species the coronoid process is higher than the condyle on either side, and the sigmoid notch shorter and deeper than it is in *L. griseoviridis.* In *Lasiopyga* the notch is always long and shallow (Plate XIII, figs. 3, 4, and Plate XVI, fig. 10). The areas for the attachment of muscles, especially for the buccinator and internal pterygoid, are more or less roughened. The angle of the ramus is always rounded, and instead of their being a 'mental process' to represent a chin, as in man, the mandible in all these apes slopes from the teeth downwards and backwards as shown in Plate XIII, figs. 3, 4, and Plate XVI, fig. 10.

I find no good figures of the skeleton of *Lasiopyga* in the literature accessible to me. The one which has so long done duty in Huxley's "The Anatomy of Vertebrate Animals," is incorrectly drawn in nearly all particulars; it has no canine teeth, the zygoma is not that of an ape, in short it is not a skeleton of *Lasiopyga.*

Almost all of the laryngeal box in these apes ossifies in the adult, certainly in *Callithrix*, while the trachial rings seem to be only formed in cartilage, or, at the most, in elementary bone. De Blainville, Owen, Mivart, and other comparative anatomists have all referred to the enormously developed body of the *hyoid* in *Mycetes seniculus;* while Flower and others have described the hyoid in other New and Old World apes, as in *Cynocephalus porcarius* and *Lagothrix humboldtii*, cerato-hyals and epi-hyals being found in the last-named species. Flower further stated in his *Osteology of the Mammalia* that "In very few of the Old World monkeys is there any ossification in the anterior hyoid arch; but in some *Cercopitheci* a short, bony, cerato-hyal is found. This occurs also in the American Monkeys, with occasionally the addition of a second piece (epi-hyal)." It would appear that the presence of an ossified stylo-hyal in any of the apes is of extremely rare occurrence, though sometimes a very small tympano-hyal became ossified.

In the skeleton of *Lasiopyga griseoviridis* (C. M., No. $\frac{5103}{1}$) the basi-hyal is large and completely ossified. It has a length of 1.3 cm., and a width above of 1.2 cm. It is broad above, and narrow below, where it bifurcates, the processes thus formed being separated by a rounded notch. Posteriorly it is deeply concave, especially above, being correspondingly convex in front, where there is a blunt, longitudinal crest developed on the median line. At its supero-external angles, short, stout apophyses project, each having on its end an articular facet for a rather long, curved thyro-hyal. Neither cerato-hyals nor epi-hyals are present.

THE AXIAL SKELETON.

(Plates XVIII–XIX, figs. 21, 22.)

THE VERTEBRÆ.

Flower among others has given us more or less full descriptions of the bones composing the skeleton of the trunk in the Primates. In the third edition of his *Osteology of the Mammalia*, on pages 78 and 79, he presents a table in which is set forth, under the five divisions of the vertebral column, the number of vertebræ found in each division. In the table *Homo sapiens* is compared in this way with no fewer than thirty-eight species of Apes from different parts of the world. In the list we find five species of *Lasiopyga* (*Cercopithecus*), including *L. griseoviridis* and also *Callithrix jacchus*.

In the specimen of *L. griseoviridis*, the skeleton of which I prepared, the animal had lost about half of its tail either prior to or after capture. Hence this part of the skeleton is imperfect. The tail is perfect in the skeleton of *Lasiopyga callitrichus* in the U. S. National Museum, and I have in my own collection a skeleton of *C. jacchus* in which the tail is perfect.

In his specimen of *Lasiopyga griseoviridis* Flower found seven cervical, thirteen thoracic, six lumbar, two sacral, and twenty-five caudal vertebræ. Upon comparing this with the skeleton of *L. griseoviridis* at hand, I find it has seven cervical, twelve thoracic, seven lumbar, and three sacral vertebræ. In counting the thoracic vertebræ, I am guided by those which support a pair of ribs, and in counting the lumbars, those are included which extend between the last thoracic and the first sacral,—a sacral being understood to be a vertebra which articulates with the pelvis and coössifies with one or more vertebræ succeeding it. In *L. griseoviridis* three such vertebræ coossify to form a sacrum, and following these, every vertebra belongs to the caudal series.

In the U. S. N. M. specimen of *Lasiopyga callitrichus*, No. 16365,—Flower did not make any record for this species,—I find seven cervical, twelve thoracic or dorsal, seven lumbar, three sacral, and twenty-eight caudal vertebræ. In only one species of *Lasiopyga* (*Cercopithecus*) did Flower find twenty-eight caudals, and that in *L. patas*.

Now coming to *Callithrix jacchus* (*Hapale*), of which I have two skeletons, I find in one seven cervicals, thirteen thoracics or dorsals, six lumbars, three sacrals, and twenty-eight caudals, the distal caudal being less than 2 mm. long and as fine as a human hair. This agrees with Flower, except as to the caudal vertebræ, of which he records only twenty-three, or six less than I find in a perfect specimen. Owen states in his Anatomy of Vertebrates that "Nineteen is the usual number of dorso-lumbar vertebræ in the Platyrrhine group, the Spider-monkeys (*Ateles*) offering the exception of eighteen, viz: D. 14, L. 4." This agrees with my count above. Owen also states that in most Platyrrhines the number of caudal vertebræ are usually thirty or upwards, "*Ateles paniscus* having thirty-three caudals." This is entirely at variance with what we find in the table given by Flower. Mivart states that "The dorsal vertebræ vary in number from eleven, as sometimes in *Cercopithecus* [*Lasiopyga*] and *Macacus*, to fourteen, as sometimes in *Hylobates*, or even to fifteen, as in *Nyctipithecus* [*Aotus*]." So far as *Lasiopyga* goes, this is not only different from Flower's count for five different species of *Lasiopyga* (*Cercopithecus*), but it is evidently incorrect. But this is only one instance out of many where these two eminent anatomists disagree with respect to the number of vertebræ found in the several divisions of the spinal column of the Primates. We are dealing here, however, only with *Lasiopyga* and *Callithrix*.

In the atlas of both these genera of apes there are two foramina, on either side, one above and one below the transverse process, for the passage of vessels. They lead to a common opening, which is found just posterior to the superior articular surface for the occipital condyle. It is for the passage of the vertebral artery, on either side; but exactly in what manner the branching takes place I shall be unable to state, until an opportunity occurs to dissect another specimen in the flesh. In man the foramen for the vertebral artery is single on each side. The vertebral vein may upon quitting the cranium pass through the other foramen. Owen seemed to believe that both perforations were for the vertebral artery in the marmoset (*Hapale jacchus*) when he stated that in that species "The transverse process of the atlas is perforated lengthwise and vertically by the vertebral artery, and the neural arch is perforated." The vertebral canal passes through all the cervical vertebræ increasing in calibre as it approaches the thorax, save in the last vertebra. In both *Lasiopyga* and *Callithrix* the inferior lamellæ of the transverse processes are broadened from side to side, and their extremities expanded, thus forming lengthened, longitudinal processes. These inferior lamellæ are absent in the seventh cervical vertebra. The neural spine in the axis is thick and relatively large; is much smaller in the third cervical, becomes sharp and pointed in the fourth, after which it gradually becomes sharper and longer to and including the seventh or last cervical.

The seventh cervical in both *Lasiopyga* and *Callithrix* has a demi-facet on either side of the centrum to form part of the articulation of the first pair of ribs.

In *Lasiopyga*, and especially in *L. callitrichus*, the neural spines of the dorsal vertebræ are long, rather pointed, but with slightly expanded apices. They become progressively and gradually shorter as we proceed backward, and less and less inclined in that direction (Plate XVIII, fig. 21). The last two thoracic vertebræ have characters approaching those of the anterior lumbars. In the last dorsal vertebra the transverse processes are aborted, a gradual diminution from the strong ones in the fore part of the series having taken place and they are supplanted by the sharp-pointed pleurapophyses, directed backwards, so that on the last dorsal we have a pair of these, as well as a pair of ribs, which articulate only with the centrum of that vertebra. These spine-like pleurapophyses persist in the lumbar vertebræ, including the penultimate, becoming smaller and smaller, and disappearing entirely on the last lumbar. In articulation they powerfully assist in holding the prezygapophyses in place, being in any instance situated just below a postzygapophysis, thus forming a recess into which the prezygapophysis of the vertebra next following accurately fits. Transverse processes commence again on the first lumbar, and become more and more prominent to and including the last one of this series (Pl. XIX, fig. 22).

The neural spines of the lumbars are conspicuously developed, rather high, elongate, oblong, and are in each of these vertebræ nearly as long as its centrum. Essentially all of these characters are repeated in the spinal column of the marmoset; but in it the neural spines of the last dorsals are not as long or as pointed. These monkeys have long, slender ribs, requiring no special description. Barring the last pair, they articulate between the vertebral centra, thus giving rise to demifacets to accommodate them. In *Lasiopyga* eight of these articulate with the sternum by means of cartilaginous hæmapophyses or costal ribs; in *Callithrix* only seven are so joined; the last three in the first-named species are "floating ribs," while the costal ribs of the ninth pair articulate with the lower margins of the costal ribs of the eighth pair. The sternal ends of these costal ribs articulate *between* the several pieces composing the sternum, which latter remain separate bones apparently throughout life. A large, triangular manubrium surmounts the series, and the xiphoid process at the distal end is rather large and expanded, particularly in *Callithrix*.

In *Lasiopyga* the three sacral vertebræ in the adult are firmly fused together to form one single bone, the lateral processes of the first being conspicuously thrown out to mold themselves on an extensive iliac articulation of the pelvis upon either side. In *Callithrix* only the two first sacrals thus coössify, and the third closely resembles the first caudal vertebræ (Pl. XIX, fig. 22).

Lasiopyga callitrichus has the first three caudal vertebræ of a distinctive type. In some respects they resemble the last sacral vertebra, but all the processes are slenderer, more prominent and projecting. Moreover, we find rudimentary chevron-bones here present, lapping the centra, but not fusing with them. In *Callithrix* the three anterior caudals more closely resemble the last sacral of that genus, and the chevron-bones are small. The fourth caudal vertebra in *L. callitrichus* differs very markedly from the one which precedes it, as it is more elongated, and its prezygapophyses are distinct, short, stout processes directed forwards and outwards, and its postzygapophyses are fused into one long, rather slender process, which springs from the middle of the centrum to arch backwards. The lateral or transverse apophyses are broad, outstanding, triangular lamellæ and different from those of any other vertebra anterior to it. There is a rudimentary pair, which are stronger in the fifth caudal, after which they become much reduced. In the fourth and fifth caudals, the chevron-bones, completely ossified, are V-shaped in form, free, and articulate with the centrum anteriorly and below, encroaching very slightly on the vertebra next beyond. This encroachment is better marked on the part of the chevron-bone of the fifth caudal, after which these elements become double and distinct, and more and more rudimentary as we follow the vertebræ distad until they finally disappear entirely on the fourteenth or fifteenth caudal. This is also the fate of the outstanding processes, each vertebra, as we approach the end of the tail, becoming more rod-like and longer with enlarged extremities, and rudimentary in character with diminished calibre to and including the tenth, after which they progressively shorten again and become shorter and shorter to the end of the appendage, the last ten or twelve being merely rudimentary little rodlets, the terminal caudal being only 5 mm. long as compared with the seventh, for example, which has a length of 35 mm.

The characters of the caudal vertebræ in *Callithrix* in many ways resemble those of *Lasiopyga*, though the chevron-bones are more rudimentary and the apophyses in the anterior caudals not so conspicuous. Only the first four caudals in *Lasiopyga* have the neural canal a closed tube, though it may exist in the fifth, where its calibre becomes of mere hair-like proportions. It is better marked in the fifth caudal of *L. griseoviridis*, in which species the fifth caudal more closely resembles the third, which is not the case in *L. callitrichus*. *Callithrix* has its few anterior caudals much flattened out from above downwards Mivart noted that "Chevron-bones and processes for their attachment are altogether wanting only in the *Simiinæ* and in *Macacus inuus*. They attain their maximum in *Ateles*, where they present almost every variety of development in one or other part of the caudal region."

In those monkeys having prehensile tails, as in *Ateles* for example, the processes of the caudal vertebræ are exceptionally well-developed in order to afford attachment for the caudal muscles employed in the grasping power of the appendage in this genus; and it is a well known fact that all the vertebræ in these animals vary considerably throughout the group.

THE APPENDICULAR SKELETON.

THE FORE LIMB. (Plate XX, fig. 23).

In his excellent article "Ape" in the *Encyclopædia Britannica*, Professor Mivart has given us the proportions of bones, particularly the long bones of the skeletons of a great many of the representatives of the group here under consideration. This has been done so fully that it obviates the necessity of touching upon this part of the subject in the present contribution, as the space can be better utilized for presenting the description of the actual characters. In this connection it is to be noted that Mivart in the aforesaid article, treating of the "Appendicular Skeleton," refers to *Lasiopyga* but once, and that is when he says that "The index digit, with its metatarsal, compared with the spine, is as 38 to 100 in *Simia*, and it varies thence down to 21 in *Cercopithecus*." I find in *Lasiopyga callitrichus* it is less than 18.

The Clavicle. In this same skeleton the clavicle has a length of 4 cm., and, when duly articulated with the sternum and scapula, the surface which corresponds with the anterior in man, in the ape become the superior, and the other surfaces change aspects accordingly. This is also the case in *Callithrix*. In *Lasiopyga griseoviridis* the clavicle has a length of 4.7 cm., while in *C. jacchus* it has a length of only 2 cm. In all of these species its form is to a large extent similar, and its mode of articulation interesting. We find its sternal extremity enlarged, bearing an extensive facet mesially for articulation with the sternal manubrium above the costal cartilage of the first rib, the interval in *Callithrix* being considerable and proportionately much less in *Lasiopyga*. The scapular end of the bone is very much curved downward especially its outer, expanded part, where it materially assists in protecting the articulation for the head of the humerus. This expanded portion in *L. griseoviridis* is largely scooped out to form a notable fossa, which is not as well marked as in *L. callitrichus*, and absent in *Callithrix*. When duly articulated with the coracoid and acromion processes, the clavicle closes in a large, circular foramen between these two apophyses and the adjacent border of the glenoid cavity, assisted as it is by the scant trapezoid ligament.

The Scapula. *Lasiopyga* and *Callithrix* have the scapula much alike in all of its essential characters. Its form is not a little different from its form in man. As compared with the latter, we find in *Lasiopyga* that the superior and internal borders are of equal extent, and no very definite "superior angle" occurs at their juncture, as in man, where the internal or vertebral border is fully four times longer than the superior. Again in the ape the spine of the scapula, which is conspicuously developed, is continued to the internal border; not so in man, where a very considerable smooth surface intervenes, over which in life the trapezius muscle glides. There is no evidence of any "suprascapular notch" in *Lasiopyga*, and the external border of the bone is much thickened and profoundly grooved from the neck of the bone almost to the inferior angle, the grooving being broadest and deepest at its upper part, and gradually shallowing and narrowing as the lower angle is approached. The acromion process is large and strong and only slightly bent, while the smaller coracoid process is straight, flat on its glenoidal and outer surfaces, and joined to its base at a right angle. The scapular neck is well defined, and the articular surface for the humeral head of the bone of the arm is pear-shaped with the larger end below. The subscapular fossa of the anterior aspect is smooth throughout, but generally exhibits a shallow groove running longitudinally from below the neck almost to the inferior angle.

The Humerus. Among the higher races of men the shaft of the humerus is normally always straight, while in *Lasiopyga griseoviridis* its shaft is not only somewhat twisted upon itself, but very decidedly curved for its entire length; the concavity of this curvature, extending from the head to the internal condyle, is along its inner aspect, the corresponding convexity being down the other side of the bone. This curvature is less evident in the shaft of the humerus in *Lasiopyga callitrichus*, while in *Callithrix jacchus* the humeral shaft is almost straight. It is a strong, big, heavy bone in *Lasiopyga* with a large, semiglobular head, the upper surface of which is on a level with the tuberosities. We find the nutrient foramen at the juncture of the middle and lower third of the shaft, above the internal condyle in *Lasiopyga;* while in *Callithrix* it is just below the head at the upper end of the bone. *Lasiopyga* has the internal condyle but very moderately produced, while the marmoset has it very conspicuously produced; and again, in the first-named genus, the outer crest of the trochlea for the ulna is very sharp, prominent, and produced distad; the trochleæ are in the same plane in *Callithrix.* The olecranon fossa in *Lasiopyga* is always pierced by a large circular foramen, which does not occur in my skeletons of *Callithrix*, though the bone is quite thin at the site. The usual grooves for muscles and nerves are present, the musculo-spiral groove being particularly well marked in *Lasiopyga*, in which genus no part of the shaft can be said to be cylindrical, so pronounced are its borders and the longitudinal grooves between them. No such distinctive features as either an anatomical or a surgical neck exists in the humeri of these apes, and in *Lasiopyga* the head of the bone does not unite solidly with the shaft until comparatively late in the life of the individual. It has an extreme length in *L. griseoviridis* of 12.3 cm., in *L. callitrichus* of 11 cm., and in *Callithrix* of 4.3 cm.

The Radius. In *Lasiopyga* only the proximal fifth, including the head, of the shaft of the radius is straight and moderately compressed, the balance of the bone being greatly curved for its entire length, this curvature having its concavity toward the interosseus space in the articulated skeleton. The shaft gradually, though moderately, increases in caliber for its lower four-fifths, presenting three sharp borders, the surfaces between them exhibiting longitudinal grooves. *Callithrix* also possesses a radius like this, but in it these grooves are absent. Both have a circular head with a moderate central depression at its summit, and the distal extremity larger than the proximal. The bicipital tuberosity is elongate and not perceptibly raised above the surface of the shaft. Distally the styloid process is fairly well-produced, and this epiphysis does not unite with the shaft until late in life, a remark which also applies to the ulna, and, as already stated above, to the head of the humerus.

The Ulna. *Lasiopyga* has an unusually straight ulna, it being slightly curved in the marmosets. It gradually diminishes in caliber from the big olecranon to the distal end, where we find a styloid process present, and articulation with the carpus takes place, which is not the case with this extremity of the radius. *Lasiopyga* has the greater and lesser sigmoid cavities of the ulna extensive and very concave; in fact, this end of the bone very much resembles the proximal end of the ulna in man. In the Green guenon its shaft is deeply and longitudinally grooved for the lesser sigmoid cavity down to a point about its middle. Below this point the shaft is more or less cylindrical in form.

The Carpus and Manus. Coming now to the carpus and the manus, Mivart has pointed out that the "carpus consists, in *Troglodytes*, of the same eight bones as in man. In all the other genera there is a ninth bone, the *intermedium*." Flower in the third edition of the *Osteology of the Mammalia*, on page 286, figures the bones of the carpus of a Baboon (*Cynocephalus anubis*) where the intermedium is present, and there called the *centrale*, so there are also in the wrist-joint of this animal nine bones. In the Baboon there is also another bonelet present, it being the "radial sesamoid," which is free and articulates with the margins of the trapezium and scaphoid. It belongs to the tendon of the *flexor carpi radialis* muscle. All this agrees with what we find in the carpus of *Lasiopyga* and *Callithrix*, in each of which genera the unciform is larger than the magnum, and the pisiform very prominent, and in articulation making a right angle with the shaft of the ulna.

The bones of the *metacarpus* are proportionally longer, more curved, and narrower than in man; but, together with the *phalanges*, are the same in number. These last are also more curved than they are in man, the distal pha anges being compressed from above, downwards, except in *Callithrix*, where the compression is in the other direction, being curved, as in some birds, and sharply pointed, having the form of the distal d'gital thecæ which encase them. In *Lasiopyga*, a pair of sesamoids are found on the palmar aspect at the metacarpo-phalangeal joints, and also at the joints beyond the index and minimus digits.

THE HIND LIMB. (Plate XVIII, fig. 21; Plate XIX, fig. 22, and Plate XXI, fig. 25).

The Pelvis. Differing considerably in form from the pelvis in *Homo*, and likewise from the big pelvis in *Troglodytes* with its great, broad ilia, the ilium as a who'e in *Lasiopyga* is much elongated and comparatively narrow. Either ilium rises considerably above the sacral articulation to a point opposite the middle of the penultimate lumbar vertebra in the articulated skeleton. Its crest is moderately convex and roughened, and it is here that the bone is broadest, gradually narrowing as it approaches the acetabulum. Upon its outer surface it is concave, and correspondingly convex upon its inner surface, where it presents an extensive roughened area for articulation with the sacrum. The anterior border is sharp, while the posterior border is rounded, the thickest part of the bone being just anterior to the cotyloid cavity. This causes the greater sacro-sciatic notch to be long and shallow, while the lesser one is hardly deserving of a name. In form, the acetabulum very closely approaches what we find in man, and the bone at its base is very thin, though never exhibiting any perforations. There is an interval of bony surface between the cotyloid notch and the large subcircular obturator foramen.

Pubis and Ischium. Deep and prominent, the symphysis pubis is in life firmly united by ligament, and the pubic arch presents the same sexual characters as we find in the pelvis of man. The tuberosity of the ischium, with the adjacent ramus of the pubis and ischium, is curved forward, thus forming a concave surface anteriorly below the obturator foramen. This tuberosity is most extensive externally, gradually narrowing as it approaches the pelvic outlet or pubic arch, and its surface is much roughened for attachment of the ischial callosities in this genus.

Barring its very much smaller size, the pelvis in *Callithrix* presents essentially the same characters as the bone in *Lasiopyga*. It is, however, proportionately shorter, the obturator foramen proportionately larger, and more circular, thus causing the cotyloid notch to be nearer to its margin, while the ischio-pubic surfaces, internal and external, are flat, and the tuberosity of the ischium is but very slightly enlarged. From its external point to the anterior pubic angle, the border of this pelvis is uniformly convexly curved and almost sharp. The spine of the ischium is absent in *Callithrix*, and very rudimentary in *Lasiopyga*. Mivart found this process prominent in *Simia*.

The Femur. Apart from the matter of relative size, the femur in *Lasiopyga griseoviridis* presents the same characters as are met with in that bone in *Lasiopyga callitrichus;* in the former it has an extreme length of 14.8 cm., and in the latter of 13.2 cm. In *Callithrix jacchus* it is only 5.4 cm. long.

In *Lasiopyga* the femoral head is smooth, hemispherical in form, and presents a deep pit for the insertion of the *ligamentum teres*. The neck is as well marked as it is in *Homo*, but it does not make quite as open an angle with the axis of the shaft, and the massive trochanter major rises somewhat above both it and the head of the bone. The digital fossa which it overshadows is deep and circumscribed, and on the posterior surface leads by a groove almost to the summit of the very prominent trochanter minor, which groove is bounded by a definite trochanterian line, no "spiral line" as in man being found opposite it on the anterior aspect. Strong and highly polished, the cylindrical shaft of the femur is considerably curved between the extremities, the curve being quite uniform with the convexity in front.

The *linea aspera* is fairly well seen, and a single nutrient foramen is found on the posterior surface of the shaft at a point between its middle and upper third. Distally, the bone is much enlarged, and in many respects resembles this extremity in the femur of man. The lower points of the condyles, however, are in the same plane, the internal condyle being the lower in man. There is a deep intercondylar fossa between the jutting, prominent condyles posteriorly. Each of these, in this locality, is surmounted by a large sesamoid, which in each case articulates with it at its summit. Similar sesamoids of relatively similar proportions are found in the skeleton of *Callithrix* occupying like positions. No authority at hand mentions these sesamoids, certainly not Huxley, Mivart, or Flower, yet they are very conspicuous in the skeleton of *Lasiopyga*. A large, ovate, elongate *patella* is present in all the apes here being considered, it being uniformly convex anteriorly, and very shallowly doubly concave posteriorly, a very faint mid-longitudinal elevation appearing between the two concave surfaces.

Callithrix has a femur presenting a number of points unlike those just described for *Lasiopyga*. The head of the bone comes considerably nearer being a complete sphere. The upper fourth of the bone, or down as far as the well-developed lesser trochanter, is gently bent anteriorly, while below the "trochanterian line" there is an extensive, circumscribed triangular surface, which is not found in *Lasiopyga* at all. Its shaft is quite straight, for its posterior third wide, and flattened in the antero-postero direction.

In the *short external lateral ligament*, just above the head of the fibula in *Callithrix*, a minute sesamoid is present, but I fail to find its counterpart in either species of *Lasiopyga*.

The Tibia. The tibia of *Lasiopyga griseoviridis* is 14.3 cm., of *L. callitrichus* 12.4 cm., and of *Callithrix jacchus* 5.4 cm. in length; the fibula in any case being but very little shorter. Essentially all the characters we find in the human tibia and fibula are repeated in the same bones in these apes, even including *Callithrix*. Apart from the matter of the great difference in size in such a comparison, it is truly remarkable how similar they really are. *Lasiopyga* has the upper third of its shaft more compressed transversely, and here it is quite concave in the longitudinal direction as far down as the juncture of the middle and upper thirds. This is not as evident in *Callithrix*, in which form the tibia exhibits considerable compression for its entire length until we near the enlarged distal extremity in both genera, when the bone is somewhat flattened in the opposite direction to accommodate itself for articulation with the astragalus. The tibial crest is much rounded off in these apes, and the tubercle for the insertion of the ligamentum patellæ is very rudimentary. The internal malleolus is prominent, and its long axis is in line with the axis of the tibial shaft.

The Fibula. The fibula is a slender bone, extremely so in *Callithrix*, straight, more or less cylindrical, barring the moderately flattened surfaces for muscular insertion, and presenting the usual enlarged ends for articulation with the tibia above, and below with the astragalus, its malleolus being quite as long as that process in the tibia. This is a departure from what we find in man, where the fibula extends much beyond the tibia, causing the external malleolus of the leg to be the lower of the two.

The Tarsus. As in all other simians and apes, we find in the tarsus of *Lasiopyga* and *Callithrix* the seven usual bones, and these have practically the same relative size, and articulate in much the same manner as in *Homo.* When ligamentously articulated as in life, they form a plantar double arch, an antero-posterior one, and a transverse one. We also find in the foot of each of these genera the paired sesamoids on the plantar aspect, beneath the metatarso-phalangeal articulations as in the manus; but they appear to be absent from the more distal joints. There is also in these genera another sesamoid present, which I fail to find elsewhere described for the apes, although it may have, and probably has, been described. It occurs in both *Lasiopyga* and the marmoset, and consists in a somewhat sizeable segment, semiellipsoidal in form, and articulates with the postero-external angle of the cuboid, being embedded in the tendon of the *peroneus longus* muscle as it passes this point on its way to its insertion at the infero-posterior internal angle of the base of the metatarsal of the hallux. It may be conveniently named the *peroneal sesamoid.*

Most of the observable departures in the form of the podial bones from those in man are due to the peculiar twisting of the foot in the ape. Both the astragalus and the calcaneum are rather large bones with extensive articular surfaces, the posterior moiety of the latter being concave on its inner side and slightly bent in that direction. The area for the insertion of the *tendo Achillis* on its hinder aspect is abruptly defined by a sharp line. The anterior articular surface of the os calcis for the scaphoid or navicular bone is concave; whereas the corresponding facet on the astragalus is convex. The cuboid and scaphoid are of about the same size, and articulate with each other in the middle line of the foot. The middle cuneiform is the smallest of the three cuneiform bones, while the saddle-shaped ectocuneiform and the scaphoid dip down far below all the others in the sole of the foot. Mivart has described in his article in the Encyclopædia Britannica many of the characters of the tarsal bones and phalanges, and compared their proportions, especially for *Simia*, *Ateles*, *Hylobates*, *Pithecia*, *Troglodytes*, *Lagothrix* and *Cebus*, but has little or nothing to say of *Lasiopyga* and *Callithrix.* The morphology of the tarsus in the latter is much the same as we find it in *L. callitrichus.*

Metatarsus and Phalanges. All of the metatarsal and phalangeal bones, save the terminal joints, are considerably curved, the concavity being palmad. This is most evident in *Lasiopyga callitrichus;* rather less in *L. griseoviridis*, and least of all in *Callithrix*. In the marmoset, as in its hand, the terminal joints of the pes are laterally compressed, much curved, and pointed. In *Lasiopyga* it is the third metatarsal which is the longest bone of the tarsus and possesses the biggest shaft; while in *Callithrix* the fourth metatarsal is a shade longer than the third, and its shaft is about equal in caliber with it. In proportion to the size of the animal, the marmoset possesses a long and narrow foot, its slender tarsal bones and toe-joints exhibiting but little curvature, are when articulated almost parallel to each other, and to this the hallux forms no exception.

CLOSING REMARKS.

This paper has aimed especially to point out the main skeletal differences, especially in the skull and axial skeleton, which may exist between two species of apes which have been placed in the same genus, viz., *Lasiopyga callitrichus* and *L. griseoviridis*. It also essays to clear up faulty records and illustrations of previous writers, particularly in the matter of the correct number of vertebræ in various divisions of the spinal column. It gives in detail the osteology of *Callithrix*. The illustrative plates should possess value, and should especially prove to be of assistance to those engaged in the study of the craniology of this group.

In the first volume of "A Review of the Primates" Dr. Elliot gives considerable information concerning the "Bald-headed Tamarins" of the genus *Seniocebus*. They are placed by him in Family I of Suborder 2 of the Anthropoidea, and three species are described, viz.: *S. bicolor*, *S. meticulosus*, and *S. martinsi*. Their dental formula is given thus: I. $\frac{2-2}{2-2}$; C. $\frac{1-1}{1-1}$; P. $\frac{3-3}{3-3}$; M. $\frac{2-2}{2-2} = 32$.

The literature relating to this genus and the marmosets, covering the eaily writings of Linnæus (1758) to date, is quite extensive.

Elliot places the tamarins in the four genera *Seniocebus*, *Cercopithecus*, *Leontocebus*, and *Œdipomidas*. Formerly they were arrayed with the marmosets either in the genus *Hapale* or in *Callithrix*.

"The chief difference between members of *Callithrix*," says Elliott, "and the species now under consideration [*Seniocebus*] is found in the teeth, the canines of the lower jaw being longer than the incisors, a distinction deemed by some authors as perhaps hardly sufficient to cause the Tamarins to become separated generically from their relatives. Tamarins and Marmosets resemble each other, and the skulls with the large brain-case are much alike" (p. 179).

Elliot gives a number of plates, each presenting four views of skulls of the several genera and species named above. The one of *Seniocebus* (1½ natural size) is very good (Plate XXII). It closely resembles the skull of *Callithrix leucopus* (Plate XXVII. ½ larger than nat. size).

There are but four or five skins of *Seniocebus meticulosus* in the hands of science, and probably not more than three skeletons. One of the latter appears to be in the American Museum of Natural History (New York); I understand there is one in the U. S. National Museum (not examined by me), and, finally, one prepared by myself, which has been placed in the Carnegie Museum at Pittsburgh. Thus it will be seen that this little monkey is one of the rarest species known. The type was obtained in northern Colombia (Rio San Jorge).

I have carefully compared in all of its details my skeleton of *Seniocebus meticulosus* with the corresponding characters of the skeleton, as presented in two adult skeletons and other osteological material before me representing *Callithrix jacchus*, and I fail to find any characters in the skeleton of the former (the teeth do not belong to the skeleton) which point to such a thing as generic differences separating these two species. Some slight differences are apparent, but they are entirely referable to individual variation, and it is safe to say that they will not be found to be constant. The fact that the canine teeth of the mandible in *Seniocebus* are longer than the incisors, whereas they are not so in *Callithrix*, by no means furnishes sufficient reason for creating a new genus for the former. Moreover, although they are not quite as pointed as they are in *Seniocebus*, we sometimes find the lower canine in *Callithrix jacchus* somewhat longer than the outer incisor upon either side; so that, too, proves to be a variable character among these species (Compare Figs. 9 and 10 of Plate XVI of this paper) and consequently an unreliable feature upon which to base generic differences.

As is the case among human skulls, the facial angle differs in different individuals. For example, the facial angle in the skull of *Seniocebus* I have in my collection is markedly less than it is in the skull of that form figured by Elliot (Vol. 1, Plate XXII), where it practically agrees with the facial angle of the skulls of *Callithrix jacchus* now at hand.

With respect to these skeletons, there is nothing like the differences which are to be found in and which characterize the skeletons of *Lasiopyga callitrichus* and *Lasiopyga griseoviridis*, as set forth above. The nature of these differences are well exemplified in the skulls of these two species of apes in the figures given in Plates XII–XV.

The skeletal characters of the trunk and limbs in the case of *Seniocebus* practically agree in all particulars with the corresponding features in any of the marmosets of the genus *Callithrix;* and in my opinion, the fact of the matter is, in so far as their osteology goes, there are no constant characters to be found which justify the creation of different genera to contain these tamarins and marmosets. The lower canines in a skull of *Callithrix leucopus*, as figured by Elliot (Plate XXVII), are exactly the same in character, both in form and in relative lengths, as compared with the mandibular incisors, as they are seen to be in *Seniocebus meticulosus* (Plate XXII), or, as for the matter of that, in *Cercopithecus midas* (Plate XXIII) or in *Leontocebus* (Plate XXIV) or *Œdipomidas* (Plates XXV and XXVI). All these animals belong in the same genus, each presenting excellent distinguishing *specific* characters, which characters are external rather than internal.

According to Elliot (*l. c.*, Vol. II, pp. 1–20) there are fifteen species in the genus *Aotus* of the family *Cebidæ*, they being known by the vernacular name of Douroucoulis. They are chiefly nocturnal in habit, and, "with one exception, *A. rufipes* from Nicaragua, Central America, whose habitat is somewhat doubtful, the species of this genus are found only in South America, and are distributed across the continent from the Atlantic to the Pacific Ocean."

Elliot figures the skull (four views) of but one of these species, namely *Aotus miriquouina* (Vol. II, Plate I) and gives some of its measurements (p. 11). There is a complete skeleton of this species in the collections of the U. S. National Museum, and this I have before me at the present writing (No. 103917 ♂).

The skull is quite different from the one figured by Elliot, it being more elongate and vertically compressed, while the breadth of the brain-case (35 mm.) is the same in each. In the skull which he figures, however, the "occipito-nasal length" measures but 57 mm., while in the skull belonging to the National Museum this diameter measures 67 mm. This is an excellent example of individual variation, in so far as it refers to the skulls of these animals belonging to the same species.

As will be seen in my figures, the orbital cavities in the skull of *Aotus miriquouina* are circular and of great size, being hemispherical in form, each in its entirety, with the margins sharp, except where they are formed by the nasals and frontals. The vault of the cranium, superficially, is smooth, and probably it will be found that the direction of the lines of the sutures exhibits in different skulls as many variations as we find among human skulls, as well as those of other anthropoids. For example, in the skull figured by Elliot the *coronal suture* forms an arc with the concavity forwards; in the skull at hand it forms an angle, the sharp apex of which, directed backward, is met by the anterior extremity of the sagittal suture. On the lateral aspect of this skull it will be noted that the squamous portion of the temporal is small, as is likewise the case with the alisphenoid. This allows the parietal to make an extensive articulation with the malar of the same side, while the alisphenoid is far removed from both the frontal and parietal bone, articulating with the temporal and malar far down in the fossa nearly opposite the zygoma. The aural apertures are circular in outline, and the bullæ conspicuously elevated with their osseous walls inclined to be thin. These bulbous enlargements of the "petrous portion" of either temporal bone are entirely absent in such an ape as *Lasiopyga callitrichus*. The occiput is especially prominent, and there are two marked concavities between it and the foramen magnum, placed side by side, transversely.

The form of the *mandible* in *Aotus* is well shown in the figures on the plates, and it is to be noted that the ramal walls are thin, while the symphysial is thick and strong. The "sigmoid notch" between the coronoid process and condyle is narrow and semi-circular in outline, the process rising considerably above the condyle.

The *hyoidean apparatus* in this specimen has been lost, and so has the *atlas* vertebra.

In the "spinal column" we find seven cervicals; twelve dorsals; nine lumbars; three sacrals and twenty-five caudals. There are thirteen pairs of ribs, *nine* pairs of which join with the sternum through costal ribs. An abnormality is seen here in the elongation of the pleurapophysis of the second lumbar vertebra on the left side, articulating with the extremity of which there is a small, free rib, some seven mm. in length.

The three *sacral vertebræ* are thoroughly fused together, their neural spines forming a single piece, with all sutural traces obliterated. The lateral processes of the first sacral vertebra make very extensive articulations, on either side, with the *pelvis*, the latter being of an elongate form with narrow ilia and large, sub-circular obturator foramina.

With respect to the skeleton of the limbs of *Aotus miriquouina*, the bones present nothing worthy of special note. But little curvature is present in any of the long bones, they all being for the most part straight and slender (see Plate XVII, fig. 20, for the skeleton of the pectoral limb of the left side).

The *clavicle* shows the sigmoid curve very markedly, particularly at the outer moiety. The blade of the *scapula* is flat and triangular in outline.

The *pisiform* is prominent and long, and when duly articulated makes a right angle with the line of the shaft of the corresponding ulna.

The *humerus* has a length of 6.7 cm. and the ulna of 7.2 cm.

In the *pelvic limb* the shaft of the *femur* is very straight and cylindrical, the bone having a length of 9 cm., the trochanter minor being well developed, and the *caput femoris* hemispherical in form.

The supracondylar sesamoids are present, and another small one is found on the summit of the tibia, just above the articulation of the fibu'ar head.

For its upper two-thirds the shaft of the *tibia* is much flattened transversely, and somewhat bowed to the front.

The *fibula* is straight and slender, especially the proximal half of its shaft, while its distal extremity is much enlarged to form the *external malleolus*.

The skeleton of the *pes* presents nothing peculiar, though it may be said that it is of an elongate form with the *metatarsal* joints and *phalanges* inclined to be quite straight and rather slender; but this does not apply to the short and tapering ungual joints.

EXPLANATION OF THE PLATES.

PLATE XII.

FIG. 1. Facial view of the skull, mandible included, of *Lasiopyga callitrichus*. Left lower-mid-incisor tooth missing. (Coll. U. S. National Museum, No. 16365.)

FIG. 2. Facial view of the skull, mandible included, of *Lasiopyga griseoviridis*. Several incisor teeth missing. Both figures natural size, from photographs by the author. (C. M. Cat. Mamm. No. $\frac{5103}{1}$.)

PLATE XIII.

FIG. 3. Right lateral view of the skull, including the mandible, of *Lasiopyga callitrichus*. Same specimen as in Plate XII, Fig. 1.

FIG. 4. Right lateral view of the skull, including the mandible, of *Lasiopyga griseoviridis*. Same specimen as in Plate XII, Fig. 2. Both figures natural size, from photographs by the author.

PLATE XIV.

FIG. 5. Direct superior view of the skull, mandible removed, of *Lasiopyga callitrichus*. Same specimen as shown in Plate XII, Fig. 1, and Plate XIII, Fig. 3.

FIG. 6. Direct superior view of the skull, mandible removed, of *Lasiopyga griseoviridis*. Several incisor teeth missing. Same specimens as shown in Plate XIII, Fig. 2, and Plate XIII, Fig. 4. Both skulls natural size, and from photographs by the author. Both of these skulls are from individuals not fully adult, judging from the sutures in the crania, and from the fact that in other parts of the skeletons the epiphyses are not firmly united with the shafts of the long bones to which they belong.

PLATE XV.

FIG. 7. Direct basal view of the skull of *Lasiopyga callitrichus*, ♂, mandible removed; dental armature complete. Same specimen as shown in Plates XII–XIV, Figs. 1, 3 and 5.

FIG. 8. Direct basal view of the skull of *Lasiopyga griseoviridis*, ♂, mandible removed; three incisor teeth missing. Same skulls as in Plates XII–XIV, Figs. 2, 4 and 6. Both skulls natural size, from photographs by the author.

PLATE XVI.

FIG. 9. Superior view of the mandible of *Callithrix jacchus;* all the teeth missing. Not fully adult individual; belongs to the cranium shown in fig. 12.

FIG. 10. Left lateral view of skull, including mandible, of *Callithrix jacchus*, adult male; dental armature complete.

FIG. 11. Left lateral view of skull, including mandible, of *Seniocebus meticulosus*, adult male; some of the teeth missing.

FIG. 12. Superior view of the cranium of *Callithrix jacchus;* mandible removed (fig. 9); teeth missing; not fully adult.

FIG. 13. Superior view of the cranium of subadult specimen of *Callithrix* (sp.?) male. No. 35640, Coll. U. S. Nat. Mus. (Mandible shown in fig. 14.) Died at National Zoölogical Park.

FIG. 14. Mandible of *Callithrix* sp.?, seen from above. Belongs to the cranium shown in fig. 13.

FIG. 15. Left lateral view of the skull, including mandible, of *Aotus miriquouina*. No. 103917, Coll. U. S. Nat. Mus. Dental armature complete.

All figures natural size and photographed from the specimens by the author.

PLATE XVII.

FIG. 16. Antero-oblique view of the skull of *Callithrix jacchus* (Same as shown in figs. 9 and 12 of Plate XVI of this article).

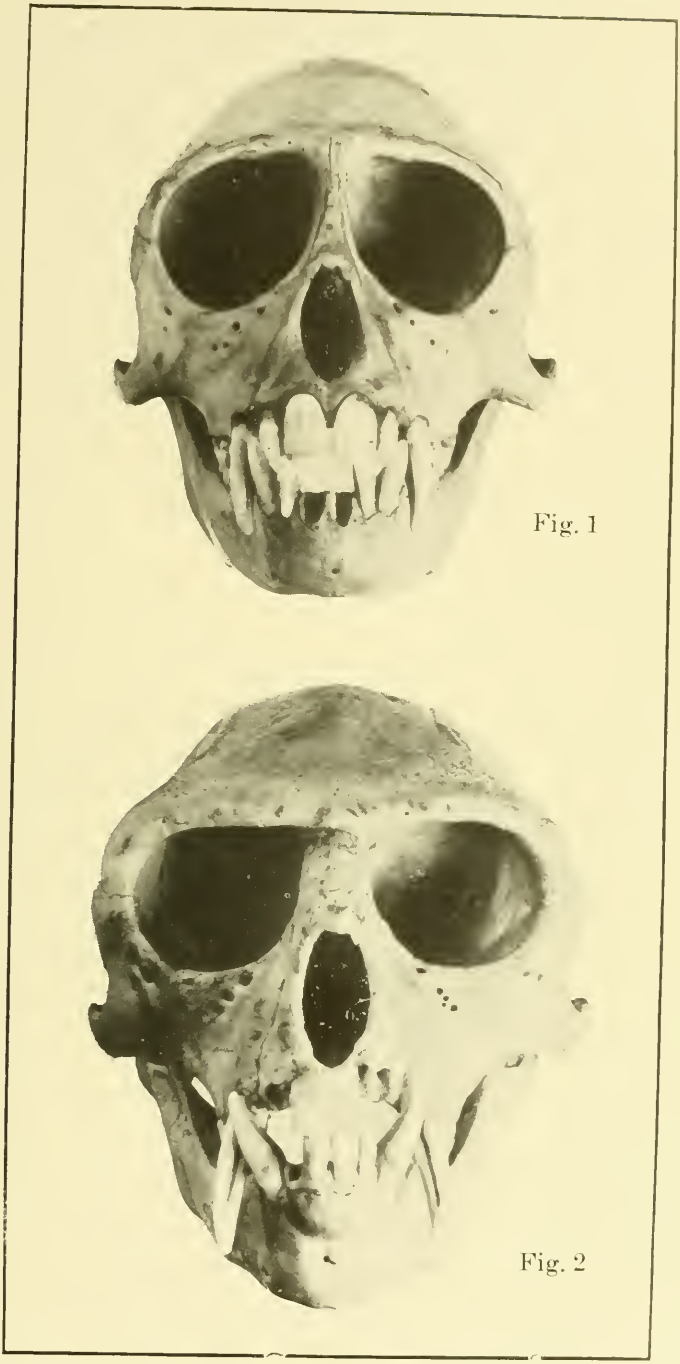


Fig. 1. *Lasiopyga callitrichus.* U. S. N. M., No. 16365.
Fig. 2. *Lasiopyga griseoviridis.* C. M., $\frac{5103}{1}$.

Fig 3

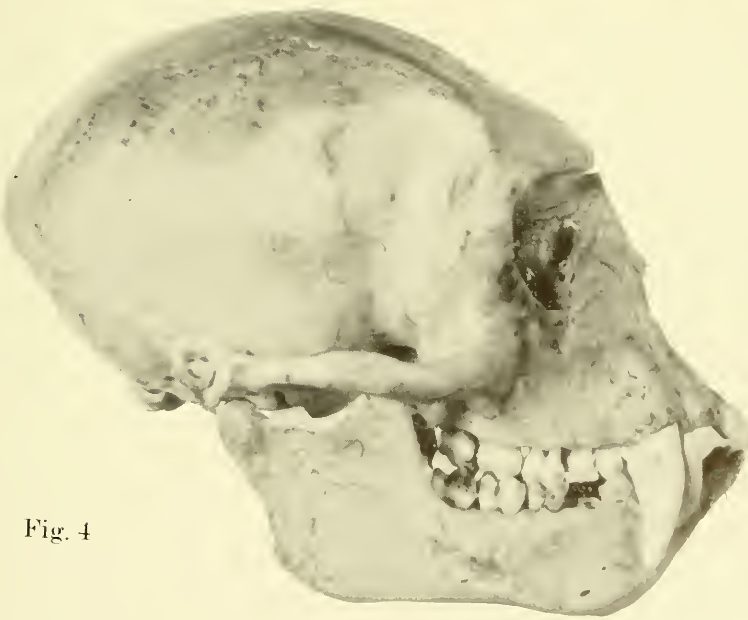


Fig. 4

FIG. 3. *Lasiopyga callitrichus.* U. S. N. M., No. 16365.
FIG. 4. *Lasiopyga griseoviridis.* C. M., No. $\frac{5103}{1}$.

Fig. 5

Fig. 6

Fig. 5. *Lasiopyga callitrichus.* U. S. N. M., No. 16365
Fig. 6. *Lasiopyga griseoviridis.* C. M., No. $\frac{5103}{1}$.

Fig. 7

Fig. 8

Fig. 7. *Lasiopyga callitrichus.* U. S. N. M., No. 16365.
Fig. 8. *Lasiopyga griseoviridis.* C. M., No. $\frac{5103}{1}$.

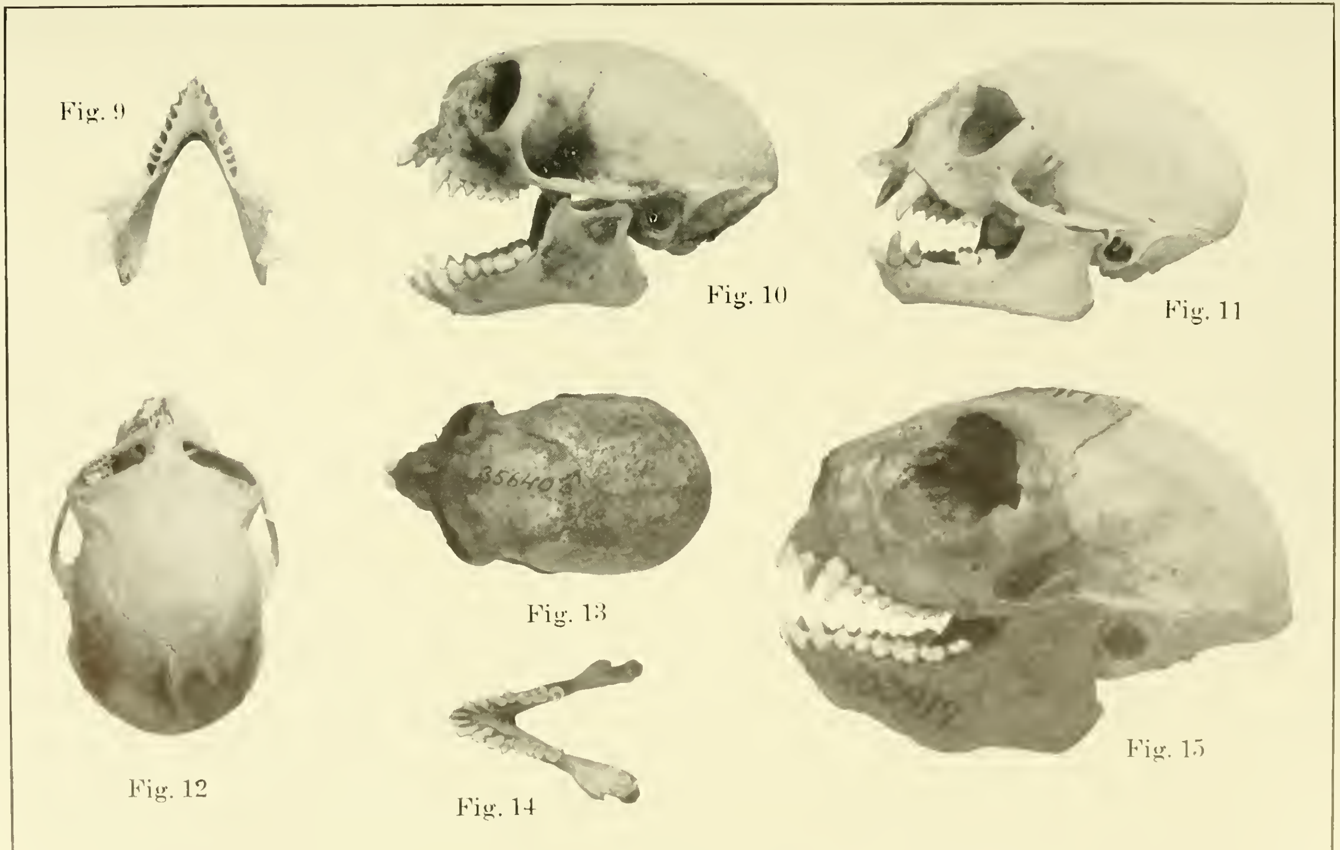


Fig. 9 Fig. 10 Fig. 11 Fig. 12 Fig. 13 Fig. 14 Fig. 15

FIGS. 9, 10, 12. *Callithrix jacchus*. C. M., No. $\frac{5103}{2}$. FIG. 11. *Seniocebus meticulosus*. C. M., No. $\frac{5103}{3}$. FIGS. 13, 14. *Callithrix* sp. (?). U. S. N. M., No. 35640. FIG. 15. *Aotus miriquouina*, U. S. N. M., No. 103917.

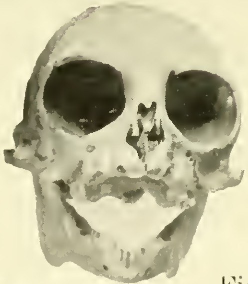


Fig. 16

Fig. 17

Fig. 18

Fig. 19

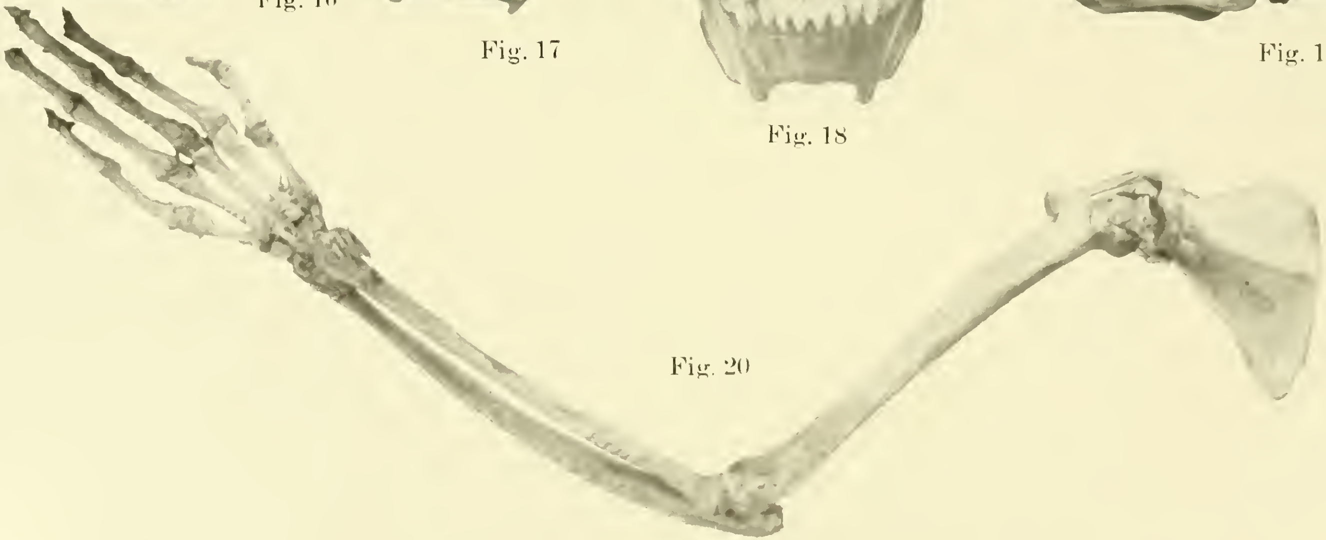


Fig. 20

FIG. 16. *Callithrix jacchus* C. M., No. $\frac{5103}{2}$. FIG. 17. *Seniocebus meticulosus.* C. M., No. $\frac{5103}{3}$. FIGS. 18, 20. *Aotus miriquouina.* U. S. N. M., No. 103917. FIG. 19. *Callithrix* sp. (?). U. S. N. M., No. 35640.

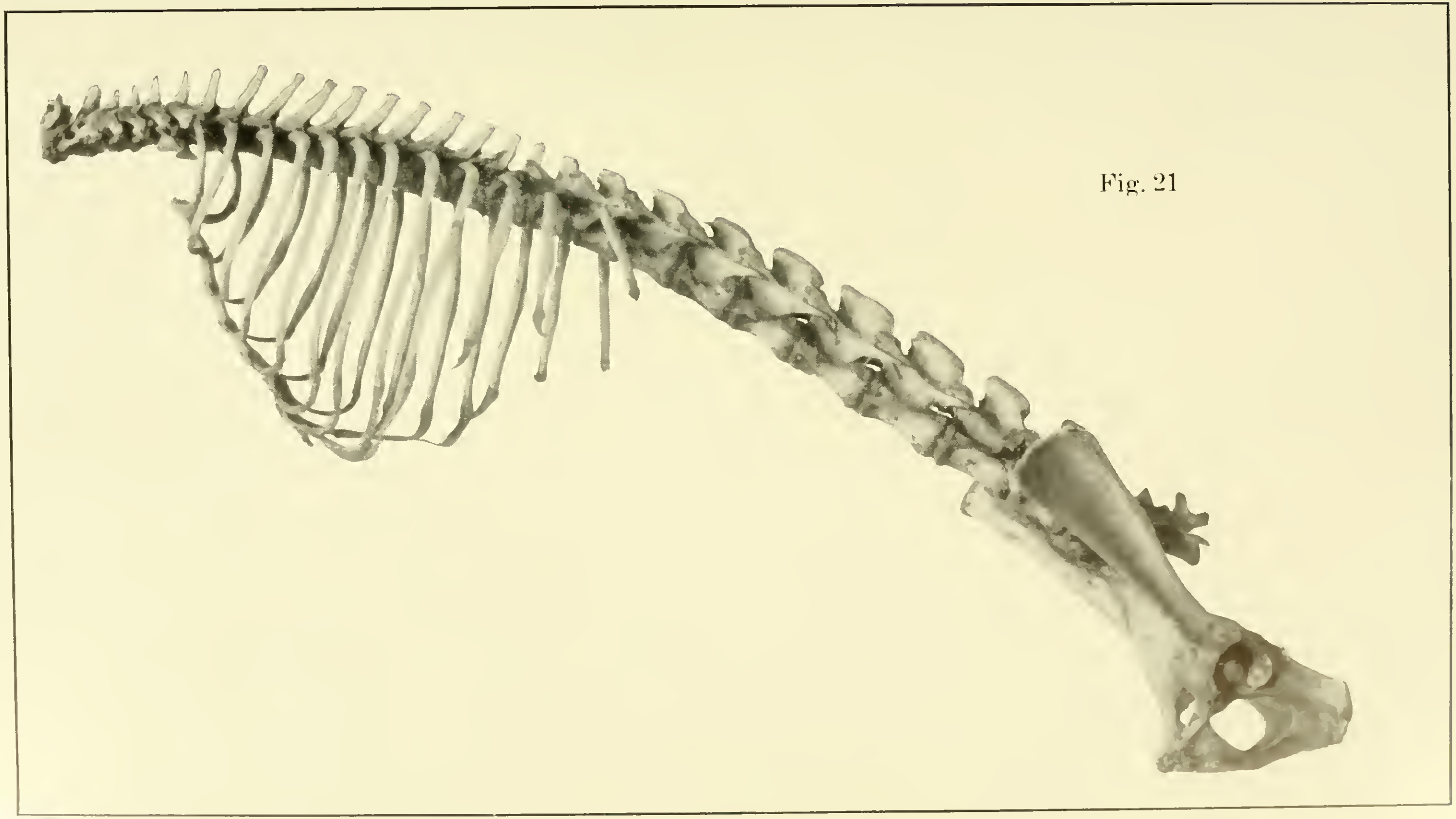


FIG 21. *Lasiopyga callitrichus.* U. S. N. M., No. 16365.

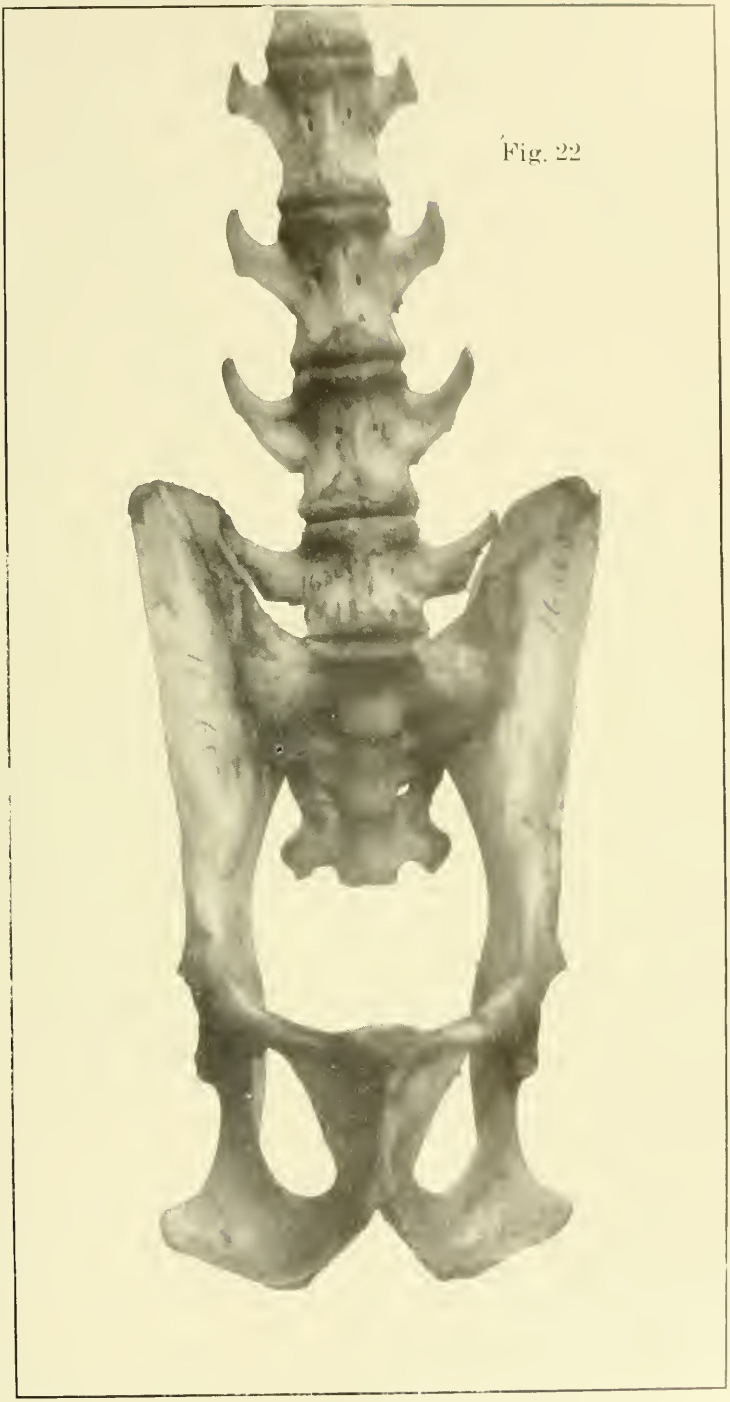
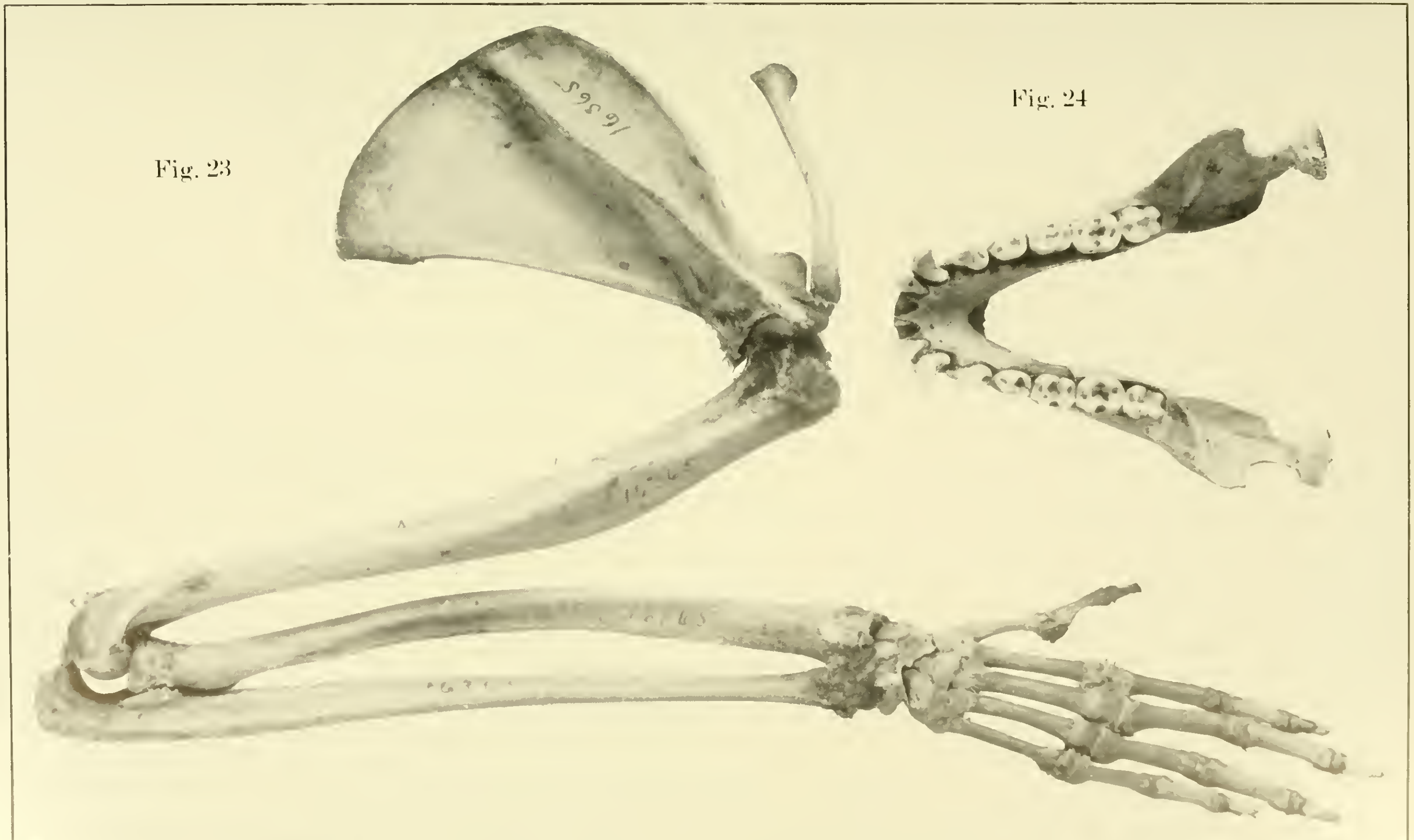


FIG. 22. *Lasiopyga callitrichus.* U. S. N. M., No. 16365.



FIGS. 23, 24. *Lasiopyga callitrichus.* U. S. N. M., No. 16365.

Fig. 25. *Lasiopyga callitrichus.* U. S. N. M., No. 16365. Fig. 26. *L. griseoviridis.* C. M. No. $\frac{5104}{1}$

FIG. 17. Antero-oblique view of the skull of *Seniocebus meticulosus*. Some teeth missing. Same specimen as shown in Plate XVI.

FIG. 18. Direct front view of the skull of *Aotus miriquouina*. (Note how the upper teeth overlap those of the mandible when the jaws are closed, as they are in this figure.) Same specimen as shown in fig. 15 of Plate XVI above.

FIG. 19. Lateral view of the skull of *Callithrix* sp.? Dental armature complete. Same specimen as figs. 13 and 14 of Plate XVI above.

FIG. 20. Left pectoral limb of *Aotus miriquouina*, outer aspect, with scapula and clavicle attached. Some of the bones slightly thrown from their normal positions. The skull shown in fig. 18 of this plate belonged to the same skeleton.

All the figures in this plate are of natural size, from photographs taken by the author.

PLATE XVIII.

FIG. 21. Skeleton of trunk of *Lasiopyga callitrichus*, left lateral view, reduced rather less than one-half. Belonged to the skeleton of which the skull in Pl. XII, Fig. 1, is a part. Coll. U. S. Nat. Mus., No. 16365. Slightly rotated in the figure in order to better show the character of the pelvis, which, although belonging to the lower extremity, is left attached. Photographed by the author.

PLATE XIX.

FIG. 22. Anterior view of the pelvis, posterior lumbar vertebræ and sacrum of *Lasiopyga callitrichus*. From the skeleton of the same individual shown in preceding plates (Coll. U. S. N. M., No. 16365). Natural size, photographed from the specimen by the author.

PLATE XX.

FIG. 23. Right pectoral limb of *Lasiopyga callitrichus* with scapula and clavicle articulated therewith. From same skeleton as figures previously given (Coll. U. S. N. M., No. 16365). Natural size, outer aspect. The total length of the humerus in the specimen is 11 cm. The limb is rotated so as to show the skeleton of the hand upon the dorsal aspect. Photographed by the author.

FIG. 24. Mandible of *Lasiopyga callitrichus;* seen directly from above. Same jaw as shown in figs. 1 and 3 of Plates XII and XIII.

PLATE XXI.

FIG. 25. Left pelvic limb, including patella, ligamentously articulated, of *Lasiopyga callitrichus*, from the skeleton of the same individual to which belonged the arm shown in Pl. XX, fig. 23. Photographed by the author and about natural size, inner aspect. Extreme length of femur in the skeleton 13.5 cm.

FIG. 26. Mandible of *Lasiopyga griseoviridis* seen directly from above. Same jaw as shown in figs. 2 and 4 of Plates XII and XIII.

V. A NEW RHYNCHOCEPHALIAN FROM THE JURA OF SOLENHOFEN.

By Norman MacDowell Grier.[1]

(Plate XXII.)

Homeosaurus digitatellus sp. nov.

The specimen figured is part of the Bayet Collection (No. 4026, Carnegie Museum Catalog of Vertebrate Fossils). Through the kindness of Dr. C. R. Eastman, of the Section of Paleontology, Carnegie Museum, it was placed in my hands for identification and description.

The skeleton has been injured to some extent through cracking and other damage sustained by the matrix, but is in good condition as regards many parts. It is so placed in the matrix as to reveal the dorsal aspect, and surrounding it appears the impression of the contour of the body in relief on the matrix, this impression being of a dull red color probably occasioned by the putrefaction of the body. The matrix itself is quite hard.

The Cranium.—Injuries are evident here. The cranium is slightly flattened, possibly by the imbedding of the animal. The premaxillaries as well as the greater part of the nasals, have been lost. Judging from the impression in the matrix, the premaxillaries were arched anteriorly. Nothing can be said of the superior maxillaries. The left superior maxillary is broken off, as is also the greater portion of the right; the position of the skull furthermore does not give much opportunity to observe them. The frontals (See Plate XXII, *a*) are united by a distinct suture, the adjuncts of which appear to taper both anteriorly and posteriorly. They are approximately one-eighth of the greatest width of the skull. Only the right orbital ridge is at all well-defined (*b*). Here the prefrontal, postfrontal, and the articulation of the quadrate-jugal bone with the latter may be observed (*c*). The anterior

[1] Extracted from the thesis presented by the author to the Faculty of the Graduate School of the University of Pittsburgh, June, 1912, for the degree of Master of Arts. The thesis embodies a lengthy discussion of the relationships of *Sphenodon* to the other Reptilia, which the editor of the Annals does not feel that he has the space to print, and which he therefore has omitted, although it is meritorious as a review of what is known as to the Rhyncocephalia, to which the genus *Homeosaurus* belongs.

border of the orbit and the lachrymal bone have taken part in the formation of a cup-shaped depression, (*d*), which I have not observed in any other species of this genus. Although the left orbit is for the greater part obliterated, the remains of this peculiar depression are well discernible, which would possibly indicate something more than an accidental origin for it. A small wedge-shaped projection, protruding at right angles from the posterior border of the orbit (*e*) is evidently the pterygoid bone *in situ*.

The parietals (*f*) are broad and inclose a small fontanelle. They have been slightly flattened, and compose one-fifth of the greatest breadth of the cranium. Portions of the paroccipital and basisphenoid bones have been crowded upon them. The temporal arches of the right side of the skull (*g*) are in position, the constituents showing normally, but the infra-temporal arch appears rather small. On the left side of the skull, the temporal arches are disorganized, and only vestiges of the lower arch are apparent. The quadrate bone is invisible, but portions of the mastoid may be seen. The skull has become disarticulated from the vertebral column in such a way, as to permit both the occipital condyle and the foramen to be observed (*h*).

The Vertebral Column.—Of the cervical vertebræ, the atlas (*i*) is alone well enough preserved to indicate any peculiarities of structure, appearing as a transverse, arched bar. Well defined impressions of transverse processes are present in the anterior cervical region, and there are at least two pairs of ceıvical ribs to be seen. The first five thoracic vertebræ are in fairly good condition, the neural spines being apparently reflexed upon the centra during fossilization, while the transverse processes are missing or indistinct. Various exposed portions of the vertebræ indicate their amphicœlous nature. The vertebræ seem to have been quite large, their width being one-tenth that of the skull, and their length one-sixth that of the femur. The sacral vertebræ are indistinguishable.

The greater part of the tail is wanting, the portion which has been preserved consisting of the impressions of seven vertebræ which are characterized by the possession of strong transverse processes, and which have the same numerical relations as the other vertebræ. Intercentra can not be seen throughout the entire length of the vertebral column. The vertebræ in the specimen are as follows: cervicals 6; presacrals 7; sacrals (?); caudals 7.

Pectoral Girdle and Ribs.—Of the pectoral girdle there are left but a few unsatisfactory remains. To the right, a rib-like projection from the posterior cervical region is evidently the clavicle (*j*) and a doubtful impression below it is probably the shoulder-blade. There are vestiges of a coracoid and scapula on the left side of the body. The shoulder girdle was evidently ossified.

In close association with the remains of the right shoulder-blade, are the two short and blunt cervical ribs. There are some seventeen pairs of sternal and abdominal ribs. Anteriorly they are smooth, much the same as in *Sphenodon*. Posteriorly they are considerably shorter than those in the middle of the body, are not so broad, and are nearly equal in extent to five dorsal vertebræ. As far as could be determined, all the ribs have solitary, broad, compressed, and acuminate extremities.

Pelvic Girdle.—The pelvic girdle (*k*) is only to be distinguished by the impression it has produced on the surrounding matrix. It is approximately four-fifths of the width of the cranium. The obturator foramen (*l*) was quite small, having a width one-fourth of that of the pelvis.

Fore-Limbs.—The fore-limbs are quite weak in proportion to the rest of the body, and are shorter and not nearly so strong as the hind-limbs. The humerus is very broad in its distal portion, but an ectepicondylar foramen is not visible. The radius and ulna are proportionally large, curved slightly inward, and are approximately the same length. On both members of the fore-limbs, the carpals, metacarpals, and digits are so obscure, that description is impossible beyond stating that they are unusually fragile for a reptile of the size they support.

Hind-Limbs.—The proximal portion of the femur is long and curved as judging from the impression. It is connected with the distal portion by a large shaft increasing in size toward that end. The tibia and fibula are both strong bones, the former being somewhat stouter than the latter. Both tarsals and metatarsals in either foot are too obscure for further remark. Five toes are present, the number of the phalanges of which are 2, 3, 4, 5, and 4, respectively. The digits are of delicate construction and the claws of the hind-feet are longer than those of the fore-feet.

MEASUREMENTS.

	Cm.
Width of cranium	1.6
Length of cranium	2.
Length of mandible	1.8
Length of humerus	.7
Length of ulna	.7
Length of radius	.65
Length of 4th metacarpal	.2
Length of finger	.8
Length of femur	1.15
Length of tibia	.95
Length of fibula	.9
Length of 4th metatarsal	.45
Length of toe	1.1
Distance cranium to pelvis	7.3
Length of whole skeleton	9.5

Six species of the genus *Homeosaurus* have been described, viz: *macrodactylus*, *maximiliani*, *pulchellus*, *neptunia*, *jourdani* and *rhodani*, the last having been unfortunately described from only the pelvic and caudal portions of the skeleton. In the form *digitatellus*, however, the position of the skeleton within the matrix, as well as injuries received during imbedding, preclude the use of many osteological characters, which were of advantage in the identification and description of the other species which have been cited. Still, as the accompanying plate shows, the outlines or impressions of the more important bones are clearly defined for accurate measurement and comparison.

Upon consultation of the appended table of measurements prepared from the species already described, the relative resemblances and differences will become apparent.

This species has a length of cranium which is proportionately less in comparison with that of the body than in any other species of *Homeosaurus*, except *H. maximiliani*, which it but slightly exceeds in this respect. On the other hand, however, the length of the cranium compared with the width is shorter than in the latter form.

The relative length of the cranium to the femur greatly exceeds that of any of the described species, while that of the humerus bears a similar relation, which is closely approximated by *H. neptunia*, a species, however, which is excluded from comparison by its diminutive size. The ulna and tibia likewise differ, the former most resembling in size that of *H. pulchellus*, the latter being less than that of any other species. The relative length of the tibia to the femur is less than in any other species excepting *H. neptunia*, which it exceeds.[2]

While the above are the principal points of difference leading to the distinction of the form in question from other species of *Homeosaurus*, similar discrepancies will be found to exist in the relations of all other accessible portions of the skeleton. Collectively these indicate that we are dealing with a new species, which on account of the somewhat fragile digits, I have named *Homeosaurus digitatellus*. For the more accurate distinction of these forms the following key to the species has been prepared.

Genus HOMEOSAURUS.

SPECIES.

Length of cranium approximately equalling the combined length of the humerus and ulna, or twice the length of the humerus. Femur the length of the fibula or .8[3] the length of the cranium. Length of the fourth metatarsal and toe twice that of the fourth metacarpal and finger.................... *macrodactylus*.

Length of cranium approximately 1.375 of width, twice the length of the fourth toe. Radius approximately the length of the fourth metatarsal and toe. Combined length of humerus and ulna approximately the length of the tibia or fibula. *maximiliani*.

Length of cranium approximately 1.55 of the width. Width of cranium the length of the fibula, or twice the length of the fourth finger............... *pulchellus*.

Length of cranium approximately 1.50 of the width, 1.65 the length of the femur, 2.5 length of the fibula. Combined 1.50 the length of the fibula...... *neptunia*.

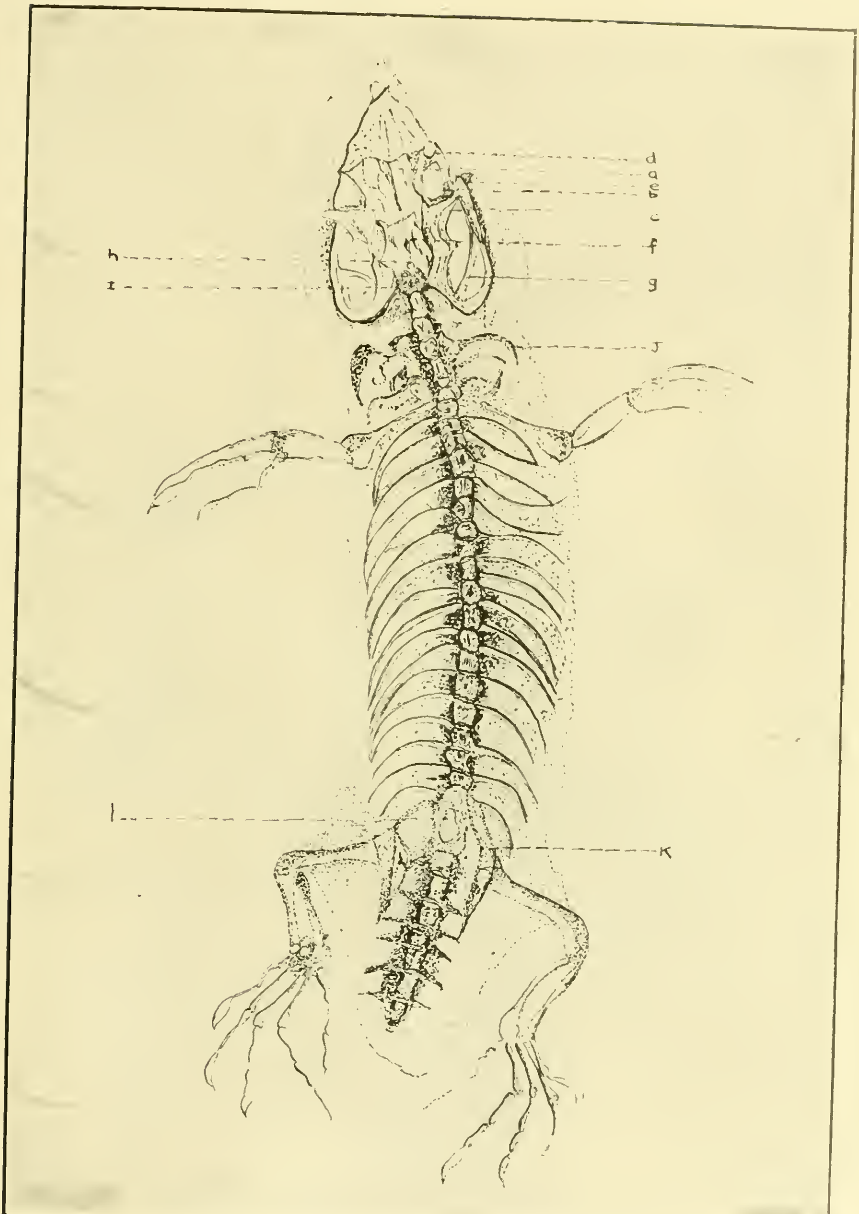
Length of cranium 1.33 the width. Fibula and fourth metatarsal length of fourth toe. Fourth metatarsal and toe twice the length of the femur....... *jourdani*.

Fibula and fourth metatarsal the length of the fourth toe; fourth metatarsal and toe twice the length of the femur.................................. *rhodani*.

Length of cranium 1.25 of the width, twice the length of the fourth metacarpal and finger. Length of fourth metatarsal and toe approximately width of cranium. *digitatellus*.

[2] This proportion is stated for the elimination of *H. rhodani*, with special reference to its imperfect state of preservation.

[3] Within 1 mm.



Homeosaurus digitelallus Grier. Sp. nov.

MEASUREMENTS OF THE DESCRIBED FORMS OF *Homeosaurus*, OBTAINED FROM THE DESCRIPTIONS OF THOSE WHICH HAVE APPEARED IN THE PUBLICATIONS REFERRED TO, AND GIVEN IN THE FOOT-NOTES BELOW.

	H. digitatellus.	*H. macrodactylus.*[4]	*H. maximiliani.*[5]	*H. pulchellus.*[6]	*H. neptunia.*[7]	*H. jourdani.*[8]	*H. rhodani.*[8]
	Cm.	Cm.	Cm.	Cm.	Cm.	Cm.	Cm.
Width of cranium	1.6	1.4	1.7	1.8	.8	1.85	...
Length of cranium	2.	2.5	2.25	2.8	1.25	2.55	...
Length of mandible	1.8	1.	2.	2.6	1.15	2.45	...
Length of humerus	.7	1.3	1.7	1.5	.45	1.65	...
Length of ulna	.7	1.2	1.2	.95	.35	1.4	...
Length of radius	.65	1.2	1.4	.95	.35	1.4	...
Length of fourth metacarpal	.2	.49	...	.466	.18	1.05	...
Length of fourth finger	.8	1.06	...	.6	.37	1.05	...
Length of femur	1.15	2.	2.05	2.	.75	2.	1.
Length of tibia	.95	1.76	1.9	1.73	.512	1.85	.85
Length of fibula	.9	2.	1.9	1.7	.5	1.65	.85
Length of fourth metatarsal	.45	1.1	.1	1.1	.37	.2	.6
Length of fourth toe	1.1	2.11	1.2	1.52	.67	1.6	1.4
Distance from cranium to pelvis	7.3	7.9	8.1	6.4	3.8	7.9	...

[4] "Neu Aufgefundene Saurier-überreste aus den Lithographischen Schiefern und dem Obern Jurakalk," A. Wagner, *Abhand. d. K. Bayer. Akad. d. Wiss.*, 1852.

[5] "Beschreibung einer Fossilen und Etlicher Anderer Reptilien-überreste," A. Wagner, *Abhand. d. K. Bayer. Akad. d. Wiss.*, II, GI, VII, Bd. I.

[6] Zittel, "Grundzüge der Palæontologie," II, 1911, p. 206.

[7] *Nov. Act. Akad. Leop., Nat. Cur.*, XV, 1, 115, Bd. II.

[8] Archives du Museum d'Histoire Naturelle de Lyon, Tome 5me, "Reptiles Fossiles du Basin du Rhone."

VI. THE SCALES OF THE SOUTH AMERICAN CHARACINID FISHES.

By T. D. A. Cockerell.

(Plates XXIII–XXVIII.)

In the *Smithsonian Miscellaneous Collections*, Vol. 56, No. 1 (1910) I reported on the scales of the African Characinidæ. It has been a great pleasure, for which I am indebted to Dr. Eigenmann, the Curator of Ichthyology in the Carnegie Museum, to now examine the scales of the South American species, or at least a considerable number of them. The investigation emphasizes the well-known fact that the American Characinids are not only much more numerous, but also very much more diverse than those of Africa. It further indicates, that

1. The strongly ctenoid Distichodontine type of scale is represented only by *Ctenobrycon* in America. The nearest other approach known to me is found in *Luciocharax*, which seems to be a sort of connecting link with the Alestines. I know the *Luciocharax* scale only from a figure.

2. The *Hemigrammus* type of scale, so abundantly represented in America, is totally wanting in Africa.

3. The African and American series come together in the Alestines, particularly in such types as *Chalceus macrolepidotus* and *Alestes macrolepidotus*.

4. The Erythrinines, so far as squamation goes, connect up with the Old World Cyprinids.

5. If *Hiodon* (which has completely transverse apical circuli) has any relationship with the Characinids, it must be with the Curimatines, although the Serrasalmonine scale is not without resemblances, the system of circuli being about the same. *Hiodon tergidus* has the fine pustular markings seen in *Curimatus spilurus*. I figure (Plate XXV, fig. 3) *Hiodon tergidus* from Wisconsin (Polk County, Graenicher).

6. I cannot at present connect the Catostomids with the Characinids through the scales. *Moxostoma aureolum* has a very Erythrinine-looking scale, *but the apical circuli are entirely transverse.*

With regard to the history of the Characinids, the obvious indications are that the neotropical region is their original home. Africa appears to have been supplied with only a few types, perhaps three or four, at long intervals of time. Whether one or two may have gone by a southern route in very early times, it is now impossible to say; but I do not see why the ancestors of the Hydrocyoninæ might not have arrived *via* Asia, during the Tertiary, at some period when the northern climate was warm and America and Asia were continuous. The period of mmigration into North America and Asia (probably two or three genera only) might have been relatively short, and the chances of finding any fossil remains might therefore be very remote. The close resemblance of the Erythrinine scale to that of Old World rather than New World Cyprinids must surely be significant.

ANODINÆ.

Scales not seen.

CURIMATINÆ.

Curimatella alburnus (Müller and Troschel). Scales broad, semicircular in form, the base strongly pleated and wavy; two more or less imperfect apical radii, far apart; circuli moderately densely transverse in the apical field. This is a quite ordinary Curimatine type; the apical margin is not at all dentate.

Psectrogaster and *Curimatus* are figured (*cf.* Plates XXIII–XXV). The scales in this group are broad, the base approximately straight except for the strong crenulations. There are often two forms of scales on the sides of the same fish, one with the circuli dense, the other with them much less so. The apical radii are variable, but there are often a pair of strong ones (*Aphyocharax* type), and others weak, or rudimentary. The margin in the scales seen by me is not properly ctenoid, but merely inclined to be toothed between the weak radii. *Curimatus*, *Curimatopsis*, and *Psectrogaster* do not essentially differ in the scales. The weaker type of scale, as in some (immature?) specimens of *Psectrogaster*, is like the African *Citharinus*. *Citharinus* has only the weak system of radii. Gill describes *Psectrogaster auratus* Gill, from Bolivia, as having the scales all deeply pectinate. The figure of the scales of *P. ciliatus* (M. & T.) now given shows only wavy irregular teeth, but the specimen is probably immature. The teeth, even if well-developed, would have no resemblance to those of *Distichodus*, etc., but may be compared with those of *Citharidium*.

The following species have been studied:

Psectrogaster ciliatus (Müller & Troschel). The character of the scales is sufficiently shown in Plate XXIII.

Psectrogaster curviventris Eigenmann & Kennedy. Scales broad, 3 mm. in diameter or rather more, strongly emarginate or biplicate basally; nucleus slightly below the centre, a broad granular nuclear area in some scales, in others it is circulate practically to the middle; circuli very strong and regular; *basal circuli minutely beaded;* radii apical only, confined to a couple of parallel rather faint lines (comet-orbit style); upper half of apical field free from circuli, lower half with transverse, not-angled circuli; apical margin very coarsely dentate, the teeth sharp, broad at base. Faint lines show that the marginal teeth have the same origin and character as those of *Citharidium.* One scale shows a parasite.

The principal differences between these scales and those of *P. ciliatus*, already described, seem to be due to the immaturity of the latter.

Curimatopsis macrolepis Steindachner. The scales have distinct laterobasal angles, and in general closely resemble those of *Curimatus spilurus.* The dermal pigment-spots are as in *C. spilurus.* The scales are not ctenoid.

Curimatus spilurus Günther. The characters are well shown in Plate XXV, figures 2 and 4. The scale of this younger specimen is from Rockstone.

Curimatus microcephalus Eigenmann & Eigenmann. A lateral line scale is shown in Plate XXV, fig. 5.

Curimatus morawhannæ Eigenmann. Scales like those of *C. spilurus.*

Curimatus schomburgkii Günther. Scales of the Curimatine type, the circuli rather coarse. The laterobasal angles are evanescent, broadly rounded much as in *P. ciliatus*, not evident and produced as in *C. spilurus*, etc. The apical margin also has a few broad wave-like teeth, as in *P. ciliatus.* *C. schomburgkii*, when compared with *C. spilurus*, *microcephalus*, etc., is a different-looking fish, with proportionately much smaller scales, which are brilliantly silvery, with hardly any radii. In *C. spilurus* and *microcephalus* the radii are very distinct. A young *C. spilurus* (Plate XXV, fig. 2) has shining scales which closely resemble those of *C. microcephalus*, while an older one (Plate XXV, fig. 4), though having the characteristic caudal spot, has duller scales with more radii. The older fish is altogether more heavily pigmented, with a strongly dusky caudal fin.

Boulenger has referred *Curimatus* to the Citharininæ. I give a figure (Plate XXV, fig. 6) of the scale of the African *Citharinus congicus* Boulenger. It lacks the laterobasal angles of *Curimatus spilurus*, etc.

PARODONTINÆ.

Parodon paraguayensis Eigenmann (cotype). Scales about 3 mm. broad and high, the apex broadly rounded, the laterobasal angles evident, the basal middle very deeply acutely emarginate; radii very strong, usually four apical and three or four basal, the apical more spreading, the radii are attached to a transverse median bar, which may be very short, or one-third of width of scale, in the latter case becoming zigzag; apical margin with an obscure miscroscopic very low denticulation; apical field (space between the apical radii) with a very minute vermiform sculpture, its circuli coarse, about twice as widely spaced as the basal, longitudinal, but in the middle becoming oblique, meeting in the middle line at a very acute angle; other circuli (lateral and basal) fine, normal, except that in some scales the circuli in the upper part of the basal area are modified into a fine vermiform or labyrinthine pattern.

Parodon piracicabæ Eigenmann. Scales larger and broader, but entirely of the same type. The apical circuli meet at a larger angle. These scales are of course of the Alestiform type (*cf.* Proc. Biol. Soc. Wash., XXIII, p. 146.)

HEMIODINÆ.

Hemiodus quadrimaculatus Pellegrin (from Tumatumari) has been examined. The scales are of a Curimatine type with simple base, usually four strong apical radii, no weak radii, no sign of apical teeth. The laterobasal angles are moderately distinct. The basal margin is not crenate. The dermal pigment-spots are relatively large.

Anisitsia notata (Schomburgk). The brilliantly silvery scales are considerably larger in the ventral region than in the dorsal, but the sculpture is the same. Latero-basal angles obtuse; nucleus a little basad of middle; circuli fine, transverse in apical field, but usually failing toward the margin; about four to six fine apical radii; basal margin gently convex. All this is practically as in *Hemiodus*.

Anostomus anostomus (Linnæus). Scales shaped as in *Leporinus megalepis* and *L. nigrotæniatus*, with the same strong midbasal notch, laterobasal angles, etc. Radial system strong, but variable; always a transverse (lateral) radius on each side, directed a little upwards; a pair of apical radii not far apart, or sometimes only one; sometimes two basal radii; polygonal areas sometimes slightly developed. Apical circuli longitudinal, but failing apically. This is not far from the type of *Leporinus megalepis*. It is also strongly suggestive of the African *Petersius*, although the fishes are very dissimilar. Superficially the fish *Anostomus* looks like the African *Neoborus*, which has totally different (ctenoid) scales.

PROCHILODINÆ.

Prochilodus rubrotæniatus Schomburgk (Plate XXIV). Large scales, about nine and one-half mm. long and ten mm. broad, the laterobasal angles rounded, the basal middle emarginate, with or without a radius running to nucleus; one to three pairs of lateral radii, more or less joined, U-like at base, and a single apical radius or none, nucleus a little apicad of middle, more or less multiple; apical margin finely irregularly dentate; apical field (bounded by the uppermost lateral radii) with coarse vertical (oblique toward middle) circuli basally, but beyond this the circuli are entirely broken up to form a dense labyrinthine pattern; lateral and basal circuli fine and regular. A remarkable type of scale, representing an early stage in the development of the ctenoid character, combined with an Alestiform radial pattern. So far as the scales go, it must be considered a stem-form.

CHILODINÆ.

Chilodus punctatus Müller & Troschel (Plate XXVI, fig. 1) was actually referred to *Citharinus* by Cuvier and Valenciennes, but Boulenger places the related *Cænotropus* in the Hemiodinæ (Hemiodontinæ). The scale is very distinctive. It has indeed the Curimatoid shape, but a strong transverse line (part of alestiform pattern), and the apical circuli longitudinal, but not reaching the apex, and hence the scale is not ctenoid. This doubtless illustrates the beginning of the development which culminates in such specialized ctenoid scales as those of the African *Xenocharax*. The fact that in this and other genera South America supplies types connecting the extremely different African groups typified by *Distichodus* and *Alestes*, may be taken as an indication that the Characinidæ originated in the Neotropical rather than the Ethiopian region.

Tylobranchia maculosa Eigenmann (cotype). Plate XXVI, fig. 2. The figure shows the form of the scale, which is about six and one-half mm. broad. The radial system is reduced to a single very strong line crossing the scale, as in *Bryconamericus*. Base crenate; basal and lateral circuli fine, the latter longitudinal (herein quite different from *Bryconamericus*); nuclear field very broadly pustulose; apical field without circuli; apical margin with low teeth. This may also be compared with *Tetragonopterus*, but the direction of the lateral circuli is entirely different. The closest resemblance is evidently to *Chilodus*, which must surely be a close relative. In the shape of the scale and the direction of the lateral circuli, there is a curious resemblance to *Tilapia nilotica*, but the latter has a regular system of fan-like basal radii or grooves.

GYMNOCHARACININÆ.

The single species is unknown to me. It has no scales.

ANOSTOMATINÆ.

The scales of *Leporinus* are of the Curimatoid shape, but usually narrower, with a strong tendency to polygonal areas in the discal region, and a *deep* median basal notch. The radii are usually distinct, but not numerous. The circuli resemble those of *Alestes sadleri*, with a consequent slight tendency to apical teeth, as in some *Alestes*. The relationship with the Alestoids seems evident, in spite of the different habits and important adaptive modifications. The following have been examined:

Leporinus friderici Bloch. Scale shown in Plate XXVI, fig. 3. The photograph is unfortunately too dark to show the polygonal discal areas, with distinct apical and imperfect basal radii leaving them. The apical circuli slope obliquely toward the centre. There is in all this a very strong resemblance to the radial system of the Asiatic cyprinid *Barbus pleurotænia*.

Leporinus megalepis Günther. Scales similar to those of *L. friderici*, but the polygonal areas are less developed, and there are few but strong basal radii.

Leporinus fasciatus (Bloch). Scales rather long, the basal radii imperfect, the apical ones numerous, and the oblique apical radii strong. Thus the scale comes to quite closely resemble that of the Asiatic Cyprinid *Cirrhina jullieni*.

Leporinus nigrotæniatus (Schomburgk). Scales similar to those of *L. fasciatus*, but the coârse apical circuli become *transverse*, forming low broad arches over the large granular nuclear field, but evanescent apically.

LEPORELLINÆ.

The single species is unknown to me.

NANNOSTOMATINÆ.

Boulenger places these with the Anostomatinæ. The scales of *Pœcilobrycon* and *Nannostomus* are like those of *Leporinus*, but with a strong radial system of the type well shown in the figure (Plate XXVI, fig. 4) of *Pœcilobrycon ocellatus*. The apical circuli are sub-longitudinal (somewhat oblique), but fail toward the margin. *Characidium* is entirely different. The following have been studied:

Nannostomus marginatus Eigenmann (cotype). A minute fish, about 20 mm. long. The scales agree with those of *P. ocellatus* (Plate XXVI, fig. 4), except that they are rather broader.

Pœcilobryon ocellatus Eigenmann (Plate XXVI, fig. 9). The figure of a specimen from Rockstone, shows the characters well.

Characidium vintoni Eigenmann. A very striking type of scale, quadrate in form, the base gently arched, not crenate or notched, the nuclear area very near the base, about twenty-four long, parallel (somewhat divergent at sides) apical radii, the laterobasal angles approximately at right angles, the relatively coarse circuli running up the sides of the scale, but *not invading the field of the radii*. With wear, the scales fray out at the apex, and appear dentate. There is, in all, a strong resemblance to the scales of the Gobioniform Cyprinidæ, particularly to the genus *Pseudogobio*. The basal radii are variably indicated by extremely fine lines.

Characidium blennoides Eigenmann (cotype). The scales are in general similar to those of *C. vintoni*, but are distinctly triangular, the three sides about equal, the lateral margins convex, the apex very obtuse. The circuli seen in the broad laterobasal fields, are very widely spaced; the apical radii are greatly reduced in number, being only about eight. In some scales the field of the apical radii is very finely longitudinally striate, a sculpture very much finer than the circuli, and apparently having nothing to do with them. In many ways the scales of *C. blennoides* are curiously like those of *Gobio fluviatilis;* among the Characins they show a certain general approach to *Aphyocharax*.

PYRRHULININÆ.

Pyrrhulina filamentosa Cuvier & Valenciennes has been examined. The form of the scales (with strong laterobasal angles) and their strong and characteristic radial sculpture, are entirely those of the *Pœcilobrycon-Nannostomus* group. The apical circuli are longitudinal, and the apical margin has low and inconspicuous but genuine crenulations. With a high power it is noted that the dense transverse basal circuli in *Pœcilobrycon ocellatus* are moniliform, broken into innumerable short pieces, averaging perhaps twice as long as wide. In *Nannostomus marginatus* and the *Pyrrhulina* these circuli are broken here and there, but are essentially entire. Thus, going on the scales alone, we should reach a different classification from that current, as follows:

1. *Characidium.*
2. . . . . { *Pœcilobrycon.*
   . . . . 3. { *Nannostomus.* *Pyrrhulina.*

APHYOCHARACINÆ.

Aphyocharax ery hrurus Eigenmann (cotype) is shown in Plate XXVI, fig. 5. The shape resembles that of *Pœcilobrycon*, *Pyrrhulina*, etc., but the strong radial system is wanting, the radii being really reduced to a long U-shaped figure pointing apically, as the figure well shows. The figure does not show that the base of this U is finely reticulated, and that the field between its arms has a fine longitudinal striation, like that in the interradial field of *Characidium blennoides*. The widely spaced apical circuli, wholly longitudinal, simulate radii. All this could well be a modification of the *Characidium* type.

Cheirodon insignis Steindachner was figured in Smiths. Misc. Coll., vol. 56, No. 1, p. 3. It is a much weaker form of scale, with the sculpture evanescent apically.

CRENUCHINÆ.

The two known species have been examined.

Crenuchus spilurus Günther. Scale broad, with the nucleus far basad; apical circuli longitudinal, widely spaced; apical radii about six.

Pœcilocharax bovallii Eigenmann. Scale of the same character, but not so broad. Compared with *Aphyocharax erythrurus*, these scales differ conspicuously by the gently convex base, without the notch or bilobation. The nucleus also is more basad, and the radial system is not reduced to a U, though there is a certain tendency for two of the radii to connect and form this figure. The abundant longitudinal circuli in the interradial region distinguish Crenuchine scales from those of *Characidium blennoides*. So far as the scales go, the Crenuchines seem more primitive, or less specialized, than the fishes with which I have compared them.

IGUANODECTINÆ.

The only species is *Iguanodectes tenuis* Cope. The scales are transversely oval, with the broad nuclear area approximately central; circuli basal and lateral only, the latter widely spaced; no radii. This is evidently not far from the condition found in *Cheirodon insignis*. The fish itself is superficially just like some *Menidia*.

BRYCONINÆ.

Brycon falcatus Müller and Troschel (Plate XXVI, fig. 6). The large subquadrate scales are about ten mm. long and twelve mm. broad, the exposed part strongly silvery, the rest dull. The silvery part (about the apical third, or a trifle less) is ornamented with numerous (about thirty) radii, which are more or less curved, as the figure shows. This radial field is variably crossed by irregular growth-ridges, which are interrupted at the radii. The other part of the scale is densely covered with the finest possible circuli, except in the broad nuclear field, where the circuli are broken up and form a minutely labyrinthine pattern. The nuclear and adjacent regions present fine irregular cracks, which do not seem to represent degenerate radii. The basal circuli are entirely transverse. This is a very distinct scale.

Holobrycon pesu (Müller and Troschel). As in *B. falcatus*, the exposed part (about one-third) is silvery, the rest dull. The scales are about as broad as long (about five mm.), and have evident laterobasal angles. The apical field has a very variable number of radii (six to twelve or more), which extend over about half the length of the scale. The radial field has very distinct though widely-spaced circuli, which converge mesad, but are not far from longitudinal. The other part of the scale has very fine circuli in the manner of *B. falcatus*, but the nuclear modified area is small and rather different, the broken circuli being reduced more nearly to minute spots. This is evidently close to *B. falcatus*, the latter being the more specialized of the two.

TETRAGONOPTERINÆ.

A very large subfamily, of which numerous species have been studied.

Phenacogaster megalostictus Eigenmann. Very broad scales, about three and one-half mm. broad and only two and one-fourth mm. long. They have basal and lateral circuli, the latter widely spaced; apical field with rather strong growth-ridges, but no circuli; a few (2 to 4 or 5) widely spaced, weak radii. This scale has no resemblance to that of the Bryconinæ (*Brycon* and *Holobrycon*), but is like that of *Cheirodon*.

Deuterodon pinnatus Eigenmann. Small scales of entirely the same type as the last, but only moderately broad, length about 1.5, breadth 2 mm. or a fraction over. The radii vary from about 4 to 7. The nuclear field, which is subbasal, is microscopically reticulate, this pattern being derived from modified circuli. Exactly the same reticulation may be seen in the scales of *Phenacogaster megalostictus*, but it is not always very distinct.

Astyanax Baird & Girard is a very large genus, divisible into *Astyanax* proper and *Pœcilurichthys* Gill. The species examined are placed under these headings.

1. *Pœcilurichthys*.

Asty nax polylepis (Günther). Small scales, broader than long, with rounded outlines, and evident, though broadly rounded, laterobasal angles; circuli basal and lateral, the latter widely spaced; nuclear area broad, with microscopic reticulations as in *Deuterodon;* apical field with six or seven widely spaced radii, and no regular circuli, but the compound microscope shows numerous broken rudiments, slanting toward the middle line. This is certainly close to *Deuterodon.*

Astyanax abramoides Eigenmann. Scales not unlike those of *A. polylepis*, but the circuli are more dense and regular, the radii are about four, and the apical field is fully covered with circuli, which meet at a very broad angle in the middle line. The nuclear rectiulation is very irregular, and quite distinctive.

Astyanax bimaculatus (Linnæus) (Plate XXVI, fig. 7). Scales large and thick, about six mm. long and seven and one-half mm. broad; nucleus very little below the middle, with a minute labyrinthine sculpture, derived from the circuli; circuli extremely fine and dense, covering the whole scale, meeting at approximately right angles in the middle of the apical field; apical margin very faintly inclined to be crenulate; basal folds quite strong; radii apical, very strong, very variable, about 4 to 10, the arrangement fan-like, the outer ones often curved. A very distinct type of scale, much less like that of *A. polylepis* than the latter is like *Deuterodon*.

Astyanax potaroënsis Eigenmann. Small transversely suboval scales with the nucleus subbasal and the radii few; the nucleus is reticulate as in *A. polylepis*, and the radial area is covered with widely spaced, largely broken circuli, which meet in the middle line at less than a right angle. This is of the general type of *A. polylepis* and *abramoides*.

Astyanax mucronatus Eigenmann. Small broad scales, with nearly the outline of a half circle; obtuse laterobasal angles; basal and lateral circuli, the latter widely spaced; nuclear area minutely squamose; radii usually reduced to two, which are distinct; no circuli in apical field, and the last of the lateral circuli strongly oblique (directed to the margin). This is strikingly different from the other species of *Pœcilurichthys*, and approaches the condition of *Cheirodon* quite closely. (Superficially, the fish is much like *Cheirodon*.)

2. *Astyanax* s. str.

Astyanax mutator Eigenmann. Small scales, quite of the *A. polylepis* type, the radii about six, the radial field wholly without circuli; lateral circuli widely spaced, the innermost longitudinal, or some even bending over mesad; nuclear region simple, not reticulate.

Astyanax guianensis Eigenmann. Scales thin, much broader than long, exactly as in *A. mucronatus*, except that the two especially strong radii are usually more divergent, so that if continued basally to the nucleus they would form a V. The nuclear area has a sort of honeycomb-like reticulation. The fishes *mucronatus* and *guianensis* are much alike.

Astyanax essequibensis Eigenmann. Broad thin scales, inclined to be triangular; characters in general as in *mucronatus*, but radii weaker and more irregular. The widely spaced lateral circuli are oblique, directed toward the margin; there are no circuli in the radial or apical field; nuclear area not reticulated, all that is left of the reticulation being a few irregular markings.

According to the scales, the species of *Astyanax* would be classified thus:

1. *bimaculatus.*

2. . . . . (*a*) *polylepis, abramoides, potaroënsis* and *mutator.* (*b*) *mucronatus, guianensis* and *essequibensis.*

Bryconamericus hyphessus Eigenmann. Small, thin, more or less semicircular scales, with a very distinct pattern, as well shown in Plate XXVI, fig. 8. A strong curved line goes across the scale; below it are widely spaced circuli, above it no sculpture whatever. The condition strongly recalls certain scales of Clupeids, but there is little resemblance in detail.

Creatochanes Günther.

The scales of *Creatochanes* have a characteristic form, well shown in Plate XXVI, fig. 9, and Plate XXVII, fig. 1. The outline is much like that of *Leporinus*. At first sight there seems little or no resemblance to *Bryconamericus*, but closer inspection shows that, as in *B. hyphessus*, the apical area is free from circuli, and the circuli end abruptly at a line passing from the nucleus to the margin. The bounding line, however, is very broadly V-shaped instead of gently curved, and is not marked by anything more than the terminations of the circuli. Another difference is found in the presence of apical radii in *Creatochanes*. According to these characters, *Bryconamericus* could be derived from *Creatochanes*, but hardly the reverse.

Creatochanes melanurus (Bloch) (Plate XXVII, fig. 1). The scales have a diameter of about 2½ mm.; there are two strong apical radii forming a sort of U (compare *Aphyocharax*), and occasionally one or two additional.

Creatochanes affinis Günther (Plate XXVI, fig. 9). Similar, but the radii evanescent, sometimes wholly absent. In both species the nuclear area is reticulate, with the reticulations more or less broken down, becoming labyrinthiform.

Creatochanes caudomaculatus Günther. Scales about four mm. broad, of the same general type, the circuli fine, and the strong radii two to eight, arranged in a fan-like manner. When only two radii are present they usually form a V rather than a U. The nuclear area is broadly ornamented with a minute vermiform sculpture, consisting of irregular bent and curved short strands, and intermingled dots, with dots also scattered over the basal half of the radial field. All this nuclear sculpture is derived from broken-up circuli; compare the structures in the Cyprinids *Barbichthys* and *Osteochilus*, as figured in Zool. Anzeiger, Sept. 27, 1910, pp. 252–253.

Ctenobrycon spilurus (Cuvier & Valenciennes). Scales transversely long-oval or oblong, about one and one-third mm. long and two mm. broad; nucleus a short distance basad of the middle; radii two, in the form of a V, or one, or none; the whole scale covered with circuli, which are widely spaced except basally, the apical ones practically transverse, but forming a very open angle where they meet in the middle line. A very distinct type of scale, wholly unlike those of *Creatochanes*, etc.

Ctenobrycon hauxwellianus (Cope). Collected by William James at Ica (Thayer Expedition). Scales thin, transverse, about two mm. long and two and one-half mm. broad, with rounded laterobasal corners; basal and lateral circuli ordinary, but quite widely spaced; apical circuli transverse, but more or less broken, and in the submarginal area thrown into waves, which become strong on the margin, producing an irregular series of short marginal teeth (of the general type of those in *Citharidium*, but less developed) a few feeble, irregularly placed apical radii. This, the type of *Ctenobrycon*, has scales which differ considerably from those of *C. spilurus;* the latter should probably be separated generically or subgenerically, in which case it falls into the subgenus *Pœcilurichthys*.

Hemigrammus Gill.

The small thin scales of this genus are very uniform, and are of the form shown in Plate XXVII, fig. 2, representing *H. orthus* Durbin, from a drawing by Miss Evelyn Moore. It will be seen at once that this is the *Cheirodon* type of scale, and has no resemblance to *Ctenobrycon*, and not very much to *Creatochanes*, although agreeing in the absence of circuli in the apical field.

Hemigrammus rodwayi Durbin. Scales three mm. broad; apical radii strong, very variable, from three to twelve; nuclear area pustulose in appearance.

Hemigrammus analis Durbin. Scales about one and one-third mm. broad; radii about two to four; nuclear sculpture as in *H. rodwayi*.

Hemigrammus orthus Durbin (Plate XXVII, fig. 2). Scales about or hardly one mm. broad; radii two, rarely four; nuclear sculpture as in *H. analis*, but less distinct.

Hemigrammus cylindricus Durbin. Scales about one and two-thirds mm. broad, much rounder than in the other species; radii usually two, sometimes four; nuclear sculpture distinct. The form of the scales accords with the shape of the fish, which is not nearly so deep-bodied as is usual in the genus.

Hemigrammus unilineatus Gill. Scales about one and two-thirds broad; radii usually four; nuclear sculpture as usual; radial area longitudinally striatulate.

Hemigrammus ocellifer Steindachner. Scales about one and two-thirds mm. broad, very broad for their length; radii about four to six; nuclear sculpture distinct.

Hyphessobrycon Durbin.

The scales are entirely of the *Hemigrammus* type.

Hyphessobrycon gracilis (Reinhardt). Scales about one mm. broad; radii usually four; only about three circuli basad of the nucleus, the circuli failing in the middle of the base, instead of becoming crowded as in most scales.

Hyphessobrycon rosaceus Durbin (cotype). Scales hardly one mm. broad, but very much broader in proportion to their length than those of *H. gracilis;* circuli very few and widely spaced; radii two, rarely four.

Hyphessobrycon eos Durbin (cotype). Scales one and one-half to one and two-thirds mm. broad, shape as in *H. gracilis;* radii six to nine.

Hyphessobrycon stictus Durbin (cotype). Scales about one mm. broad, shape nearly as in *H. gracilis;* radii usually two, sometimes more. In all these fishes, the deepening of the body is accompanied by a widening of the scales, rather than an increase in the number of rows.

Pristella Eigenmann.

Scales also of the *Hemigrammus-Cheirodon* type.

Pristella riddlei (Meek). Scales very broad for their length; breadth about one and three-fourths mm.; radii usually four; nuclear sculpture weak.

Pristella aubynei Eigenmann. Scales not nearly so broad in proportion to length; radii usually five; nuclear area broadly reticulated, but the network more or less broken.

Moenkhausia Eigenmann.

In this genus the circuli appear to be basal and lateral only, as in the *Hemigrammus* series, but *the radial field is always minutely longi-*

tudinally striate. As in other scales, this striation seems not to be connected with the circuli, but in *M. oligolepis* it is clearly seen to be connected with and derived from the minutely labyrinthine pattern of the broad nuclear area, and this latter certainly results from modified circuli.

The genus may be divided into groups as follows:

(*a*) Group of *M. oligolepis.*

Moenkhausia oligolepis Günther (Plate XXVII, fig. 3). Large scales about six mm. long and seven mm. broad; base strongly bilobate in middle (compare *Leporinus*, etc.); circuli fine; radii very strong, variable, about 5 to 10 apical, *and one or two basal;* nuclear area broad, little below middle, with a minute labyrinthine or nodulose pattern; laterobasal angles strong.

(*b*) Group of *M. lepidulus.*

Scales much smaller, the largest (*M. chrysargyrea*) about three and two-thirds mm. broad; pattern quite *Hemigrammus*-like, but with the well-defined apical striation; radii about four to six, arranged fan-wise; nucleus with well-defined pustuloid pattern. The species are so much alike that no separate descriptions seem necessary.

Moenkhausia chrysargyrea (Günther).

Moenkhausia lepidurus (Kner).

Moenkhausia collettii (Steindachner).

Moenkhausia copei (Steindachner).

Moenkhausia cotinho Eigenmann.

Moenkhausia browni Eigenmann.

(*c*) Group of *M. dichrourus.*

Moenkhausia dichrourus (Kner). Scales agreeing with the *lepidurus* group, except that the radii (4 to 8) are arranged like straight branches of a tree, leaving the main axis (the middle line) at angles of about 45°, only there is no actual median structure from which they arise.

Moenkhausia grandisquamis (Müller and Troschel). Scales of the same type as *M. dichrourus*, but even more extreme, most of the divergent radii becoming actually horizontal, transverse to the antero-posterior axis of the scale, the upper ones are more oblique, and all curve at the base, the whole pattern resembling closely an English peach tree trained against a wall. The transverse bars thus formed number about three to six on each side. Thus the *longitudinal* lines in *M. cotinho*, etc., are wholly homologous with the *transverse* lines in *M. grandisquamis*. *M. grandisquamis* and *dichrourus* surely should be separated, at least subgenerically, from the other species examined.

Tetragonopterus Cuvier.

Tetragonopterus chalceus Agassiz (Plate XXVII, fig. 4). Broad scales, the outline well shown in the figure; breadth about four and one-fourth mm. As in *Bryconamericus*, there is a strong line or band across the middle of the scale, and the apical (exposed) field is without any distinct sculpture. The much finer circuli, however, do not stop at the line, but go a short distance above it, especially at the sides. The base of the scale is wavy. The transverse line belongs of course to the radial system, but otherwise there are no radii. The lateral circuli are directed very obliquely toward the margin.

Reviewing the Tetragonopterine scales, it must be said that *Ctenobrycon* stands quite apart. *Tetragonopterus* and *Bryconamericus* may be grouped together, though not very closely related; *Creatochanes*, still more different, may yet be placed in the same vicinity. *Astyanax bimaculatus* may be a stem-form leading toward the more usual *Astyanax* type, which connects with the *Hemigrammus* series, but the latter could not properly include such a form as *A. bimaculatus*. *Hemigrammus*, *Hyphessobrycon*, *Pristella*, *Phenacogaster*, *Deuterodon*, part of *Astyanax*, and *Moenkhausia* may be grouped together. In all about four distinct tribes are apparently indicated, or perhaps the subfamily should be divided.

Diapominæ.

Unknown to me.

Stevardiinæ.

Not examined.

Piabucininæ.

Chalceus macrolepidotus Cuvier. A fish having the most amazing resemblance to *Alestes macrolepidotus* (Cuvier & Valenciennes) of the River Nile, though on closer inspection important differences are apparent in the structure of the head. The resemblance extends even to the general light straw-color, and the iridescent lilac borders of the scales. The detailed structure of the scales is also remarkably similar, both having the same coarse longitudinal circuli in the region apicad of the nucleus, while the radial system is little different, except for the well-developed polygonal areas in the *Alestes*. Plate XXVII, fig. 5 shows the scale of *Chalceus macrolepidotus* so well that further description is hardly necessary. With regard to the polygonal discal areas of *Alestes macrolepidotus*, it must be said that they are not wholly distinctive, for the discal region shows some polygonal areas in the *Chalceus;* it is therefore only a matter of degree. As the figure shows, the basal and lateral circuli are extremely fine. Boulenger places *Chalceus* in the Hydrocyoninæ along with *Alestes*.

LEBIASININÆ.

Lebiasina bimaculata Cuvier & Valenciennes (W. Ecuador). Large reddish scales, about six mm. long and broad, the apical field minutely dotted with dark reddish pigment-spots, stellate in form; laterobasal angles strong; basal middle strongly bilobed, emarginate between the lobes; nucleus very slightly apicad of the middle, from it radiate about ten very strong thick radii, normally three apical, three basal, and two on each side widely spreading, forming a V; apical margin not toothed; lateral and basal circuli twice as fine as apical, the latter coarse, vertical, oblique toward the middle, joining at an acute angle. This is not far from *Alestes* in scale-characters; among the neotropical types it is essentially as in the Erythrininæ.

GASTEROPELECINÆ.

Gasteropelecus sternicla (Linnæus). Transversely oval scales, with the exposed part shining silvery-green; nucleus central; radii strong but few, one or two apical, and one on each side (or only on one side) lateral, all meeting in the middle; circuli very dense, but wanting on the exposed part of scale; nucleus with fine labyrinthiform sculpture. Peculiar scales, with a certain resemblance to *Creatochanes*.

Carnegiella strigata (Günther). Small scales, formed essentially as in *Gasteropelecus*, but the radii very weak and irregular, and sometimes as many as nine, while the nuclear area is very broadly minutely irregularly reticulated.

Chalcinus rotundatus (Schomburgk) (Plate XXVII, fig. 6). Quite large scales (about eight mm. broad). The shape well shown in the figure, the base strongly bilobed, much as in *Leporinus*. The exposed part is shining silvery-green, and is without distinct sculpture, except for a single median radius, with perhaps rudiments of others. This radius is joined in the centre by others, namely one which continues in the same straight line to the basal notch, and one on each side, which soon branches, giving rise to a lateral V, the lower fork of which usually branches again. The circuli, covering all except the exposed part, are exceedingly dense, and are very largely moniliform, or broken into minute bead-like elements, as in *Scleropages*. The broad area just apicad of where the radii meet is covered with labyrinthine markings. In the region of the nucleus there are numerous scattered translucent spots.

Chalcinus elongatus Günther. Smaller, proportionately broader scales, without angles: length about four mm., width slightly over five mm.; structure quite as in *Gasteropelecus*, with the same sort of radii, but often with a fine basal radius. The region apicad of the nucleus, narrowing on each side, so far as the sculpturing goes, is densely covered with labyrinthiform markings, the inner basal circuli become largely moniliform. This is intermediate between *C. rotundatus* and *Gasteropelecus*.

STETHAPRIONINÆ.

Fowlerina orbicularis (Cuvier & Valenciennes). The scales are entirely of the character and pattern of the *lepidurus*-section of *Moenkhausia*. Apical radii usually three or four, arranged in a fan-like manner.

AGONIATINÆ.

Piabucus dentatus Kohlreuter (British Guiana). Small, transversely oval scales; no radii; nucleus about twice as far from apex as from base; basal circuli fine, close together; apical circuli widely spaced, continuous with basal, meeting in the middle line at about a right angle just above the nucleus, the angle becoming wider and wider apicad, until near the margin it is virtually absent. A characteristic little scale.

STICHANODONTINÆ.

Stichanodon insignis Steindachner. (Specific identity not quite certain.) (Collected by William James at Manacapouru, Thayer Expedition.) Scale agrees with that of *Moenkhausia dichrurus*.

SERRASALMONINÆ.

Pygopristis denticulatus (Cuvier). Scales oblong, not very far from circular, the nucleus a short distance below the middle; the whole scale covered with practically uniform circuli, forming complete circles; no radii. The nucleus is very small, not sculptured. Some of the scales differ by having a very broad, strongly reticulated nuclear field, and the circuli (13 or 14 in all) widely spaced. Intermediate forms also occur. These scales are very closely related in structure to those of *Ctenobrycon*.

Pygocentrus piraya (Cuvier). Small scales with precisely the same characters as those of *Pygopristis*, and the same variation, except that when the nuclear field is broad and sculptured, the sculpturing is labyrinthine.

Serrasalmo gymnogenys Günther. Again the same type as *Pygopristis*.

Serrasalmo rhombeus (Linnæus) (Plate XXVII, figs. 7 and 7*a*). Again the same, with two forms, as shown in the figures. These scales closely resemble those of *Argyrosomus*, in the Salmonidæ.

MYLINÆ.

Myleus rubripinnis Müller & Troschel. Scales exactly like those of the Serrasalmoninæ. The circuli very fine and dense in the normal form. Plate XXVII, fig. 8, shows a double scale, a monstrosity.

CYNODONTINÆ.

Hydrolycus scomberoides (Cuvier) (Rockstone, British Guiana, collected by Max Ellis). Scale agrees with that of *Myleus rubripinnis*, but is larger, and the lateral line scale has a curious system of basal grooves, with four broad Y-like prongs pointing basad, the most lateral reaching the prominent laterobasal angles. The ordinary scales are rounded, without angles. The grooves of the lateral line scales are curiously suggestive of the extinct Chirocentrid genus *Cladocyclus*.

CHARACINÆ.

Charax gibbosa (Linnæus) (Plate XXVIII, fig. 1). Very broad scales without angles, as the figure well shows. The structure is like that of the Serrasalmoninæ, with however the important difference that the apical region is sharply differentiated, without true circuli, but with fine growth-lines simulating them. Along the transition line, especially mesad, is a fine reticulation. There are no radii. Although the circuli are much less dense, and there are no radii, there is quite a close resemblance to *Chalcinus elongatus*. We seem to get a hint here of how a Serrasalmonine type of scale may be modified into one more characteristic of the S. American Characinidæ in general.

Acanthocharax microlepis Eigenmann. Scales extremely broad, length about one and one-third mm., breadth about two and one third mm.; sculpture as in *Cheirodon insignis* or *Hemigrammus orthus*, except that the circuli are more numerous, and there are no radii whatever.

HYDROCYNINÆ.

Hydrocynus cuvieri (Agassiz). Small round scales resembling those of the Serrasalmoninæ, but the strong circuli are only moderately dense, and in the apical field are irregular and much wider apart; there are also a few strong radii, more or less in the form of a cross or an ×, usually two being basal. The nucleus is central, or nearly so. A distinct type.

The scale of *Luciocharax* was figured by Bean in Proc. U. S. Nat. Mus., 1908. It is entirely different from that of *Hydrocynus*, but is extraordinarily like that of the African *Phractolæmus ansorgii* Boulenger. The fishes *Luciocharax* and *Phractolæmus* are of course totally different. In the scale of *Luciocharax* we have something wanting in the African Characinid fauna—a connecting link between the Alestiform and Distichodontine types of scale.

ACESTRORHAMPHINÆ.

Acestrorhynchus microlepis (Schomburgk) and *A. falcatus* (Bloch) have small round scales, much like those of the Serrasalmonines, but with the larger nucleus subbasal, and the circuli failing apically, the innermost meeting at a wide angle. Plate XXV, fig. 7 shows *A. microlepis*, drawn by Miss Evelyn Moore.

ERYTHRININÆ.

These all have a purplish pigment on the exposed part of the scale (very strong and dense in *Hoplias macrophthalmus*); the same sort of thing is seen in *Leporinus* and *Characidium*.

Erythrinine scales are quite large, about as broad as long (broader in *Hoplerythrinus*), the laterobasal angles approximately right angles, the basal margin usually wavy or crenate, the median notch often deep; nucleus nearly central; apical margin rounded, without teeth; radial system very strong, *both basal and apical*, the radii meeting at the nucleus; large discal polygonal areas developed in some scales of *Hoplerythrinus;* lateral and basal circuli fine (much coarser in *Hoplerythrinus;* finest in *Hoplias*); apical circuli differentiated, longitudinal, slightly oblique near the middle line.

Hoplias malabaricus (Bloch). Apical radii five or six, counting the sublateral ones; basal about six, the outermost, when complete, arched at upper end.

Hoplias macrophthalmus (Pellegrin) (Plate XXVIII, fig. 2). Large scales, over ten mm. across; apical radii, counting sublateral, about sixteen to eighteen, basal about eight to eleven: outer apical and basal both arched near base when complete. The figure sufficiently shows the arrangement.

Hoplerythrinus unitæniatus (Spix) (Plate XXVIII, fig. 4). Scales about five mm. long and six broad; about four to eight apical radii, about the same basal, and usually some lateral; large pentagonal areas developed in some scales; apical circuli very widely spaced.

Erythrinus erythrinus (Bloch & Schneider). Scales about three and one-fourth to three and one-half mm. long and broad; sculpture and pattern as in *Hoplerythrinus*, but fewer radii.

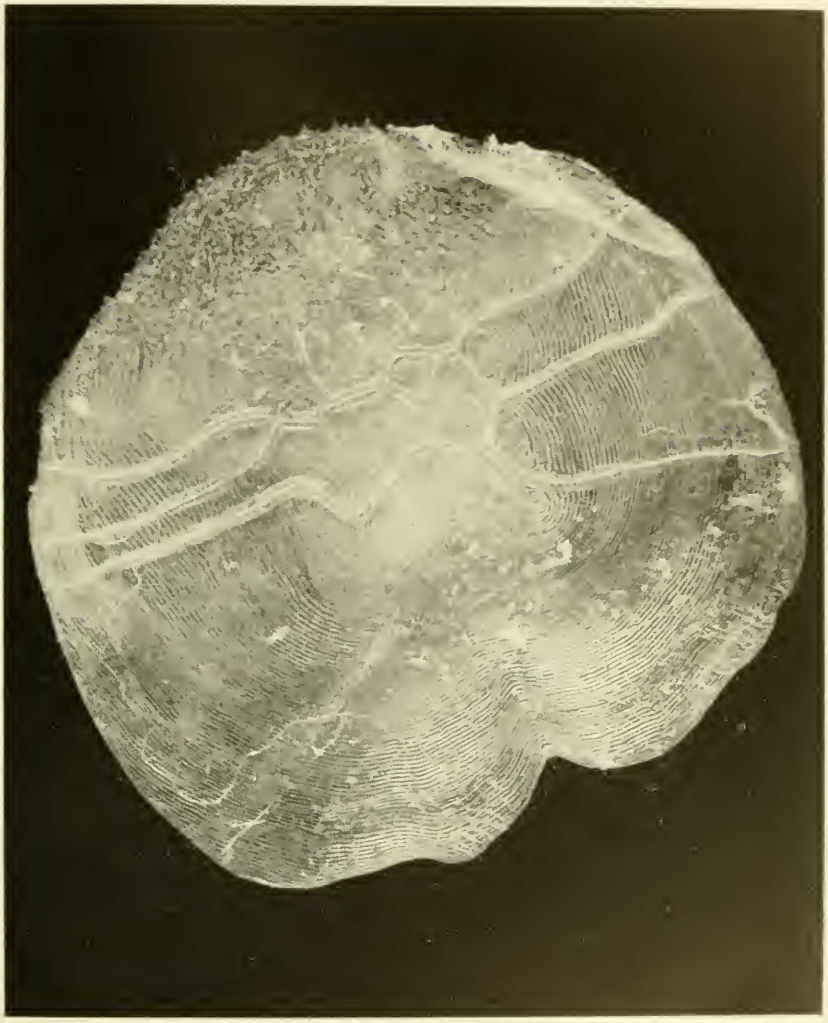
I give a figure (Plate XXVIII, fig. 3) of the scale of the Asiatic *Barbus chola*, a Cyprinid type which shows in its squamation a strong resemblance to *Erythrinus*. Here, so far as the scales go, the Characinids and Cyprinids meet, and it is at least significant that this occurs in the Erythrinine group on the one hand, and the *Barbus*-group on the other.

APPENDIX.

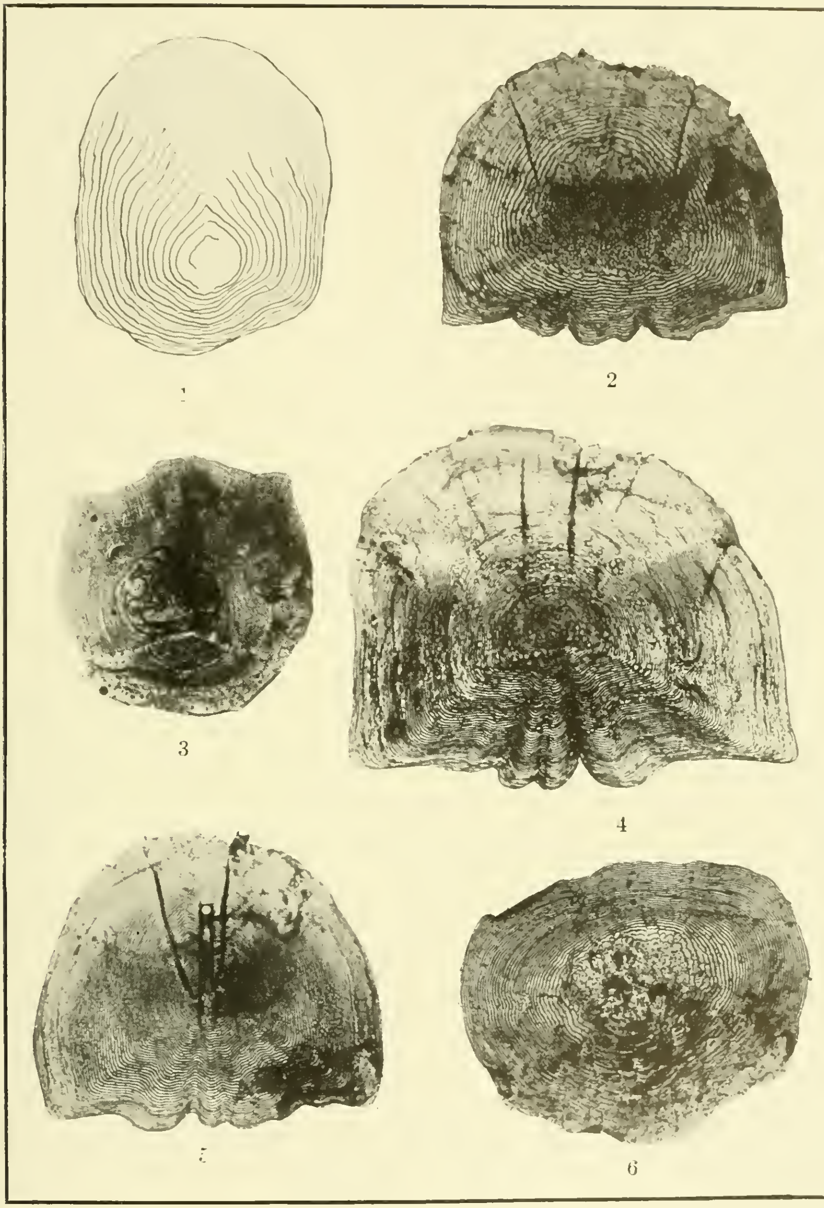
Brycon æthiops microstoma Günther (Plate XXVIII, fig. 5). Ksibi River (*Bates*). British Museum. This African genus was omitted from my paper on the Characinidæ of that continent. The scale is about five and one-half mm. broad with weak sculpture, the broad nuclear region finely pustulose, and the apical field with nothing to represent the circuli, except a sparser pustulose ornamentation, even this failing toward the margin. The radial system is represented by a few irregular polygonal areas, from which arise imperfect and very asymmetrical radii. This is a weak type related to *Alestes*.

Hydrocyon forskalii Cuvier. (Plate XXVIII, fig. 6.) I give a figure

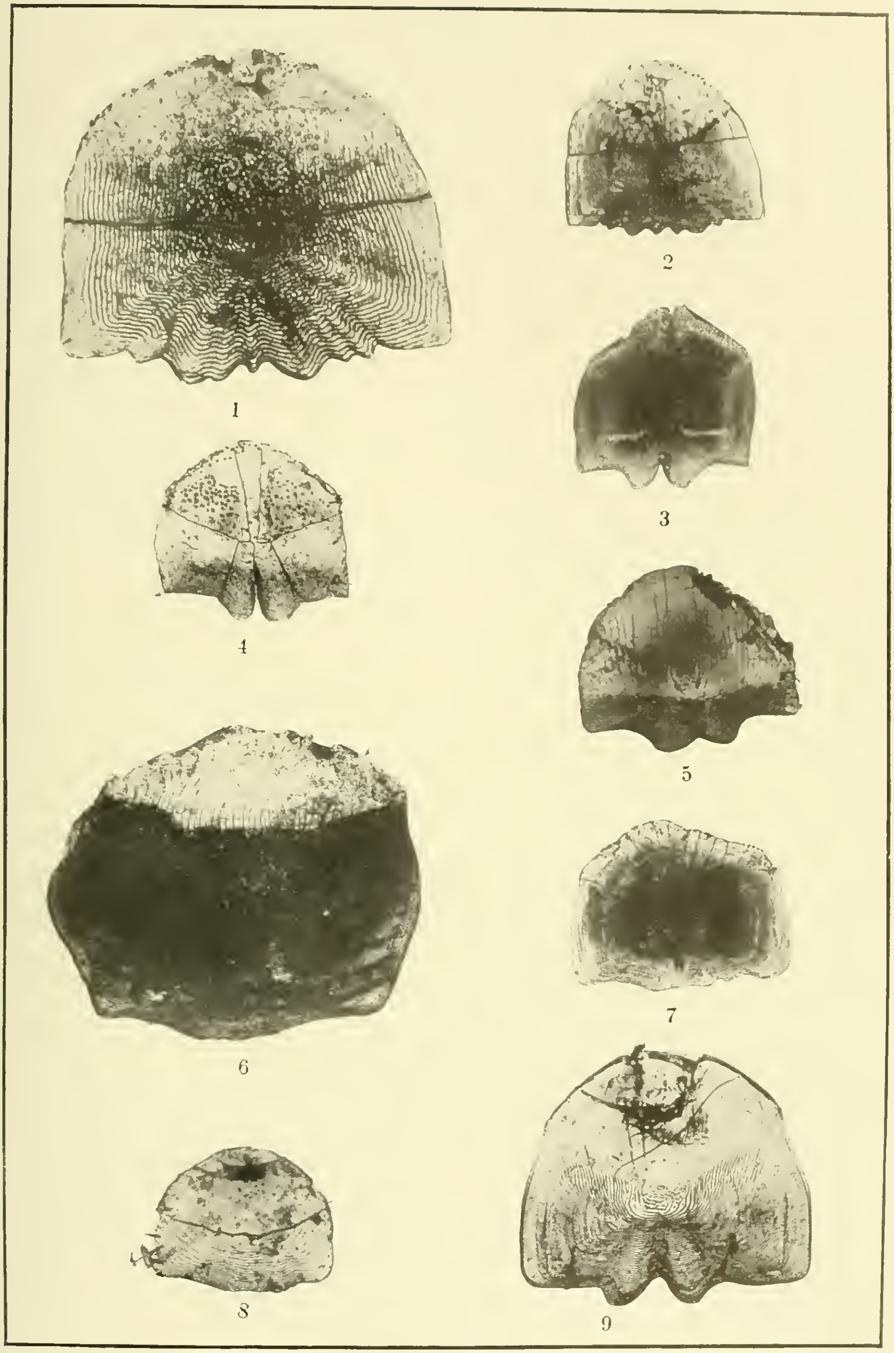
Psectrogaster curviventris.



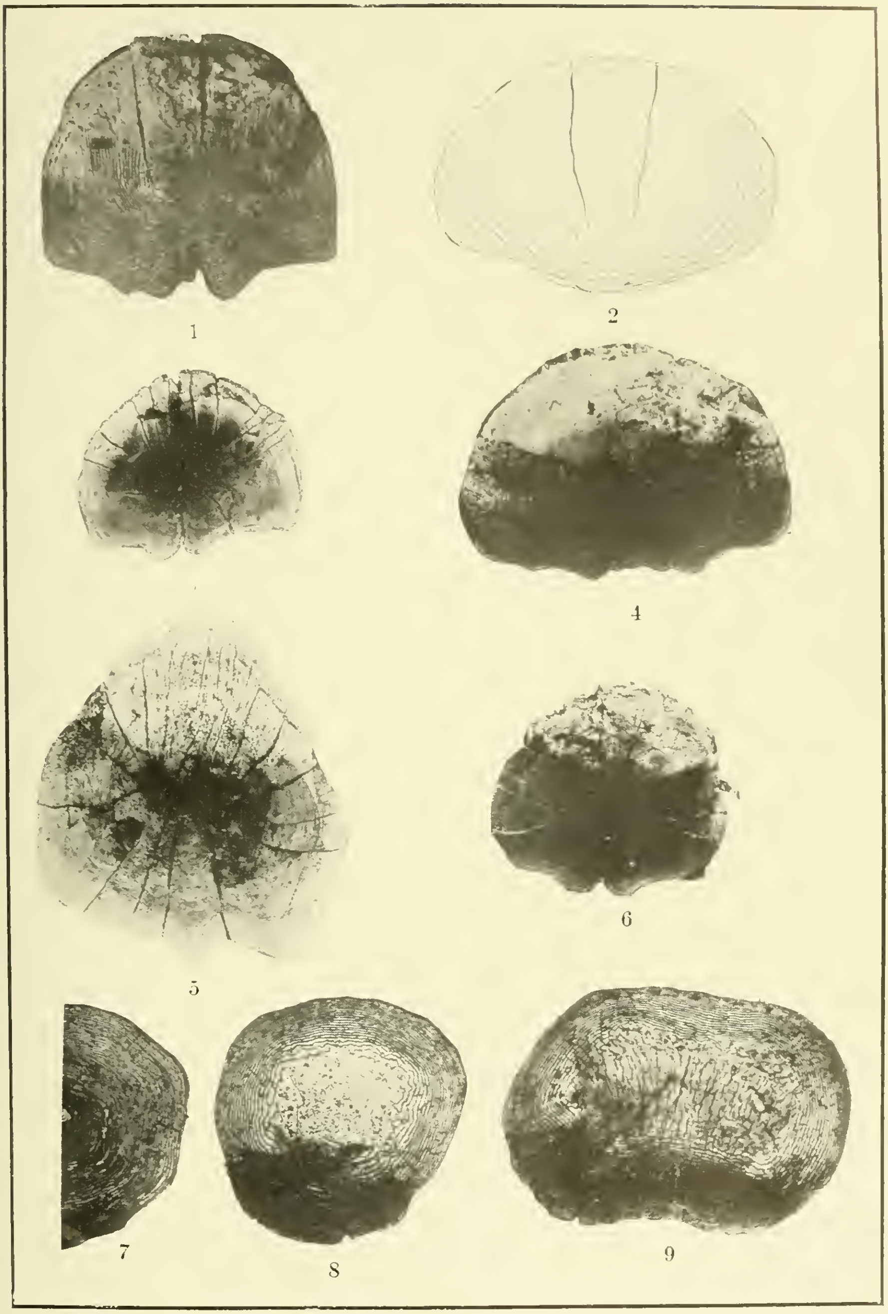
Prochilodus rubrotæniatus.



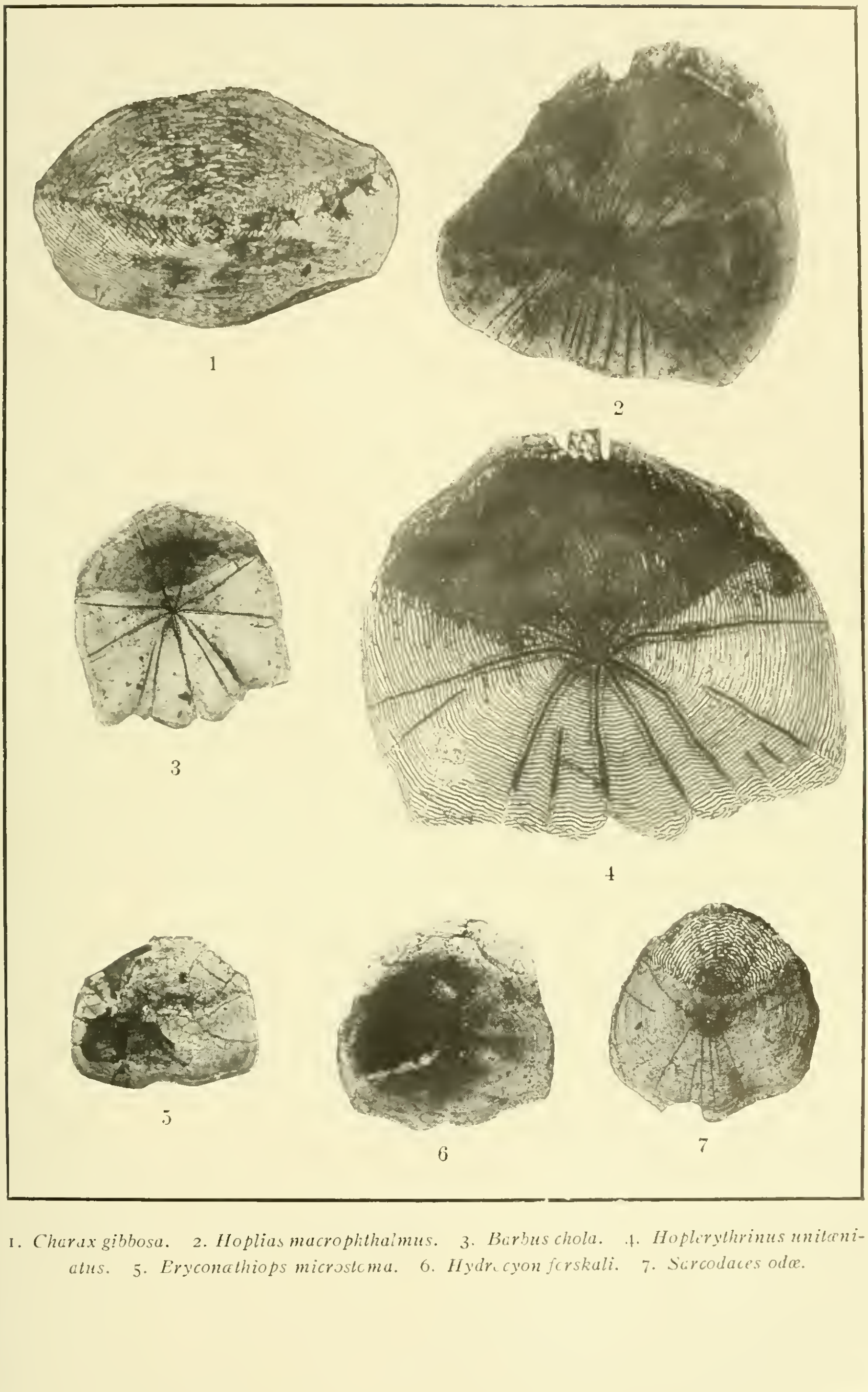
1. *Acestrorhynchus microlepis.* 2. *Curimatus spilurus,* juv. 3. *Hiodon tergisus.* 4. *Curimatus spilurus,* ad. 5. *Curimatus microcephalus.* 6. *Citharinus congicus.*



1. *Chilodus punctatus.* 2. *Tylobranchia maculosa.* 3. *Leporinus friderici.* 4. *Pœcilobrycon ocellatus.* 5. *Aphiocharax erythrurus.* 6. *Brycon falcatus.* 7. *Astyanax (Pœcilurichthys) bimaculatus.* 8. *Bryconamericus hyphessus.* 9. *Creatochanes affinis.*



1. *Creatochanes melanurus.* 2. *Hemigrammus orthus.* 3. *Mœnkhausia oligolepis.* 4. *Tetragonopterus chalceus.* 5. *Chalceus macrolepidotus.* 6. *Chalcinus rotundatus.* 7–8. *Serrasalmo rhombeus.* 9. *Myleus rubripinnis.*



1. *Charax gibbosa.* 2. *Hoplias macrophthalmus.* 3. *Barbus chola.* 4. *Hoplerythrinus unitæniatus.* 5. *Eryconæthiops microstoma.* 6. *Hydrocyon forskali.* 7. *Sarcodaces odœ.*

of this Characinid from the Nile, as it has never been figured, and is the type of Hydrocyoninæ, to which Boulenger refers many American genera.

Sarcodaces odoë (Bloch). (Plate XXVIII, fig. 7). This African genus is also figured for the first time. It is the only member of a distinct tribe.

VII. A MOUNTED SKELETON OF PLATIGONUS LEPTORHINUS[1] IN THE CARNEGIE MUSEUM.

By O. A. Peterson.

(Plate XXIX.)

In 1894 while making an excavation for material for a brickyard at the town of Goodland in the extreme western part of the state of Kansas, there were discovered in the Pleistocene formation a number of fossil bones. These were sent to Professor S. W. Williston then connected with the University of Kansas. Realizing the importance of this discovery, Professor Williston immediately went to Goodland and secured the remainder of the material. In all nine animals were represented. Upon this Professor Williston based his description of *Platigonus leptorhinus*. From this material an articulated skeleton was prepared and is exhibited in the Lawrence museum. A second skeleton was assembled from this collection and forwarded in exchange to the American Museum of Natural History, New York City. A third skeleton from this same material was recently obtained by the Carnegie Museum through exchange with the Museum of the Kansas University. These three articulated skeletons represent the type-material upon which Professor Williston established his species and made his studies.

The skull (No. 2806, C. M. Cat. Foss. Vert.) with the skeleton in the Carnegie Museum is one of the immature skulls which Professor Williston used in his description comparing it with Professor Leidy's *Euchœrus macrops*.[2] In the Journal of Geology (Vol. X, p. 777–782) for November and December of 1903, Dr. George Wagner calls attention to some variation in the anatomical features of the head of *Platigonus* and also suggests that Leidy's figure of *Euchœrus macrops* may in part be faulty. Wagner concludes that the species *leptorhinus* Williston is a synonym of *P. compressus* Le Conte.[3] Even Professor Leidy himself in his description of the skulls of *Platigonus* from near Rochester, New York, seems to have come to the con-

[1] *Kansas Univ. Quar.*, Vol. III, 1894, p. 23–39.

[2] *Trans. Amer. Philos. Soc.*, Vol. X, 1852, p. 323–342, pls. 35–38.

[3] Le Conte, Y. L., *Am. Journ. Sci.* (2), V, 1848, pp. 102–6.

clusion[4] that all the material representing the fossil peccaries described up to that date pertain to *Platigonus compressus* Le Conte. Leidy says, "The various remains originally described[5] and now regarded as pertaining to *Platigonus compressus* were early attributed to nearly half a dozen different species and genera, founded on sligh differences, which, before the prevalence of the evolution theory, were looked upon as being of a fixed character and all-sufficient for the distinction of species, and were so adjudged by a master who has since passed from among us" [referring probably to the death of Prof. Louis Agassiz].

On studying the skull (No. 2806) and the articulated skeleton, now in the Carnegie Museum, I find, as Williston did, that in its main anatomical features it compares quite closely with *Euchœrus macrops* Leidy. The heavy symphysis of the lower jaws due to the extended protuberance on the chin, the shortness of the post-canine diastema, and the general robustness of the jaws and broadness of face, together with the position of the external auditory meatus and the absence of the pits or *cul de sac* separated by the vertical ridge on the anterior border of the posterior nares I regard as among the most important features of Dr. Williston's enumerated differences in his paper (*l. c.* 25). Upon recomparing the present specimen with Leidy's description and figure of *E. macrops* (*l. c.*, Pl. 36, fig. 1) I find that the external auditory meatus agrees approximately with the figure. The anterior marginal wall of the posterior nares also appears to correspond with Leidy's description. There is then left the features of the symphysis of the lower jaws, the differences in the diastema between the canine and the cheek-teeth, together with the narrowness of the face and slenderer jaws of the Kentucky specimen. These features are of much interest and importance, especially when we consider the long and slender symphysis, the long post-canine diastema, and the slender muzzle of *Mylohyus*, a genus which in the later Pleistocene lived contemporaneously with, and possibly succeeded, *Platigonus*. If an eastern species of the latter genus should be looked upon as giving rise to *Mylohyus*, it would naturally follow that *Mylohyus* would have to be placed in closer relationship to *Platigonus* than is indicated by Professor F. B. Loomis,[6] and *Prostenops* would have to be placed in a separate phylum.

[4] *Trans. Wagner Free Inst.*, Vol. II, 1889, p. 49.

[5] Referring to various publications of earlier dates than that paper.

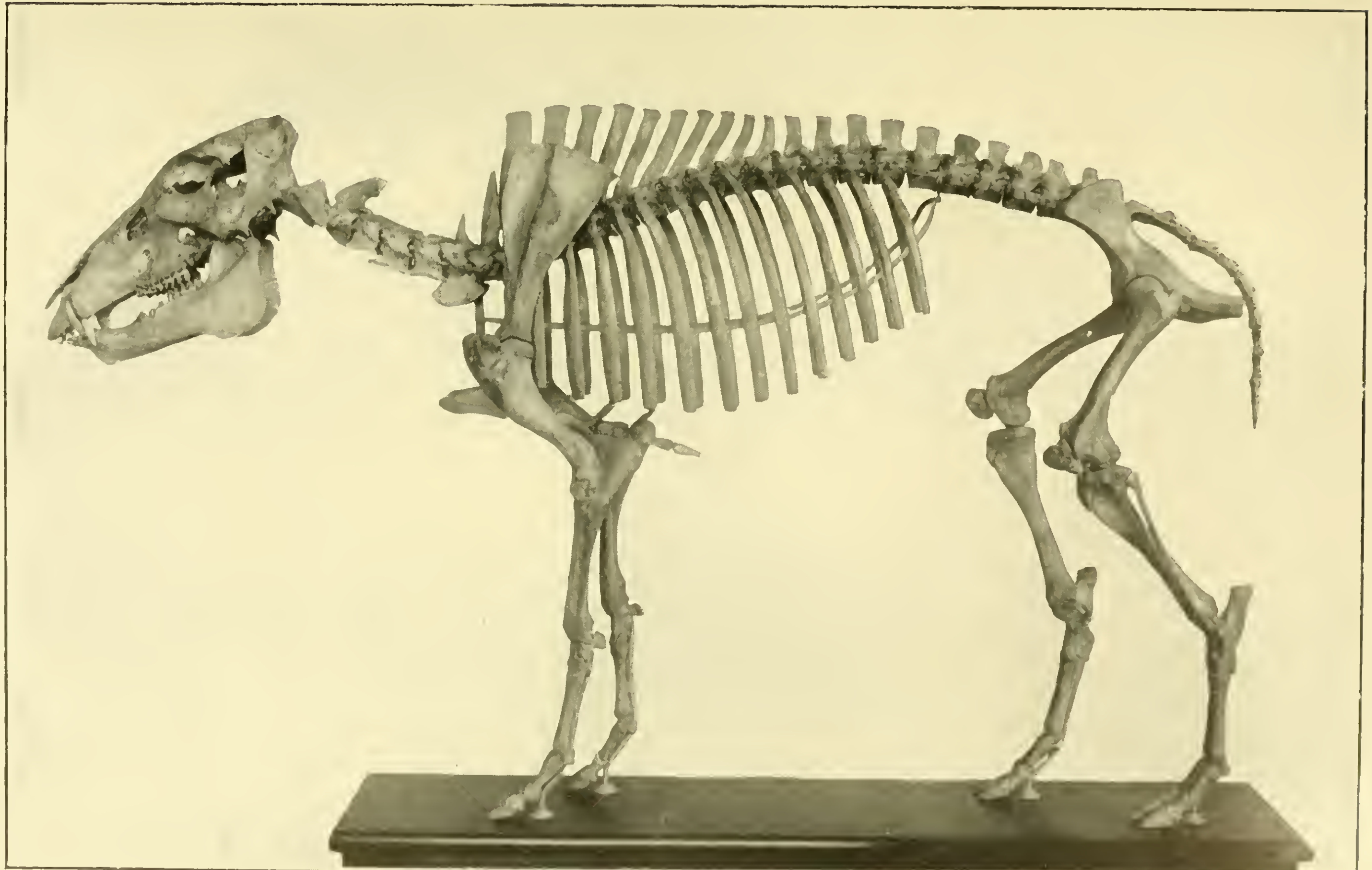
[6] *Amer. Jour. Sci.*, Vol. XXX, 1910, p. 384.

On further comparison of the dentitions of *Platigonus* and *Mylohyus*, there is little or no doubt about the close relationship so far as the incisors and canines are concerned. But in comparing the cheek-teeth (especially the lower), on the other hand, one is practically forced to the conclusion that there must have been a form with crowns lower and more bunodont than obtain in, for instance, *P. leptorhinus*, to give rise to the condition found in *Mylohyus*. Whether such forms may already have been described, *e. g.*, in the case of *P. vetus* Leidy, can only be determined by making a thorough review of all types and all other available material.

The skeleton, as it now appears in Pl. XXIX, has been finely mounted by Mr. Serafino Agostini under the direction of the writer. As may be observed in the photographic reproduction, the upright supports are eliminated by passing small steel rods through the limb-bones; which rods pass back of each foot to the base, thus supporting not only the limbs but the axial skeleton as well. Although the material represents different individuals, each component part is thought to be in approximately its proper position and the skeleton is thought to fairly well represent the bony structure, possibly of a female.

The vertebral formula is probably as follows: Cervicals 7; dorsals 14; lumbars 6; sacrals 4–5; caudals 8 + ?. The cervical region is rather heavy; the third, fourth, and fifth cervicals are without distinct spinous processes. The dorso-lumbar series are provided with prominent neural spines, the dorsals back of the tenth assuming a lumbar-like shape. The transverse processes of the lumbars are not heavy, but of considerable lateral extent, while the sacrum is apparently narrow and long. The ribs, though narrow, are quite flat throughout, and thus closely approximate those of recent forms. There are present in the skeleton five sternebræ which are rather heavy, the posterior ones broad as in the recent peccaries. There are also present a number of sternal ribs.

The limbs, and especially the feet, are as characteristic as is the head of this genus. The remarkable reduction of the lateral digits of *Platigonus* over those of the recent forms is especially worthy of note and is well described and illustrated by Professor Williston and others.



Mounted skeleton of *Platygonus leptorhinus* Williston. (C. M. Cat. Vert. Fossils, No. 2806.) $\times \frac{1}{7}$.

MEASUREMENTS.

	Cm.
Length of skeleton from end of premaxillary to end of ischial tuberosity	114
Length of skull	31.5
Length of neck	21
Length of dorsal series	41
Length of lumbar series	19.5
Length of sacrum	10
Height of skeleton at first dorsal vertebra	69
Height of skeleton at end of ischium	51.5

VIII. LICHENS COLLECTED DURING THE SUMMERS OF 1912 AND 1913 IN THE THUNDER BAY DISTRICT, ONTARIO, CANADA.

By R. Heber Howe, Jr.

In December, 1913, Dr. O. E. Jennings, of the Carnegie Museum, Pittsburgh, Pa., forwarded to me a collection of 265 packets of lichens collected by himself and Mr. R. H. Daily in the early part of the summer of 1912; by himself, Mr. R. H. Daily, and Mrs. O. E. Jennings during the remainder of the summer; and by himself and Mrs. Jennings in the summer of 1913. These collections were made in the southern part of the Thunder Bay District of Ontario, a district lying directly to the north of Lake Superior and surrounding Lake Nipigon. The region covered extended about two hundred miles east and west. The collection, though rich in specimens, was not so in species. It adds, however, a species and a variety to our North American lichen flora before unrecorded, and contains two interesting *Cladonias*, which are noted below. The collection also plainly shows the fact that our typical eastern plants extend uninterruptedly at least as far west as Lake Superior. Eastern species, such as *Platysma lacunosum* var. *atlanticum* Tuck., occur with other such typical plants, whereas western species like *Alectoria fremontii* Tuck. (Montana and Wyoming) and *Letharia vulpina* (L.) Ach. (Nebraska, Wisconsin and Minnesota) were not found. In regions lying well to the foothills of the Rockies these latter species are represented and the line that separates the floras lies somewhere between these two points or in the actual valley of the Mississippi river (95th meridian).

A complete set of the specimens is preserved in the herbarium of the Carnegie Museum; duplicates of many are to be found in the author's herbarium, and in the herbarium of the Sullivant Moss Society.

The majority of the crustose species were determined by Dr. H. E. Hasse; the *Stereocaulons* by Dr. L. W. Riddle; the *Cladonias* by Dr. Ludwig Scriba. To these gentlemen most grateful thanks are due.

Order: **GYMNOCARPALES.**

Group: *RADIATÆ.*

Family: USNEACEÆ.

1. *Usnea longissima* Ach. Lake Helen, Nipigon.
2. *Usnea barbata* (L.) Web. (= *U. dasypoga* (Ach.) Nyl.). Lake Helen, Nipigon.
3. *Usnea barbata* var. *stricta* (Schaer.) R. H. Howe, Jr. (= *U. dasypoga* var. *plicata* (Hoffm.) Hue.). Little Fluor Island, Edward Island, Fluor Island,—all L. Superior.
4. *Usnea florida* (L.) Web. Jackfish Island, L. Superior.
5. *Usnea florida* f. *hirta* (L.) Michx. Thunder Cape Mt.; Nipigon. Silver Islet; Porphyry Island, L. Superior.
6. *Usnea cavernosa* Tuck. Nipigon: a very curious and interesting specimen with cephalodia resembling alectroid apothecia; Porphyry Island, L. Superior; Silver Islet.
7. *Letharia thamnodes* (Flot.) Hue. Perry Lake, Thunder Cape; Fluor Island, Lake Superior; Current River; Nipigon; Thunder Cape; Porphyry Island, L. Superior.
8. *Ramalina farinacea* (L.) Ach. Porphyry Island, L. Superior; Nipigon. The variety *phalerata* Ach. is represented in part.
9. *Ramalina dilacerata* (Hoffm.) Wain. Porphyry Island, L. Superior; Thunder Cape; Silver Islet.
10. *Alectoria jubata* var. *implexa* (Hoffm.) Fr. Little Fluor Island, Porphyry Island, Silver Islet, and Fluor Island, L. Superior; Heron Bay; Stanley; Current River.
11. *Alectoria chalybeiformis* (L.) S. F. Gray. Porphyry Island, L. Superior.

Group: *STRATOSI–RADIATÆ.*

Family: CLADONIACEÆ.

12. *Stereocaulon paschale* (L.) Ach. Heron Bay; Silver Islet; Fluor Island and Porphyry Island, L. Superior; Sleeping Giant Mt., altitude 1,800 ft; Thunder Cape; Alexander Portage, 17 miles north of Nipigon; Nipigon. The variety *conglomeratum* Fr. is represented in part.
13. *Stereocaulon tomentosum* Fr. Silver Islet and Surprise Lake: Thunder Cape.
14. *Stereocaulon coralloides* Fr. Nipigon.

15. *Cladonia rangiferina* (L.) Web. Porphyry Island, L. Superior; Heron Bay; Silver Islet; Nipigon; Port Arthur; Rossport.

16. *Cladonia sylvatica* Hoffm. Porphyry Island, L. Superior; Heron Bay; Silver Islet; Nipigon; Port Arthur; Rossport.

17. *Cladonia alpestris* (L.) Rabenh. Nipigon; Porphyry Island, L. Superior.

18. *Cladonia coccifera* (L.) Willd. Rossport; Little & Big Fluor Islands, L. Superior; Nipigon; Heron Bay. The varieties *stemmatina* Ach., *phyllocoma* Flk., and *pleurota* Flk. are represented.

19. *Cladonia cristella* Tuck. Jackfish Island, L. Superior; Loon Lake; Rosslyn, 10 miles west of Ft. William; Heron Bay; Maloney Harbor, Magnet Pt.; Nipigon; Rossport; Paps Harbor, Black Bay Peninsula. The varieties *vestita* Tuck. and *ochrocarpia* Tuck. are represented.

20. *Cladonia amaurocræa* (Flk.) Schaer. Nipigon. The varieties *elotea* Ach. and *oxyceras* Ach. are represented.

21. *Cladonia uncialis* (L.) Web. Little and Big Fluor Islands, L. Superior; Nipigon; Rossport.

22. *Cladonia crispata* (Ach.) Flot. Little and Big Fluor Islands, L. Superior; Maloney Harbor; Nipigon. The varieties *subscrispata* Wain. and *divulsa* Arn. are represented.

23. *Cladonia squamosa* (Scop.) Hoffm. Maloney Harbor.

24. *Cladonia turgida* (Ehrh.) Hoffm. Nipigon; Heron Bay. Dr. Scriba remarks "a curious specimen near to *C. turgida*, but the podetia which seem to belong to this thallus are neither *turgida* nor *strepsilis*."

25. *Cladonia gracilis* (L.) Willd. Nipigon; Porphyry Island, L. Superior; Maloney Harbor, Magnet Pt.; Heron Bay; Silver Islet, Thunder Cape. The varieties *ochrochlora* Flk. and *hybrida* Flk. are both represented.

26. *Cladonia degenerans* (Flk.) Spreng. Nipigon; Porphyry Island, L. Superior. The material approaches both the forms *euphorea* Wain. and *gracilis* Flk.

27. *Cladonia verticillata* Hoffm. Porphyry Island, L. Superior; Nipigon; Heron Bay; Rosslyn; Maloney Harbor, Magnet Pt.; Rossport.

28. *Cladonia fimbriata* (L.) Fr. Maloney Harbor, Magnet Pt.; Heron Bay; Silver Islet.

29. *Cladonia pyxidata* (L.) Fr. Nipigon; Little Fluor Island and Porphyry Island, L. Superior; Heron Bay; Silver Islet; Rossport; Perry Lake, Thunder Cape. The material represents the varieties *pocillum* (Ach.) Flot., *neglecta* (Flk.) Mass., and *chlorophaea* (Spreng.) Flk.

Group: *STRATOSÆ.*

Family: PHYSCIACEÆ.

30. *Physcia stellaris* (L.) Nyl. Silver Islet, Thunder Cape.
31. *Physcia stellaris* var. *aipolia* Nyl. Heron Bay; Porphyry Island, L. Superior.
32. *Physcia pulverulenta* var. *leucoleiptes* Tuck. Porphyry Island, L. Superior. A part of the material represents form *turgida* Schaer.
33. *Physcia obscura* var. *endophoenicea* Harm. Oliver Creek, three miles southeast of Stanley.
34. *Xanthoria polycarpa* (Ehrh.) Oliv. Mt. McKay, Ft. William; Silver Islet, Thunder Cape; Fluor Island and Porphyry Island, L. Superior.
35. *Xanthoria lychnea* var. *pygmaea* Fr. Porphyry Island, L. Superior.

Family: CALOPLACACEÆ.

36. *Caloplaca cerina* (Ehrh.) Zahlbr. Silver Islet, Thunder Cape.
37. *Caloplaca elegans* (Link) Th. Fr. Silver Islet, Thunder Cape; Little Fluor Island, Porphyry Island, and Fluor Island, L. Superior.

Family: BUELLIACEÆ.

38. *Buellia parasema* (Ach.) Th. Fr. Rossport; Six-mile Lake and Silver Islet, Thunder Cape; Edwards Island, L. Superior.
39. *Rhinodina sophodes* var. *lecideoides* (Nyl.) Hasse, *in litt.*, Nipigon. Dr. Hasse writes "I think this variety has not been reported from this country."

Family: PARMELIACEÆ.

40. *Nephromopsis ciliaris* (Ach.) Hue. Thunder Cape.
41. *Platysma juniperina* var. *pinastri* (Ach.) Nyl. Mt. McKay, Ft. William; Silver Islet, Thunder Cape; Porphyry Island, L. Superior; Maloney Harbor, Magnet Pt.; Jackfish Island, L. Superior.

42. *Platysma lacunosum* var. *atlantica* (Tuck.) Howe. Nipigon.
43. *Parmeliopsis aleurites* (Ach.) Nyl. Nipigon.
44. *Parmelia physodes* (L.) Ach. Jackfish Island and Porphyry Island, L. Superior; Mission, Nipigon; Rossport; Thunder Cape Mt.
45. *Parmelia conspersa* (Ehrh.) Nyl. Heron Bay; Rossport; Silver Islet and Sleeping Giant, Thunder Cape; Ft. Williams; Porphyry Island, Little Fluor Island, and Fluor Island, L. Superior. This material represents also the varieties *imbricata* Mass., *stenophylla* Ach., and *isidiata* Mass.
46. *Parmelia olivacea* (L.) Nyl. Six-mile Lake and Silver Islet, Thunder Cape; Edwards Island, L. Superior; Maloney Harbor; Magnet Point. The material also represents the var. *aspidota* Ach. (= *P. exasperata* DeNot.).
47. *Parmelia Borreri* var. *rudecta* Tuck. Porphyry Island, L. Superior.
48. *Parmelia saxatilis* (L.) Ach. Nipigon; Silver Islet and Six-mile Lake, Thunder Cape; Edwards Island and Little Fluor Island, L. Superior. One example represents the form *brunnea* Harm.
49. *Parmelia saxatilis* var. *sulcata* (Tayl.) Nyl. Mt. McKay, Ft. William; Maloney Harbor, Magnet Point; Surprise Lake and Perry Lake, Thunder Cape. One example represents the form *rubescens* Roumeg.

Family: LECANORACEÆ.

50. *Candelariella cerinella* (Flk.) Zahlbr. Little Fluor Island, L. Superior.
51. *Lecanora rubina* (Vill.) Wain. Little Fluor Island, L. Superior.
52. *Lecanora cineria* (L.) Sommf. Porphyry Island and Little Fluor Island, L. Superior.
53. *Lecanora subfusca* (L.) Ach. Silver Islet, Thunder Cape. One example represents var. *distans* Ach., another var. *argentata* Ach.
54. *Lecanora symmicta* Ach. Thunder Cape.

Family: PELTIGERACEÆ.

55. *Pe tigera aphthosa* (L.) Hoffm. Nipigon; Heron Bay; Silver Islet, Thunder Cape; Rossport; Porphyry Island, L. Superior.

56. *Peltigera polydactyla* (Neck.) Hoffm. Maloney Harbor, Magnet Point, Nipigon; Rabbit Mt., fifteen miles west of Ft. William; Ft. William. One example suggests *P. pulverulenta* (Tayl.) Nyl., the spores, however, being small.

57. *Peltigera horizontalis* (L.) Hoffm. Tee Bay and Silver Islet, Thunder Cape; Mt. McKay, Ft. William.

58. *Peltigera canina* (L.) Hoffm. Nipigon; Stanley; Porphyry Island, L. Superior; Six-mile Lake and Silver Islet, Thunder Cape.

59. *Peltigera rufescens* (Sm.) Hoffm. Nipigon; Stanley; Mt. McKay, Ft. William; Maloney Harbor, Magnet Point; Silver Islet, Surprise Lake and Sleeping Giant Mountain, Thunder Cape.

60. *Peltigera spuria* (Ach.) DC. Ft. William; Stanley; Rossport; Maloney Harbor, Magnet Point.

61. *Peltigera venosa* (L.) Hoffm. Nipigon.

62. *Nephroma lævigatum* Ach. Nipigon. Represents the variety *parile* Nyl.

63. *Solorina saccata* (L.) Ach. Fluor Island, L. Superior; Rossport; Nipigon.

Family: STICTACEÆ.

64. *Lobaria pulmonaria* (L.) Hoffm. Paps Harbor, Black Bay Peninsula; Nipigon; Loon; Oliver Creek, near Stanley; Porphyry Island, L. Superior. The material represents in part the following forms: *papillaris* Del., *hypomela* Del., *sorediata* Harm.

Family: PANNARIACEÆ.

65. *Pannaria lanuginosa* (Ach.) Krb. Surprise Lake and Silver Islet, Thunder Cape; Current River, Port Arthur; Little Fluor Island, L. Superior; Heron Bay.

66. *Pannaria microphylla* (Sw.) Ach. Porphyry Island, L. Superior.

Family: GYROPHORACEÆ.

67. *Gyrophora vellea* (L.) Ach. Jackfish Island and Little Fluor Island, L. Superior; Heron Bay; Blend River, at head of Thunder Bay; Nipigon; Silver Islet and Surprise Lake, Thunder Cape. With a clear conception of *G. hirsuta* still in doubt, I am referring all this material here.

68. *Gyrophora flocculosa* Borr. & Turn. Fluor Island, L. Superior.

69. *Gyrophora Muhlenbergii* Ach. Little and Big Fluor Islands, L. Superior; Nipigon; Heron Bay; Silver Islet, Thunder Cape.

Family: ACAROSPORACEÆ.

70. *Maronea constans* (Nyl.) Th. Fr. Edwards Island, L. Superior; Thunder Cape.

Family: LECIDEACEÆ.

71. *Rhizocarpon obscuratum* (Ach.) Krb. Porphyry Island, L. Superior. Dr. Hasse writes "species believed to be new to this country."
72. *Rhizocarpon geminatum* (Flot.) Krb. Porphyry Island and Little Fluor Island, L. Superior.
73. *Lecidea parasema* Ach. Porphyry Island, L. Superior. The example represents the variety *achrista* (Sommf.) Hasse, *in litt.*
74. *Lecidea lapicida* (Ach.) Arn. Porphyry Island, L. Superior.

Group: *COLLEMÆ.*

Family: COLLEMACEÆ.

75. *Collema vespertilio* (Light.) Wain. Rabbit Mt., fifteen miles west of Ft. William.
76. *Leptogium Hildebrandii* (Garov.) Nyl. Tee Bay, Thunder Cave. This plant was determined by Dr. Riddle.

Order: **PYRENOCARPALES.**

Family: DERMATOCARPONACEÆ.

77. *Dermatocarpon fluviatile* (Weis.) Th. Br. Porphyry Island and Little Fluor Island, L. Superior.
78. *Dermatocarpon miniatum* (L.) Mann. Porphyry Island, L. Superior. The example represents the variety *complicatum* (Sw.) Zahlbr.

THOREAU MUSEUM OF NATURAL HISTORY,
CONCORD, MASSACHUSETTS.

IX. A PRELIMINARY LIST OF THE FOSSIL PLANTS OCCURRING IN THE ROOF OF THE PITTSBURGH COAL.

By Norman McDowell Grier.

In 1907 during the course of the construction of an electric railway between Wilkinsburg and Ardmore, Pennsylvania, a cut through a small hill about three-quarters of a mile southeast of Wilkinsburg exposed the roof of the Pittsburgh Coal. At that time Dr. Percy E. Raymond, then of the Carnegie Museum, made a collection of the fossil plants thus exposed to view, later placing them in the care of Dr. O. E. Jennings, of the Section of Botany of the Carnegie Museum (Acc. No. 4526). The writer has since been entrusted with their identification.

In the determination of these fossils the main reliance has been placed in the various figures and descriptions available, particularly the Atlas and Text of Lesquereux, "Coal Flora of Pennsylvania and of the Carboniferous Formation throughout the United States." Second Geological Survey of Pennsylvania, "P," 1879 and 1880; and also David White, "The Fossil Flora of the Lower Coal Measures of Missouri," United States Geological Survey, Monograph 37, 1899. The following is a list of the fossils so determined, the Department Numbers being given for the various specimens:

THALLOPHYTA.

FUNGI.

Genus Hysterites Unger, 1841. × 101*a*, *b*, *c*.

1. **Hysterites cordaitis** Grand Eury.

This fungus was observed to be extremely common upon various species of *Neuropteris*, as well as upon all species of *Cordaites* found. Apparently identical forms were found upon the different hosts.

PTERIDOPHYTA.

EQUISETALES.

Genus CALAMITES Suckow, 1784.

2. **Calamites ramosus** Artis. × 102.
3. **Calamites dubius** Artis. × 103.
4. **Calamites suckowi** Brogniart. × 104.
5. **Calamites approximatus** Schlotheim. × 108*b*.

Genus ANNULARIA Sternberg, 1822.

6. **Annularia inflata** Lesquereux. × 106, × 160*b*.
7. **Annularia stellata** (Schlotheim) Wood. × 107, × 145*a*, × 155.

SPHENOPHYLLALES.

Genus SPHENOPHYLLUM Brogniart, 1828.

8. **Sphenophyllum lescurianum** White. × 108*a*, × 147*c*.
9. **Sphenophyllum (Asterophyllites) fasciculatum** Lesquereux. × 109.
10. **Sphenophyllum bifurcatum** Lesquereux. (?) × 110*a*, × 165.

LYCOPODIALES.

Genus SIGILLARIA Brogniart, 1822.

11. **Sigillaria camptotaenia** Wood. × 111, × 143*b*, × 153*b*.

SPERMATOPHYTA.

CYCADOFILICALES.

Genus PECOPTERIS Brogniart, 1822.

12. **Pecopteris arborescens** (Schlotheim ?) Brogniart. × 112, × 158.
13. **Pecopteris vestita** Lesquereux. × 113, × 125*b*, × 144*b*, × 145*b*, × 146, × 148, × 151, × 161.

Genus CALLIPTERIDIUM Weiss, 1870. × 164*a*, *b*.

14. **Callipteridium membranaceum** Lesquereux. × 105, × 114, × 144*a*, × 160*a*.

Genus NEUROPTERIS Brogniart, 1822.

15. **Neuropteris missouriensis** Lesquereux. (?) × 115, × 143*a*.
16. **Neuropteris fasciculata** Lesquereux. × 116.

17. **Neuropteris fimbriata** Lesquereux. × 117*a*, × 124*b*, × 156.
18. **Neuropteris tenuifolia** Brogniart. × 118.
19. **Neuropteris scheuchzeri** Hoffman. × 119, × 124*c*, × 125*c*, × 126*c*, × 128, × 129, × 130, × 131, × 132, × 133, × 135, × 136, × 137, × 138, × 139, × 140, × 141, × 142, × 162*b*.

This species, described by Lesquereux as *N. hirsuta* and *N. hirsuta* var. *angustifolia*, was the most commonly preserved form in the horizon.

20. **Neuropteris clarksoni** Lesquereux. × 120.

CORDAITALES.

Genus CORDAITES Unger, 1850.

21. **Cordaites communis** Lesquereux. × 121, × 153*a*, × 159, × 162*a*.
22. **Cordaites diversifolius** Lesquereux. (?) × 122, × 163*a*.
23. **Cordaites borassifolius** Unger. × 123, × 134, × 154, × 163*b*.

Next to *Neuropteris scheuchzeri* this species seemed to be the commonest in the horizon examined.

24. **Cordaites grandifolius** Lesquereux. × 124*a*.
25. **Cordaites validus** Lesquereux. (?) × 125*a*.

Genus RHABDOCARPUS Goeppert and Berger.

26. **Rhabdocarpus (Pachytestus) mansfieldi** Lesquereux. × 126*a*.

INCERTÆ SEDIS.

27. **Radicites** Potonie = **Pinnularia** Lindley and Hutton. × 127.

Of the species listed in this paper, the following have already been described as occurring in the Lower Coal Measures of Missouri by Lesquereux,[1] Hambach[2] and White,[3] viz: *Hysterites cordaites, Callipteridium membranaceum, Neuropteris missouriensis, Sphenophyllum fasciculatum, Sphenophyllum lescurianum, Cordaites communis, Pecopteris vestita, Neuropteris Scheuchzeri, Pecopteris arborescens, Calamites suckowi, Cordaites diversifolius.* Of these, all but the last five have hitherto been regarded as being peculiar to that horizon.

[1] Second Geol. Surv. Pa., Report of Progress, "P," Vol. III, 1884, p. 879, 880.

[2] Bull. Geol. Sur. Missouri, No. 1, 1890, p. 83–85.

[3] Mon. 37, U. S. Geol. Sur., "Fossil Flora Lower Coal Measures of Missouri," p. 284.

According to White, the Lower Coal Measures of Missouri may be inferred to have a stratigraphical position, which although subsequent to the Morris, Brookville, and Clarion Coals of Illinois and Pennsylvania respectively, is earlier than either the Darlington or upper Kittanning Coals.[4] From the Darlington Coal Lesquereux has recorded *Pecopteris vestita*[5] recently shown as apt to be confused with *Pecopteris pseudovestita* White. Since *Calamites suckowi* and *Cordaites diversifolius* have not been described from any horizon as late as the Darlington Coal they may be eliminated, and the species *Pecopteris vestita*, *Pecopteris arborescens*, and *Neuropteris scheuchzeri* appear as the sole evidence of a transitional flora between the Lower Coal Measures discussed and the Pittsburgh Coal. The latter two of these species were regarded by Lesquereux[6], as being characteristic of the Pittsburgh Beds, but their distribution appears to be so generalized as to be almost useless for stratigraphical correlation. Further relations of the two floras may be obtained upon future collections in the coals of the Monongahela Series, when the relations of the Pittsburgh Coal to the other Coal Measures may then be more profitably discussed.

[4] Mon. 37, U. S. Geol. Surv., p. 289.

[5] Mon. 37, U. S. Geol. Surv., p. 85.

[6] Second Geol. Surv. Pa., Report of Progress, "P," Vol. III, 1884, p. 232.

X. SOME UNDESCRIBED REMAINS OF THE UINTA TITANOTHERE DOLICHORHINUS.

By O. A. Peterson.

The present paper is based upon the remains of an individual found by the writer in 1912 in a shaly stratum of the upper series of Horizon A of the Uinta Eocene on White River, Uinta County, Utah. The locality at which the specimen was found (a canyon leading into White River) is the one where Mr. E. S. Riggs and party from the Field Museum of Natural History, in 1910 secured a portion of the collection upon which a paper was published by Mr. Riggs.[1]

Dolichorhinus longiceps (?) Douglass. Annals of the Carnegie Museum, Vol. VI, 1909, p. 312.

The specimen (No. 2865) consists of the greater portion of the skull, the posterior part of the mandible of the left and fragments of

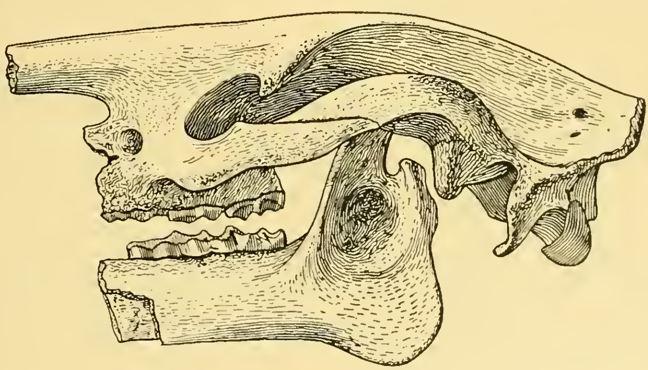


Fig. 1. *Dolichorhinus longiceps* (?) Douglass, No. 2865, ⅙ nat. size.

the right side, the hyoid arch, the cervical vertebræ, two dorsal and two lumbar vertebræ, together with the fore limb and foot practically complete.

[1] "New or Little Known Titanotheres from the Lower Uinta Formation," Field Museum of Natural History, Publication 159, 1912, pp. 17–41.

THE CRANIUM AND MANDIBLE.

The cranium is somewhat smaller than the type of *Dolichorhinus longiceps*, the sagittal area of the parietals is more compressed laterally, the zygomatic portion of the squamosal is slenderer and less expanded laterally, and the basicranial axis has a greater bend.[2] These characters together with the slightly larger teeth constitute the most marked differences in the two crania compared, but that they should be regarded as of specific value is rather questionable.

The sudden downward bend of the occiput of *Dolichorhinus heterodon*, the flatter frontal region, the smaller pre-orbital ledge, and the smaller and more delicate nasals seem to separate that species

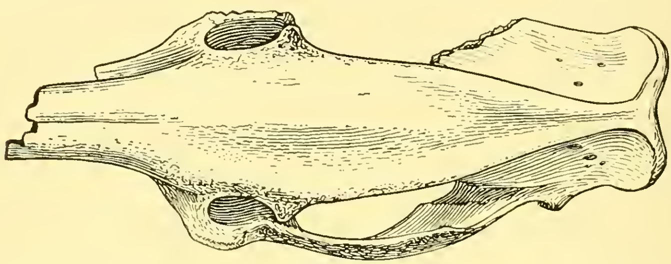


FIG. 2. *Dolichorhinus longiceps* (?) Douglass, No. 2865. Top view of cranium. 1/6 nat. size.

more widely from the present specimen. Furthermore, the difference in the geological horizons in which *D. heterodon* and the present specimen were found is to be considered. The former came from horizon "Lower C" while the latter was found in the lower part of horizon "Upper A" of the Uinta sediments.

The high coronoid process and its sudden backward turn at the top, so characteristic of the mandible of *Dolichorhinus*, is well shown in this specimen. The angle is much compressed laterally, the temporal fossa is located high up, but is quite deep, and the horizontal ramus has but small vertical diameter.

THE HYOID ARCH.

The hyoid arch may best be compared with that of the tapir, because in that genus there is apparently no extended anterior appendix or process such as is seen on the basihyal of the horse or the

[2] The base of the skull has received some crushing fore-and-aft, a fact to which the greater curvature of the basicranial axis may partly be due.

rhinoceros. However, the bone as a whole, especially its anterior border, is relatively heavier than in the tapir. The thyrohyal is unfortunately broken off on both sides. This element was perhaps relatively less developed than in *Tapirus terrestris*. The ceratohyal is also unfortunately broken off at the upper end, but its length was no doubt proportionately equal to that of the American tapir, while the shaft is less constricted antero-posteriorly. The epihyal is not present; this bone no doubt was nodular in character, as is the case in *Tapirus terrestris*. The anterior portion of the shaft of the stylohyal is rounder in cross-section than in the tapir or the horse, but the upper

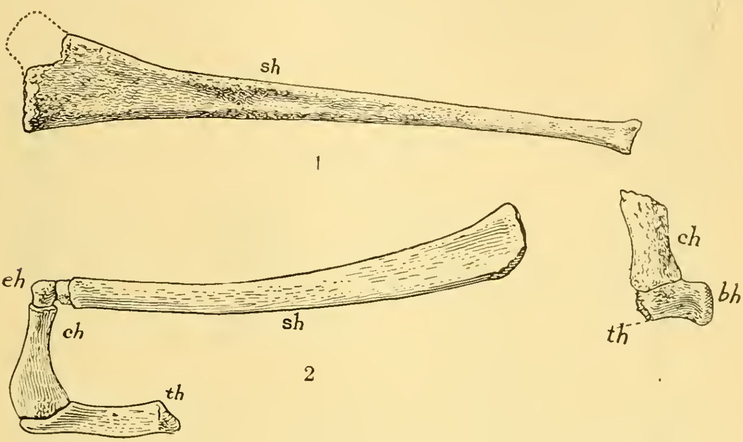


FIG. 3. Side view of hyoid apparatus. Figs. 1 and 3. *Dolichorhinus longiceps* (?), No. 2865; Fig. 2. *Tapirus terrestris*, ½ nat. size. *th* = thyrohyal, *bh* = basihyal, *ch* = ceratohyal, *eh* = epihyal, *sh* = stylahyal.

end is flattened and terminates in enlarged processes, the superior attached to the hyoidial portion of the temporal bone and the inferior somewhat more obtusely rounded, extending downwards and outwards. This rib-like upper end of the stylohyal is more suggestive of the rhinoceros or the horse than of the tapir. (See Figs. 3 and 4.)

MEASUREMENTS.

Length of skull from anterior border of the orbit to top of occiput	365	mm.
Antero-posterior diameter of upper molar series	125	"
Transverse diameter of frontals at postorbital processes	145	"
Depth of mandible at $M_{\overline{3}}$	71	"
Length of stylohyal, approximately	168	"
Antero-posterior diameter of basihyal, median line	15	"

THE VERTEBRÆ.

The Atlas.—In comparing the atlas with that of *Diploceras osborni* Peterson,[3] it is at once observed that the bone is proportionally higher and longer, but of a less transverse diameter, which is due chiefly to the shorter transverse process in the present genus. The anterior cotyle is on the whole very nearly as large as, but is deeper than, in *Diploceras*, and its inferior surface is more distinctly separated. The

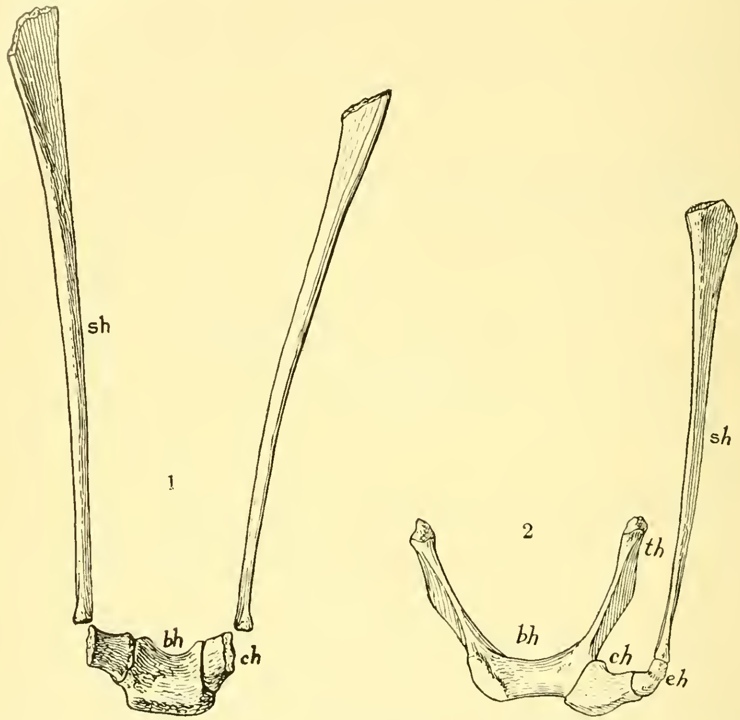


FIG. 4. Hyoid apparatus. 1. *Dolichorhinus longiceps* (?), No. 2865; 2. *Tapirus terrestris*, ½ nat. size. *bh* = basihyal, *th* = thyrohyal, *ch* = ceratohyal, *eh* = epihyal, *sh* = stylohyal.

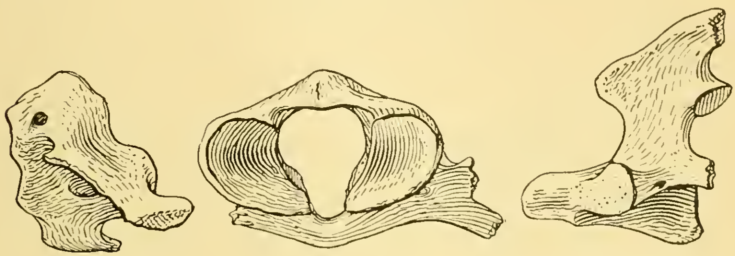
odontoid process of the axis is proportionally longer and reaches nearly through the inferior arch of the atlas, while in *Diploceras* it does not. The articulation for the axis is much deeper than in *Diploceras* and not nearly as broad, in this respect more nearly suggesting the condition found in some rhinoceroses (*Diceratherium*) than the horned

[3] ANN. CARNEGIE MUSEUM, Vol. IX, 1914, pp. 37–38.

titanotheres. The transverse process is pierced by a large foramen, unlike *Diploceras*, in which this canal is small, or completely absent.

The Axis.—The body of the axis is possibly somewhat longer than in *Diploceras*, the anterior opening of the arterial canal located further back, and the postzygapophysis is smaller and less rounded in outline, while the neural spine and the ventral keel have approximately the same general proportions. The other cervical vertebræ present no characters of sufficient importance to mention in this connection.

The dorsal vertebræ.—The first dorsal has a short depressed centrum and a prominent keel. The spine and transverse processes are broken off. The other dorsal vertebra belongs well back in the series and has a higher and more evenly rounded centrum, without ventral keel, but with the indication of a heavy neural spine.



1 2 3

FIG. 5. Cervical vertebræ of *Dolichorhinus longiceps* (?) No. 2865, ¼ nat. size. 1 left side of atlas; 2, anterior view of atlas; 3, left side of axis.

The lumbar vertebræ.—The two last lumbar vertebræ are present; the body of the last being depressed, as is usual in the case of the last lumbar, and has also the neural spine suddenly reduced in the fore-and-aft direction. The transverse process of the same vertebra is quite heavy and projects outwards and forwards. Near the base of the process on the posterior face there is a heavy and rounded process, which possibly came in close contact with a similar process on the anterior face of the pleurapophysis of the first sacral vertebra.

When the vertebræ described above are compared with the vertebral column of *Dolichorhinus*, illustrated by Professor Osborn,[4] it appears that the neural spine of the atlas of the specimen in New York is more prominent, while the position of the transverse process and the

[4] *Bull. Amer. Mus. Nat. Hist.*, Vol. XXIV, 1908, p. 612.

anterior exit of the vertebrarterial canal of the axis appear to be the same in the two specimens. The cervical series as a whole appear to be slightly shorter in the specimen preserved in New York. No other comparison is possible, as there is no description of these parts in Professor Osborn's paper.

MEASUREMENTS.

Atlas, greatest antero-posterior diameter	105	mm.
Atlas, greatest transverse diameter, approximately	180	"
Atlas, greatest vertical diameter	88	"
Axis, antero-posterior diameter of centrum, odontoid process included	95	"
Axis, height, including neural spine	125	"
Cervical region, total length, approximately	395	"

THE FORE LIMB.

The fore limb of the specimen under description is especially well preserved.

The Scapula.—The scapula is very little, if any, shorter than in *Diploceras*, as figured by Peterson (*l. c.*, p. 42),[5] but its general outlines differ from those shown in the latter genus. The lower portion of the coracoid border is more deeply notched than in *Diploceras.* The coracoid border above the notch is more curved forward, as is also the glenoid border. The general outlines of the scapula are on the whole more suggestive of the Rhinocerotidæ than the Titanotheres.

The Humerus.—The humerus is short and heavy. The bone is comparatively shorter than in *Diploceras.* Unfortunately, the greater tuberosity is broken on the postero-lateral face, but near the deltoid groove the superior face is complete and indicates very plainly that the tuberosity is not as high as in *Diploceras.* The lesser tuberosity accords more nearly with that shown in the latter genus. The deltoid groove is also of about the same size in the two genera here compared. The deltoid ridge is less prominent in *Dolichorhinus*, while the distal end of the bone is quite nearly alike in the two genera.

The Radius and Ulna.—The radius and ulna are much shorter than in *Diploceras* and proportionally also much heavier. There is a tendency to coössification of the two bones in the present specimen, the shaft is rounder, and the articulation for the humerus is less deeply excavated than in *Diploceras.* In comparing the ulna of the

[5] The length of the scapula of *Diploceras* is conjectural, as the upper and lower portions do not pertain to the same bone.

two genera in more detail, it is seen that there is a less developed tubercle on the outer margin of the tendinal groove of the olecranon process in *Dolichorhinus* than in *Diploceras*. In consequence the groove is not as well defined in the genus under description, though the termination of the olecranon process is fully as well developed. In *Dolichorhinus* there is a greater constriction of the olecranon between the upper border of the great sigmoid notch and the termination of the process than is seen in *Diploceras*. Otherwise the ulna is quite similar in the two genera.

The Manus.—The manus of the specimen under description is complete with the exception of the ungual phalanges and the proximal phalanges of digits III and IV, which were not recovered. The foot as a whole is short and broad, and, when compared with the manus of *Diploceras*, it may be said to be heavier. In comparing the carpal elements of the two genera it is at once observed that they are all of greater height in the present genus than in *Diploceras*, which indicates that the latter genus was already well advanced in the direction of the low and broad carpals of the Oligocene Titanotheres. The distal ulnar angle (the articulation for the magnum) of the scaphoid of *Dolichorhinus* is produced more downwards, but is of smaller size than in *Diploceras*. The region of the upper facet for the lunar on the ulnar face is also more overhanging in the ulnar direction than in *Diploceras*, this is especially noticeable if the scaphoid of *Dolichorhinus* and that of the Titanotheres of the Oligocene formation in the Carnegie Museum are compared. The lunar has a rather unusually broad contact with the unciform and a narrow and more nearly vertically placed facet for the magnum. A third feature of the lunar is the limited posterior extent of the facet for the unciform, and the lack of

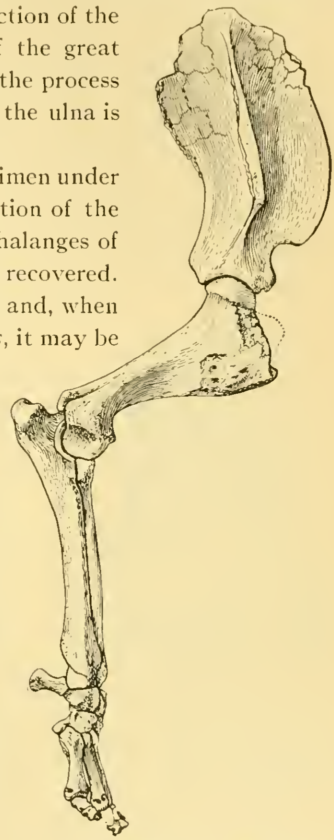


FIG. 6. Right fore limb of *Dolichorhinus longiceps* (?), No. 2865, ⅙ nat. size.

the deep excavation of this facet posteriorly, so characteristic of the Oligocene Titanotheres. Unfortunately these features cannot here be compared with *Diploceras* as the lunar is wanting in the type of that genus, but when compared with the Oligocene Titanotheres one notices especially that the facets of the unciform and magnum are more nearly subequal in width, and the posterior portion of the facet for the unciform is excavated equally as much as the posterior portion of the facet for the magnum. The cuneiform carries a proportionally large facet for the pisiform and the bone is much higher than in *Titanotherium*. The pisiform differs from that of *Diploceras* and the horned titanotheres generally by being relatively heavier. The trapezium is of considerably large size and carries three facets on the ulnar angle; a large median surface for the trapezoid, and two smaller facets separated from the larger by well defined ridges and articulating, one with the scaphoid, and the other with Mc. II. the dorso-palmar angle of the trapezoid bears indication of coming in contact with the lateral face of the posterior elevated facet of the magnum, a condition which is much more clearly revealed in the Oligocene Titanotheres, where there is a decided facet on the posterior superior face.[6] With the exception of the nearly vertical articular facet for the unciform, the broader palmar hook, and the greater height of the magnum, this bone differs in comparatively slight degree from the same bone in *Titanotherium*. The magnum is wanting in the type material of *Diploceras*. The unciform presents its most noticeable difference from the Oligocene Titanotheres in its greater height and in the proximal articulations. Although the facets for the cuneiform and lunar are separated by a prominent ridge, there is not found in *Dolichorhinus* that large hemispherical tubercle, which separates the two facets in the unciform in *Titanotherium*.

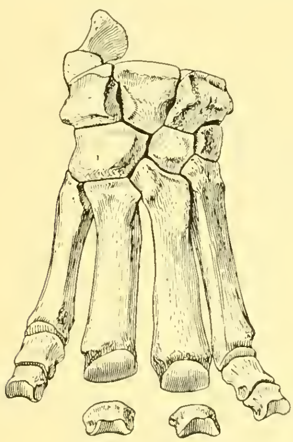


FIG. 7. Front view of manus of *Dolichorhinus longiceps* (?), No. 2865, ⅓ nat. size.

[6] In comparing the trapezoid of the paratype of *Diploceras* I find that it has a larger facet in this region than is present in the type and is perhaps much better developed in that genus than in *Dolichorhinus*.

The metacarpals in proportion to the carpals, are shorter than in *Diploceras*. The metapodial keel of Mc. II is less oblique to the long axis of the bone than that in *Diploceras*, otherwise the differences between these two genera are slight. The head of Mc. III differs from that in *Titanotherium* by having the ulnar portion more squarely truncated, and by the much smaller size of the facet for Mc. II on the radial angle. Mc. IV presents only slight differences from the corresponding bone in *Titanotherium*. In its general details Mc. V is quite similar to the same bone in *Diploceras*, but proportionally shorter.

As in *Diploceras* and the Titanotheres generally, the phalanges are short, broad, and depressed.

In comparing Professor Osborn's restoration of *Dolichorhinus*[7] with the above described fore limb it appears that the foot of the present specimen is shorter, while the radius, ulna, and scapula are longer.

Measurements.

Total length of scapula	337	mm.
Total length of humerus head to distal end	285	"
Total length of ulna	340	"
Total length of radius	295	"
Total length of manus, approximately	200	"
Height of tarsus at unciform and cunciform	59	"
Transverse diameter of carpus at proximal row of carpals	90	"
Greatest length of Mc II	116	"
Greatest length of Mc III	124	"
Greatest length of Mc IV	109	"
Greatest length of Mc V	95	"

Since writing the above paper I received from Dr. William K. Gregory some outline tracings of material representing *Dolichorhinus* in the American Museum of Natural History. These tracings are especially welcome, since they show that there are considerable variations in the length of the limb of the genus *Dolichorhinus*. The humerus,[8] and the radius, and ulna of specimen No. 1961 in the American Museum very nearly agree in general length with those of No. 2865 in the Carnegie Museum, while the fore foot of the former specimen is considerably longer than in the latter. On the other hand the specimen No. 13164 (American Museum) from the (?)

[7] *Bull. Amer. Mus. Nat. Hist.*, Vol. XXIV, 1908, p. 612.

[8] There seems to be a better development of the deltoid ridge of the humerus in No. 1961, in the American Museum than in No. 2865 in the Carnegie Museum.

Washakie (B) indicates that the humerus is relatively longer and the fore foot shorter than in the fore limb of *Dolichorhinus* in the Carnegie Museum, which is described in this paper.

Mesatirhinus, No. 10013, in the Museum at Princeton, has, according to an outline tracing, also sent me by Dr. Gregory, a proportionally longer fore foot than *Dolichorhinus*, and the facet for the magnum on the lunar is more vertical.

CARNEGIE MUSEUM,
June 26, 1914.

XI.—NOTES ON TRIASSIC FISHES BELONGING TO THE FAMILIES CATOPTERIDÆ AND SEMIONOTIDÆ.

By C. R. Eastman.

(Plates XXX–XXXII).

Highly characteristic of the early Mesozoic in this and other countries is the short-lived family of "ganoid" fishes known as the Catopteridæ, a group descended in all probability from primitive Palæoniscid stock, comprising only three genera, so far as known, attaining a wide distribution in nearly all continents, and becoming extinct at the close of Triassic time.

The type-species of the genus *Catopterus*, *C. gracilis*, was described by J. H. Redfield in 1837. A decade later the second known species of *Catopterus* was described by Sir Philip Grey Egerton, and at the same time the new genus *Dictyopyge* was established by him upon the evidence of certain well-preserved fishes obtained between 1840 and 1845 from the Richmond coal-field of Virginia.

More widely distributed than Redfield's genus, which is limited to eastern North America, *Dictyopyge* differs from *Catopterus* only in the more forward position of the dorsal fin, which never arises behind the origin of the anal. *Dictyopyge macrura*, the type, first described by W. C. Redfield, under the name of *Catopterus macrurus*, is restricted to the Trias of Virginia and the Connecticut Valley. A number of other species are known, however, from the Upper Trias of England, Ireland, Germany, Switzerland, and New South Wales, and from the Upper Karoo formation (Stromberg beds) of the Orange Free State in South Africa.

The third known member of the family under consideration is the genus *Perleidus*. The type and only known species, *P. altolepis* (Deecke), occurs in the Alpine Middle Trias of Perledo, Lombardy, where it is accompanied by representatives of the families Cœlacanthidæ and Semionotidæ, not unlike those occurring in the Trias of eastern North America. In general proportions of body, position of median fins, squamation, and arrangement of facial plates, *Perleidus* approximates *Catopterus* more nearly than *Dictyopyge*. A certain resemblance is also to be noted between it and *Pholidophorus*. The characters of the Alpine form were first recognized as constituting a distinct genus by De-Alessandri[1] in 1910.

Turning now to the family Semionotidæ, it is apparent that its members represent a higher grade of structural organization than the primitive sturgeon-like Catopteridæ. A study of their characters shows that the Semionotidæ are fully developed Protospondyli; that is to say, they belong clearly to that large group of "ganoid" fishes which flourished chiefly during the Triassic and Jurassic periods, but declined rapidly, and is represented at the present day only by two freshwater genera, *Lepidosteus* and *Amia*. From what ancient stock the Semionotidæ and other Protospondyli are descended, we do not precisely know, but it may reasonably be inferred that the late Paleozoic forerunners (*Acentrophorus*, etc.) of the higher suborder were derived from a modified type of Chondrostean. Beyond this, when we inquire as to the origin of the Chondrostei themselves, we find but few facts for our enlightenment. Their origin is at least as ancient as that of the fringe-finned "ganoids," but there is as yet no evidence of a genetic connection between the Chondrostei and Crossopterygians. Enough, however, has been ascertained to show that already in the Trias and probably even earlier the divergence between Chondrosteans and Protospondyli was strongly marked.

Notwithstanding the close study which has been given to the remains of the extinct fishes included in the families *Catopteridæ* and *Semionotidæ*, our knowledge of their structural features is still in some important respects deficient. Dr. A. Smith Woodward summarizes the present state of our knowledge as to the first-named family as follows:

"The little that is known of *Catopterus* and *Dictyopyge*, the two genera of *Catopteridæ*, forms the subject of the opening pages of the present volume. Much of this information is unsatisfactory, and needs verification; but it may be asserted, with considerable probability of correctness, that these fishes possess a Palæoniscid head and shoulder-girdle, while the tail is only hemi-heterocercal, and the single series of supports in the dorsal and anal fins almost equals in number the apposed dermal rays. Such being the case, here is an interesting illustration of the common law, that the links between a lower and a

[1] De-Alessandri, G., "Studii sui pesci Triasici della Lombardia," *Mem. Mus. Civico Milano*, 1910, Vol. VII, fasc. 1.

higher group are not to be sought among the specialized types of the former but among those with the most generalized secondary characters."[2]

There are some matters of historical interest relating to early studies of the Catopteridæ and Seminotidæ in this country, which may be introduced at this point, before proceeding to a discussion of newly observed structural details. The pioneer students of the Triassic fish-fauna of America were William C. and John H. Redfield, father and son, who contributed in all ten publications during the interval between 1837 and 1857.

In the first paper published by the junior author, to which reference has already been made, the type species of *Catopterus* is described, and provisional identifications are made of three Semionotid species. The latter were not at that time recognized as belonging to the genus *Semionotus*, nor in fact did either of the Redfields perceive that the half-dozen species of "Palæonisci" with which they were acquainted, and afterwards included in *Ischypterus* Egerton, were actually congeneric with the earlier described *Semionotus* Agassiz.

Next in chronological order after the younger Redfield's paper of 1837 appeared an article by W. C. Redfield, entitled "Short Notices of American Fossil Fishes." This was published in the American Journal of Science for October, 1841, and included brief diagnoses of the known species of "Palæoniscus" (*i. e. Semionotus*) and *Catopterus*. During the following year Sir Charles Lyell visited this country, and in company with Professor Benjamin Silliman, Jr., as he tells us, made at Durham, Connecticut, a fine collection of the remains of fishes from the Trias of the Connecticut Valley. These were examined in 1844 by Sir Philip Grey Egerton, and subsequently by Professor Louis Agassiz, whose notes in regard to them and other remains of American fishes, are quoted by Lyell in a paper published by him in 1847.[3]

It is in this communication by Sir Charles Lyell that the new generic terms *Dictyopyge* and *Ischypterus* were first proposed by Sir Philip Egerton, the former to include the species already described by W. C. Redfield under the designation of *Catopterus macrurus*, and the latter

[2] Woodward, A. S., Catalogue of the Fossil Fishes in the British Museum, Part III, Introduction, p. vii. London, 1895.

[3] Lyell, C., "On the Structure and Probable Age of the Coal-field of the James River, near Richmond, Virginia," *Quar. Journ. Geol. Soc.*, 1847, Vol. III, pp. 275–278.

to include the so-called "Palæonisci" of the American Trias, or those forms which are now commonly referred to the genus *Semionotus*. The identity between *Ischypterus* Egerton and *Semionotus* Agassiz was suspected by Newberry, clearly recognized by A. Smith Woodward, and is now generally admitted.

With the exception of L. Agassiz, Sir Philip Egerton was probably the leading authority of his time on fossil fishes. His notes on the two principal genera of American Triassic fishes, incorporated in Lyell's paper of 1847, are exceedingly brief, and it is to be regretted that he did not continue his study of these forms. Some further light in regard to his views has, however, been preserved in unpublished correspondence between the two eminent scientists, Egerton and Lyell. Copies of two letters written by the former to the latter in 1844 appear to have been sent to Professor Silliman of Yale, who collected part of the material reported upon, and through him to have reached the Redfields, by whom the documents were preserved. At all events the manuscript containing Egerton's views has been stored away for many years in the cabinet containing the Redfield Collection of fossil fishes at the Peabody Museum of Yale University. For the privilege of now bringing to light these early memoranda, and of studying a number of well-preserved specimens in the collection at Yale, the writer is indebted to the kindness of his friend Professor Charles Schuchert, Director of the Peabody Museum. The text of the correspondence is as follows:

"OULTON PARK, TARPORLY, Dec. 18, 1844.

"*Dear Lyell*:

"There are two species of *Chelonichthys*, *Asmussi* and *minor*, both found in the Old Red of Riga (Russia) and of Elgin. I have the latter also from Orkney. It is the largest of the Old Red fishes I am acquainted with. The days are so dark that I cannot do much at your Black Fish. I have, however, taken out and examined the *Catopteri*. This is a very good and well marked genus of Redfield, and deserves a more ample description than he gives it. I find two species, the one *C. gracilis*, the other new, which you may call if you please *C. Redfieldi*. It is nearly as large as *C. gracilis*, but much deeper. The bones of the head are ornamented with closely packed flattened tubercles, which also extend over the nuchal scales and the scales immediately posterior to the thoracic cincture.

"The scales of the flanks are distinctly serrated on their posterior margins, which serration is traceable nearly to the tail. The scales of the pedicle of the caudal fin are less elongated than in *C. gracilis*, and rarely extend so far on the upper lobe. In general aspect this fish is less elegant than *C. gracilis*, although the more prominent ornamentation of scales renders it an attractive species.

"I have not seen the publications you allude to, nor can I give any idea as to the age of the beds in which the fish occur. But I think there is every reason to warrant the creation of a new genus to receive the Palæonisci (so-called). The form of the fins is very remarkable, as observed by Agassiz in his description of *P. fultus;* but I have discovered a more important feature in the character of the teeth, which are not *en brosse* as in the Palæonisci, but more nearly resemble the teeth of *Tetragonolepis*. If on further examination these characters should prove constant, I should propose the name *Ischypterus* for this genus.

"In great haste, yours,
"Philip Grey Egerton."

II.

"Oulton Park, Tarporly, Dec. 28th, 1844.

"*My dear Lyell*:

"I find I can do nothing with your American Palæonisci in consequence of my ignorance of what Redfield has already done. I have only got the short paper in the Yale (Silliman's) Journal, from which it is absolutely impossible to identify a single species. The specimens sent me by himself are very imperfect, with the exception of the *P. fultus* of Agassiz, and *Catopterus gracilis* Redfield. I think you have at least five or six distinct species (besides the *Catopteri*), and they all agree in the generic characters of the fins, scales, and teeth. The latter are not *en brosse* as in the true *Palæonisci*, but are strong and conical, and the oral aperture is considerably smaller.

"I know little about *P. catopterus* of Roan Hill,[4] as my specimen is very indistinct, and Agassiz has not described the species in the *P. Fossiles*. The specific name is no doubt in consequence of the back-

[4] "*Palaeoniscus catopterus*" of Roan Hill, Tyrone, Ireland, was afterwards figured by Sir Philip Egerton (1858), and still later was shown by Dr. R. H. Traquair to belong to the genus *Dictyopyge*. The so-called *Chelonichthys asmussi* is now referred to the Arthrodiran genus *Homosteus*, and the Scottish *C. minor* is identical with *Asterolepis minor*.

ward position of the dorsal fin, but I do not think it could be classed with Redfield's genus *Catopterus*. The smooth character of the scales in your American specimens is the most distinctive mark I see as compared with the Palæonisci of the Kupfer Schiefer, Zechstein, and Magnesian Limestone, all the species found in these two formations having the scales more or less striated and serrated on the posterior margins. This character would, however, approximate them to the Coal Measure species, where the scales are all smooth, except in those from the Burdi House. The tails are certainly less prolonged in the upper lobe than any of the *Palæonisci* I am acquainted with.

"Believe me, Sir,

"Yours truly,

"PHILIP GREY EGERTON."

OBSERVATIONS ON THE GENUS CATOPTERUS.

Besides the type-species, *C. gracilis* Redfield, writers have hitherto without exception recognized at least one other valid member of the genus, namely, *C. redfieldi* Egerton. The original description states merely that this is a deeper-bodied fish than the type, and "with scales not so long in proportion to their depth" (Egerton, *loc. cit.*, p. 278). It has been observed by subsequent authors, however, that in form and proportions of body the two species are very similar, and in fact intergrade to such an extent that these characters alone are an insufficient criterion for separating them. One may speak of a deeper-bodied variety, and a less deep-bodied, or slenderer variety, but the distinction is not a trenchant nor a natural one, since it depends almost altogether upon varying degrees of mechanical compression and deformation. The fact was clearly recognized by Newberry[5] in the case of one of Redfield's cotypes of *C. gracilis*, which, although the body has slender proportions, was nevertheless conceived by this author to have been a vertically compressed example of the broad form, and for this the name *C. redfieldi* was suggested by Sir Phillip Egerton.

Two examples belonging to the Carnegie Museum and illustrated in plates XXX and XXXI, are instructive as showing that appearances may be very deceptive as to the natural contour of the body. For these specimens have been so folded over and then flattened as to display a larger number of scale-rows than belongs to a single side of the trunk, and the true dorsal contour is to be found several scale-rows

[5] Monogr. U. S. Geol. Surv., Vol. XIV, p. 56.

lower down than where we might suppose it to be along what appears to be the back; that is, the median dorsal line of the fish does not coincide with the uppermost margin of the fossil, as is proved by the row of dorsal ridge-scales which may be traced continuously in these specimens, but might readily be obliterated in others. These examples illustrate what may happen in *Semionotus* and other forms, where the true dorsal and ventral contours are often difficult of recognition.

Other characters which have been relied upon for distinguishing the deep-bodied and slender-bodied species, or varieties as we prefer to regard them, are the position of the median vertical fins and certain details of the squamation. It has been claimed, for instance, that in *C. gracilis* the "dorsal and anal fins are subequal in size and almost completely opposed"; whereas in *C. redfieldi* the dorsal fin is said to arise "opposite to the middle of the anal." This distinction, however, will not hold. Intergradations occur, and as a matter of fact, the alleged distinction applied in the reverse sense to one of the original cotypes of *C. gracilis*, in which dorsal and anal are not "almost completely opposed," but the former arises opposite the middle of the latter.

As for supposed differences in scale-characters, it has been asserted in the definition of the type-species that "the scales are smooth, none deeper than broad, those of the flank in the abdominal region very finely serrated." In the variety which has been called *C. redfieldi* the amended diagnosis reads: "Scales mostly smooth, but sometimes in part longitudinally striated, the striæ terminating in the coarse serrations of the posterior border which characterize the principal flank-scales; many of the flank-scales deeper than broad."

Examination also shows that in respect to such characters no rigid distinction can be made between the type-species, *C. gracilis*, and the deep-bodied variety, which has been commonly recognized as belonging to a separate species. The condition of smoothness in scale characters is a variable one, and appears to be due largely to differences in age, amount of wear, state of preservation, and in some cases to the operation of chemical agencies which have eroded the external surface or covered it with a thin glaze. Differences in age and wear will also account for degrees in coarseness or fineness of the striations along the posterior margin of the flank-scales. To sum up, therefore, a valid specific distinction between *C. gracilis* and *C. redfieldi* can scarcely be maintained, but on grounds of convenience it may be well to retain the latter name for the purpose of indicating a certain amount of variation from the typical *C. gracilis* in the direction of greater depth of body and coarser striation of flank-scales.

Concerning the extremely difficult subject of cranial osteology, very little can be added to the few facts already known. The bones forming the cranial roof are as a rule firmly coalesced and their sutures concealed by the tubercular ornamentation. Apparently the superior border of the orbits is formed by the large-sized frontals, which are bounded behind by the parietals (the latter separated in the median line by a small-sized supra-occipital) and squamosal. The inferior border of the orbit is formed by the expanded posterior portion of the maxilla, which is of relatively large size and decidedly paleoniscid-like in form. This plate bears numerous fine, acutely conical teeth, and there is also present a small dentigerous premaxilla, which is often found detached from the other mouth-parts.

Just how the facial plates are arranged in the space lying between the orbit and shoulder-region (clavicle) is difficult to determine. Newberry's interpretation of the elements covering this area in a single specimen studied by him is open to serious question. At least one postorbital is present in its normal position behind the eye, and there may possibly be another (or suborbital) below it. Behind these plates is the area commonly occupied by the operculum and suboperculum, but the pre-operculum was probably much reduced and nearly concealed by adjacent elements. The general configuration of this region is shown in one of the original co-types of this species now preserved in the Yale Museum, and also in a specimen belonging to the United States National Museum, which has been examined by the writer.

ON THE CRANIAL STRUCTURE OF SEMIONOTUS.

The cranial osteology of this genus has been studied chiefly by L. Agassiz, E. Schellwien, and Dr. C. F. Eaton. In general, the arrangement of plates is not unlike that in *Lepidotus*, except that the circumorbitals are relatively very small, and the suborbitals are not divided up into a number of polygonal plates. One of the best preserved specimens of American Triassic fishes showing the head-region is that shown in Pl. XXXII, Fig. 1, which probably belongs to the species *S. micropterus* Newburg. It is from Durham, Connecticut, and bears the Carnegie Museum Catalog No. 5285. It is of interest as displaying the facial and opercular plates to better advantage than in most specimens.

On an Australian Genus of Semionotidæ (Pristisomus).

Much interest attaches to the Triassic fish-fauna of the Australian region, on account of the peculiar structural features exhibited by certain genera, the fact of its being to a large extent a "relict fauna," and also on account of the knowledge it affords of the distribution of well-known North American and European genera. All told not over a dozen genera are known from the locality at Gosford, and their state of preservation is not always of the best. It has seemed desirable to illustrate one nearly complete example which has been placed in the writer's hands for study by Mr. M. E. Crane of Pittsburgh, with the understanding that it will eventually become the property of the Carnegie Museum.

Genus Pristisomus A. S. Woodward.

This genus was established by Dr. A. S. Woodward in 1890 upon the evidence of a number of fairly well preserved skeletons, which exhibited characters intermediate between *Semionotus* and the geologically later and more highly specialized genus *Dapedius*. For example, as pointed out in the original description of *Pristisomus*, "the long, styliform teeth, and certain obscurely recognizable features in the head, are most suggestive of *Dapedius;* and the depth of the trunk nearly approaches that of some of the species of the last-named genus. The dorsal ridge-scales, however, and the proportions of the median fins, more nearly resemble corresponding features in *Semionotus*, though this well-known genus is distinguished by its dentition, the absence of ventral ridge-scales, the slight vertical elongation of the flank-scales, and the greater development and more forward position of the dorsal fin."

The typical species of *Pristisomus* is *gracilis* Woodward, from the Lower Hawkesbury-Wiametta series (Upper Trias) of Gosford, New South Wales. It is accompanied in the same formation by two other species, *P. latus* Woodward and *P. crassus* Woodward, these three being all that have thus far been described, and comparatively few individuals are known of each of them.

The general characters of *Pristisomus* are given by the original author as follows:

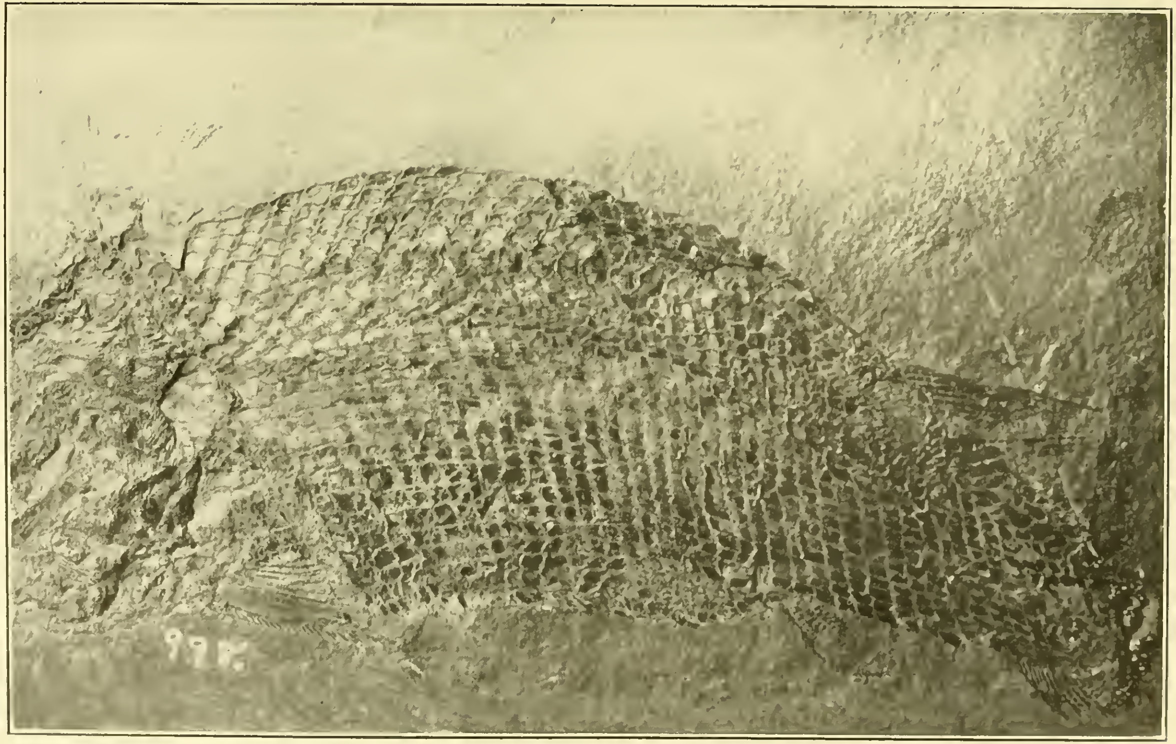
"Body comparatively deep, but fusiform, three or more series of the flank-scales vertically elongated; a dorsal and ventral series of prominent ridge-scales. Teeth large, styliform, in close series. Paired fins moderately developed; dorsal and anal fins remote, the former partly opposed to the latter; caudal fin robust, scarcely forked. Small fulcra present on all the fins."

Pristisomus latus Woodward. (Plate XXXII, fig. 2).

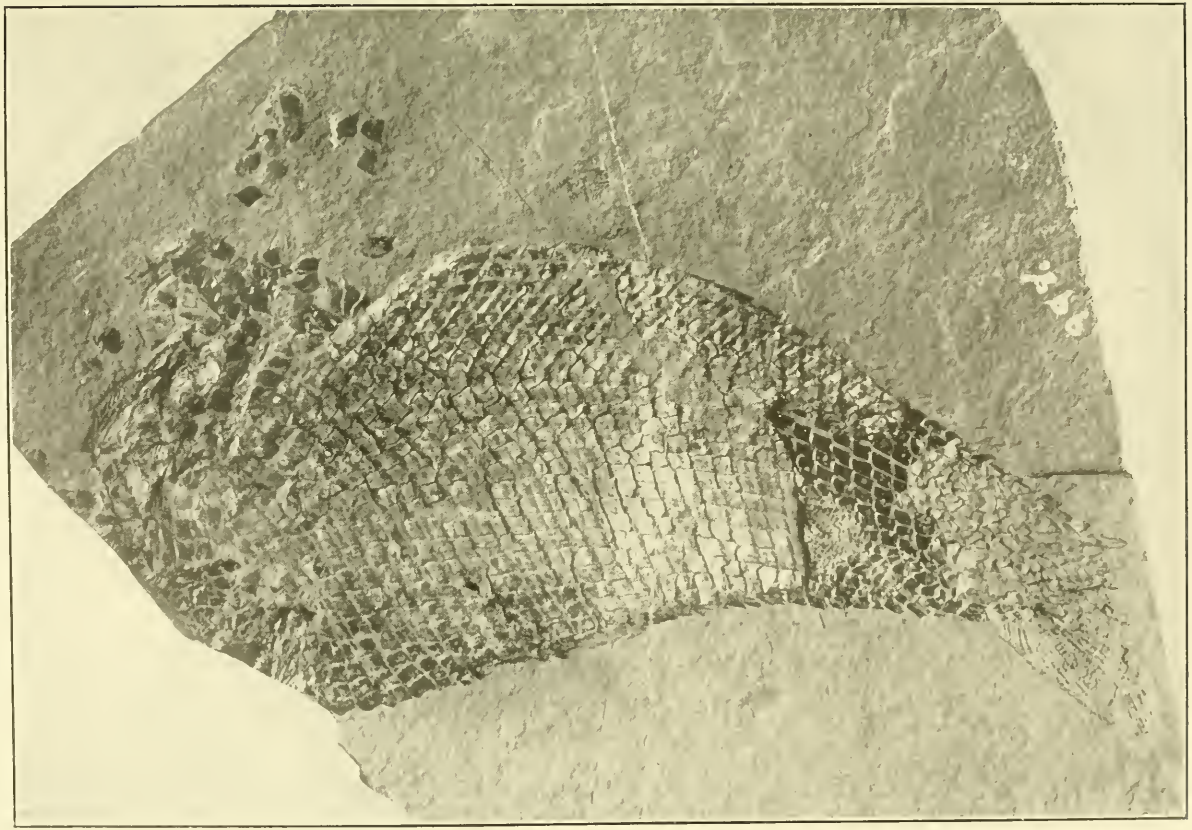
1890. *Pristisomus latus* A. S. Woodward, Mem. Geol. Surv. New South Wales Paleont. No. 4, p. 35, pl. V, figs. 2, 4.

The specimen, of which an illustration is given, is referred to this species, being distinguished from the type by its greater depth of trunk, the small size of the head, and relatively greater length of the dorsal fin. The latter is also somewhat longer than the anal, whereas in the type-species these two are described as being almost of equal size, with a short base-line, and much elevated. In the specimen before us the dorsal is seen to be composed of fifteen articular rays, and the anal of thirteen, the outermost in each being preceded by a number of short fulcra.

The head is short, triangular, and has the orbit placed far forwards. A pre-operculum, if at all present, must have been exceedingly narrow, and the operculum and suboperculum together form a long curved band, gradually widening inferiorly, and the boundaries between the two elements not directly visible. In this specimen, as in most of those described by Dr. Woodward, the actual substance of the bones and ganoid scales has been removed by chemical solution, little remaining except mineral-stained impressions.



Calopterus gracilis Redfield. From Trias of Durham, Conn. C. M. Cat. Foss. Fishes, No. 5297. $\times \frac{1}{1}$.



Calopterus gracilis Redfield. From Trias of Durham, Conn. C. M. Cat. Foss. Fishes, No. 5298. $\times \frac{1}{1}$.

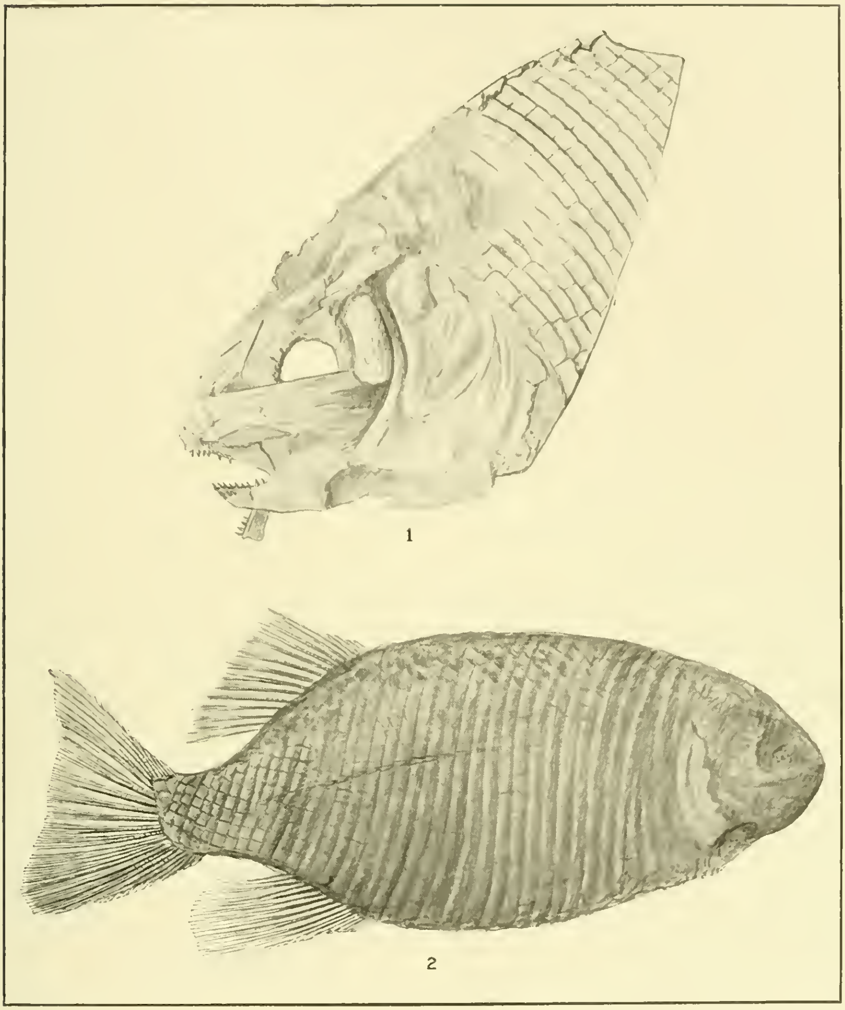


Fig. 1. Head of *Semionotus micropterus* Newberry (?). C. M. Cat. Foss. Fishes, No. 5285. $\times \frac{1}{1}$.

Fig. 2. *Pristisomus latus* A. S. Woodward. $\times \frac{1}{1}$. (Specimen deposited in Carnegie Museum.)

XII. THE OSTEOLOGY OF PROMERYCOCHŒRUS.

By O. A. Peterson.

(Plates XXXIII–XLII).

The fine material representing the genus *Promerycochœrus* Douglass, which was collected by the expeditions of the Carnegie Museum in 1901–1902 in the Miocene deposits of Nebraska and eastern Wyoming, having been prepared for study, the writer was encouraged by Dr. W. J. Holland, the Director of the Museum, to undertake its description and the following pages represent the results.

In common with my scientific associates in the Museum I wish to express the gratitude which we feel towards Mr. Andrew Carnegie, whose munificence made possible our journeys of research, and the consequent discoveries. I take the present opportunity to thank Dr. Holland not only for the unrestricted use he allowed me to make of the very remarkable skeletal remains with which this paper deals, but also for his revision of the manuscript and his kind suggestions and criticisms. I wish especially to recognize the assistance he gave Mr. Theodore A. Mills in preparing the models, figures of which are herewith published on Plates XXXVI and XXXVII. Thanks are due to the authorities of the American Museum of Natural History in New York for permission to publish herewith the illustrations of *Promerycochœrus chelydra* Cope. I also desire to express my appreciation of the skill and patience shown by Mr. Sidney Prentice in making the drawings for this paper, and of Mr. A. S. Coggeshall in making the photographs.

Genus Promerycochœrus Douglass.

Earl Douglass, *American Journal of Science*, Vol. XI, 1901, p. 82.—W. D. Matthew, *Memoirs American Museum of Natural History*, Vol. I, 1901, p. 398.—O. A. Peterson, *Annals Carnegie Museum*, Vol. IV, 1907, pp. 26, 36.—Earl Douglass, *Annals Carnegie Museum*, Vol. IV, 1907, pp. 84–109.

The genus *Promerycochœrus* was first proposed by Earl Douglass (*P. superbus* being designated as the type *l. c.*, p. 82). Later Dr. W. D. Matthew accepted the genus as valid and lengthened Douglass' generic definition by important additions (*l.c.*, p. 398). Still later Douglass and Peterson again published papers, the one by Douglass bearing especially on the history of this genus and also describing three additional species *P. hatcheri*, *P. grandis*, and *P. hollandi*. Previous to these later publications a number of important papers had appeared[1] describing in considerable minuteness the cranial features of the different species, but no detailed osteological description of the skeleton as a whole has hitherto been published, except that by Professor W. B. Scott,[2] which was to some extent based upon disassociated material. Aside from the characters of the skull the means for instituting a comparison of the osteological features of the various species are limited. As the skull is, however, a comparatively trustworthy index, it seems that with our present knowledge it is possible to divide the genus into two series, the one composed of dolichocephalic, the other of brachycephalic forms. The dolichocephalic series includes *P. superbus*, *P. leidyi*, *P. macrostegus*, *P. montanus*, *P. minor*, *P. hatcheri*, and *P. grandis;* while the brachycephalic series comprises *P. chelydra*, *P. carrikeri*, *P. vantasselensis*, *P. temporalis*, and *P. hollandi* (the two latter being rather subbrachycephalic).

The completeness of the material in the Carnegie Museum, representing not only *P. carrikeri*, but various other species, affords opportunity not only for accurate comparisons, but also for the study of the various specializations, which apparently were constantly taking place in this family during the latter part of the Oligocene and throughout the Miocene.

In *P. carrikeri* it is clear that the shortening of the limbs went hand in hand with the shortening of the skull, and it is presumable that *P. chelydra* from the John Day showed the same tendency to a marked degree. On the other hand in *P. grandis*, in which the skull and the bony frame-work in general are lighter, the limbs are longer and slenderer.

The skeletons of *P. carrikeri* in the positions in which they were originally found furnish a clue to the habits of the animals as well as to the manner in which in this instance they were finally imbedded.

[1] Leidy, J., *Proc. Acad. Nat. Sci. Phila.*, 1870, p. 111 (*Oreodon superbus*). U. S. Geol. Surv., Vol. I, 1873, pp. 211–215; Pl. I, Fig. 1; Pl. II, Fig. 16; Pl. VII, Figs. 7, 8, 9, 10, 11, (*Oreodon superbus*). Bettany, G. T., *Quart. Jour. Geol. Soc.*, Vol. XXXII, 1876, pp. 259–273, (*Merycochœrus leidyi*). Cope, E. D., *Proc. Amer. Philos. Soc.*, Vol. XXI, 1884, pp. 503–572.

[2] "Mammalia of the Deep River Beds," *Trans. Amer. Philos. Soc.*, Vol. XVII, 1893, pp. 151–162.

Specimen No. 1079, the middle skeleton (*cf.* Plate XXXIII), has the natural position of an animal lying at rest, while the adjoining skeleton, No. 1080, has the feet under the body as pigs are often seen to compose themselves when lying down. The hind limbs of the third skeleton, No. 1078, were unfortunately removed from their original position at the time they were taken up, and perhaps do not exactly hold the same position which they had in the rock. This seems the more probable inasmuch as the head, neck, vertebral column, ribs, and forelimbs are in the position of an animal at rest. From the study of this group it cannot be doubted that these creatures were gregarious. The models executed by Mr. Theodore A. Mills (Plate XXXVII) which closely follow the position of the skeletons show the group at rest in a tranquil manner. They were not mired in a spring or swamp; nor did they perish by drowning in a lake or river, but had evidently sought shelter from a severe storm, which they did not survive. "Eine Miozäne Tragödie" is the very fitting caption to an interesting article in "Aus der Natur," Jahrgang V, 1909, Heft 1, pp. 21–24, by Dr. A. E. Ortmann, who strongly favors the idea that the animals were overtaken by a sandstorm, which is not altogether unlikely. He says (p. 23).

"Die Erhaltung der drei Skelette (vgl. die Abb.; es wurden übrigens in geringer Entfernung von diesen drei Exemplaren noch mehrere andere gefunden,[3] die offenbar zu derselben "Herde" gehörten) zeigt nun klar, das die Tiere nicht nach ihrem Tode vom Wasser transportiert worden sein können. Ihre Anwesenheit in den Schichten ist also keiner Einschwemmung zuzuschreiben, sondern sie starben an Ort und Stelle. Dies geht hervor aus der natürlichen Stellung, in der sich die Skelette befinden. Kurz vor ihrem Tode drängten sich diese drei Tiere offenbar dicht an einander und legten sich nieder, was klar aus den in natürlicher Weise liegenden Extramitäten, wie auch aus der Stellung des ganzen Körpers zu ersehen ist. Dieses Sichaneinanderdrängen ist ein sehr bezeichnendes Moment. Von vielen herdenweise lebenden Huftieren ist bekannt, dass ihr Schutz gegen Feinde in ihrem engen Zusammenschliessen liegt, und dass sie sich auch bei sonstigen Gefahren aneinanderdrängen, um gemeinsam diese abzuwehren. Solche Gefahren treten in wüsten- oder steppenähnlichen Gegenden in der Form von Stürmen auf, die Staub- und Sand-

[3] One skeleton was found about nine feet from this group, which undoubtedly perished simultaneously with them. O. A. PETERSON.

massen mit sich führen. Wir wissen von Wüsten- und Steppentieren, dass sie solchen Naturereignissen gegenüber sich so verhalten, als wären sie sich der ihnen drohenden Gefahr bewusst, und dass sie ihr gegenüber das ihnen angeborene, passive Verteidigungsmittel des Sichzusammendrängens in Anwendung bringen. Dies haben offenbar auch unsere drei Exemplare von *Promerycochœrus* getan."

These skeletons were evidently buried quite rapidly, but not so rapidly as to remain completely articulated, as the caudal vertebræ are mostly gone, perhaps carried off by carnivora. If the skeletons had been completely covered up by the supposed storm in which they perished, the abdominal cavity would soon have given way to the impact of the sand, leaving the backbones more nearly in position, and the caudals would most likely also have been present. It is seen that the posterior portions of the dorsal regions are dislocated and have dropped to a lower level than the remainder of the vertebral column. This would indicate, that after the storm in which the animals perished, the backbones were exposed long enough for the muscles and ligaments to rot off, and thus the vertebræ with less completely interlocked zygapophyses or other supports dropped down out of their original positions before the ground had been raised high enough to support them in place. The position of the group together with the condition of the sediment, an imperfectly stratified mass, adds strength to the theory of the fluviatile and æolian origin of the deposits in this locality, advocated by Matthew, Hatcher, and others.[4] The habitat of these animals was undoubtedly a sandy region, permeated by rivers, lakes, lagoons, and marshes.

NARRATIVE OF THE DISCOVERY OF THE GROUP OF SKELETONS REPRESENTING PROMERYCOCHŒRUS CARRIKERI.

It is seldom in the history of mammalian paleontology that a species has been established on more complete material than the one discussed in the following pages While collecting fossils for the Carnegie Museum in 1901 on Badland Creek, Sioux County, Nebraska, the writer became acquainted with two young men, Messrs. M. A. Carriker, Jr., and M. Carry, then students in the Nebraska State University, who were collecting recent birds and mammals in the same neighborhood. Mr. Carriker, who was interested in some

[4] See the recent paper in the *Bull. Geol. Soc. America*, Vol. XXII, 1911, p. 687–714, by C. R. Keyes.

rodents which he thought might be new, expressed the desire to set some traps around our tent, after I had told him of our troubles with the small pests. The next day the traps were brought to our camp and set. A number of mice were caught, skinned, and stuffed by the writer in the usual manner, and it was a pleasure for me, a few days later, to notice how my efforts were appreciated by Mr. Carriker, who accepted the specimens with many thanks and seemingly was much elated at being the possessor of the results of my labor in spare moments.

Two or three weeks later we were again visited by the boys. On this occasion Mr. Carriker brought with him an astragalus of a large merycoidodont, which he had found in the talus at the base of a high cliff not far from their camp. Carriker gave me the bone and said if I would come up to their camp while they were there he would show me where he had found the specimen. Attaching comparatively little importance to "the find" which he reported, but not to offend the young men, I promised to visit them sometime in the near future. Accordingly I rode over to visit them one evening while our camp was being packed up for removal on the following day to a point twenty-four miles distant. In the vicinity of their camp early the next morning Messrs. Carriker. Carry, and the writer were tramping in the pine hills and after a while reached the spot where Carriker had found the astragalus.

When the preliminary work of picking up all the pieces found in the talus was completed, attention was paid to some bones sticking in the cliff above. From the fragments gathered I thought that a lower jaw and a hind limb had been weathered out and proceeded to dig out what there was left in order to take it with me to camp. The broken ends of the tibia and femur were first noticed and, together with the patella, were first dug out. In the process of this work the corresponding hind limb of the opposite side, the pelvis, and the lumbar vertebræ were successively laid bare. The prospecting now became quite interesting, in fact exciting, and there was some fear expressed that I would not be able to take with me on horseback the specimens already in sight. The work of the following hours made it very clear that the specimen was too big to be carried away in my saddle-bag as indications of the presence of a second individual in the group had already been found. It was accordingly decided to postpone the work, especially since the day was very warm, well along into the afternoon, the small prospecting pick used had been worn to a blunt point, and the stomach of the writer began to hint at the fact that lunch time had long passed. I decided therefore to return to camp in order to make arrangements for the following day. Early the next morning we were on the way back to the specimen with team, wagon, lumber, and all the necessary paraphernalia including feed for the horses, and a lunch for ourselves. We were determined to promptly finish digging out and packing the specimen that day. In spite of this purpose we were agreeably disappointed and surprised at bringing into view the skull and other parts of a third skeleton in the group (see Pl. XXXIII, No. 1080). The cut in the sandstone cliff was by this time of some size, and an additional cut in order to surround the third skeleton and take out the entire group in good order would occupy no less than three weeks. Accordingly we abandoned the work for the day, went back, and made arrangements to move our camp nearer to the work. After the new camp had been properly established, we systematically approached our task, and in due time the entire group was taken out in numbered sections and properly packed in boxes for shipment to the Museum.

In the winter of 1903–1904, while preparing this beautifully preserved and most important group for study and exhibition, the writer discovered that in the fragments picked up in the talus there was evidence of the existence of a fourth individual. As only fragments of the head and anterior portion of the skeleton were represented, the surmise was natural that either the posterior portion of the skeleton was possibly to be found somewhere in the cliff in close proximity to the spot where the group had been found, or, that the greater portion of the skeleton had already been entirely disintegrated.

On the first opportunity which presented itself while in the field during the season of 1904, I determined to endeavor to secure the fourth individual, and accordingly on May 30 (Decoration Day), I again visited the grave which had been robbed of its prehistoric remains. I again went down the canyon in search of more fragments, but finding nothing of any importance, resolved to search the upper portion of the cliff. Finding no fragments at the top, I seated myself, looking down on the excavation from which the three skeletons had been taken two years previously. The side of the cliff, though quite steep, is in places not too steep for the lodgment of talus, and in bracing myself to obtain a more secure position, I discovered that I had dislodged from the sandy slope a fragment of the fore limb of the animal I was looking for. I had been sitting directly over the object of my quest. With much excitement the tools were brought into requisition and on penetrating more solid ground I soon discovered that I had found more than the already exposed and dislocated fragments of the forelimb. In the soft surface of the cliff were pieces of ribs, which finally were succeeded by more solid parts, when undisturbed rock was reached. The remainder of the fourth skeleton was now being exposed. A letter was forwarded to Mr. J. B. Hatcher, then curator of the department of paleontology in the Carnegie Museum, requesting the drawing of the specimens already on exhibition in order to sketch in my recent find with reference to position and distance from the main group. The matter was brought to the attention of Dr. W. J. Holland, the director of the museum, and the drawing in due time was received. This sketch which was later redrawn by Mr. Prentice, is reproduced in Plate XXXIV. The fourth skeleton of the series was soon extracted from the matrix, and, as articulated, is used in the following pages as a paratype (No. 1081) enabling a more complete description of some parts, which are more or less inaccessible on account of the undisturbed position of the three specimens first found.

The foregoing account is given for three reasons. *First*, in order to impress the importance of investigating all reports of newly discovered specimens (especially fossil remains) no matter how vague the accounts received may be. The greater number of cases, it is true, in reality are disappointments; but it frequently happens that pleasant surprises await the investigator. *Secondly*, I do not believe that collectors can be too careful in searching for specimens in a place known to have yielded them, and it is a greater fault on the part of the collector to hastily finish up his work in an important locality, than to spend much time upon it, with doing which he may be reproached by his superiors, who look for and expect speedy results. *Thirdly*, although exchanges between collectors of material secured by them in the field is not to be encouraged, and it is far from the wish of the present writer to advocate such a practice, it is nevertheless believed that reasonable coöperation among fellow-workers will seldom fail to bring its reward, as in my case, where my willingness to make up a few mouse-skins led me to the discovery of the finest group of its kind in existence.

1. **Promerycochœrus carrikeri** Peterson.

ANNALS OF THE CARNEGIE MUSEUM, Vol. IV, pp. 26–29; Pls. IX and X (1907).

Type: Skeleton, complete except as to the caudal region. (C. M. Cat. Vert. Foss, No. 1080).

Paratypes: Greater portion of skeleton C. M. Cat. Vert. Foss., No. 1081, Skeletons Nos. 1078 and 1079, illustrated on Plate XXXIII.

Horizon: Lower Miocene (Upper Monroe Creek beds).

Locality: Head of Warbonnet Creek, Sioux County, Nebraska.

GENERIC CHARACTERS: [*As established by Douglass and Matthew*]. *Premolar series not reduced in length* (*Douglass*). *Molars of subequal size, the last a little larger. Skull elongate* [*or short*].[5] *Occiput narrow, produced backwards. Mastoid plates moderate in size. Zygomatic process of squamosal very wide, with a thickened, rounded margin ending bluntly at posterior edge* (Matthew).

SPECIFIC CHARACTERS: *Extreme downward thrust of the zygomatic arch and great elevation of the occiput; transverse diameter of the skull nearly as great as the antero-posterior; sagittal crest and temporal ridges very prominent; tympanic bulla of comparatively large size; body heavy; limbs short. Animals somewhat larger than Sus scrofa.*

DETAILED OSTEOLOGICAL DESCRIPTION OF PROMERYCOCHŒRUS CARRIKERI.

THE CRANIAL REGION.

(PLATE XXXVIII).

Owing to the early fusion of the sutures in the skull of this species a study of each individual segment is not possible.

The skull of *Promerycochœrus carrikeri* is more nearly similar to that of *P. chelydra* Cope, *P. hollandi* Douglass, and *P. vantasselensis* Peterson than any other species of this genus. The skull, as in the species mentioned, has the transverse very nearly as great as the antero-posterior diameter. The occiput is high with its posterior face greatly convex supero-inferiorly and concave laterally. The lambdoidal crests diverge very suddenly from the top of the occiput and again rapidly contract lower down, giving a fan-shaped outline to the upper part of the occipital plate. Superiorly the post-temporal

[5] Amendment justified by additional knowledge derived from recently described species.

ridge also contracts suddenly, so that the lateral sides of the occiput are deeply excavated (see Fig. 1). Below this excavated area the occipital plate again expands broadly, very largely on account of the great development of the post-temporal ridge. At its greatest lateral expansion the latter ridge is divided, the anterior division extending downward and slightly forward above the external auditory meatus, and uniting with the superior border of the zygomatic process, while the posterior division extends downward back of the meatus and

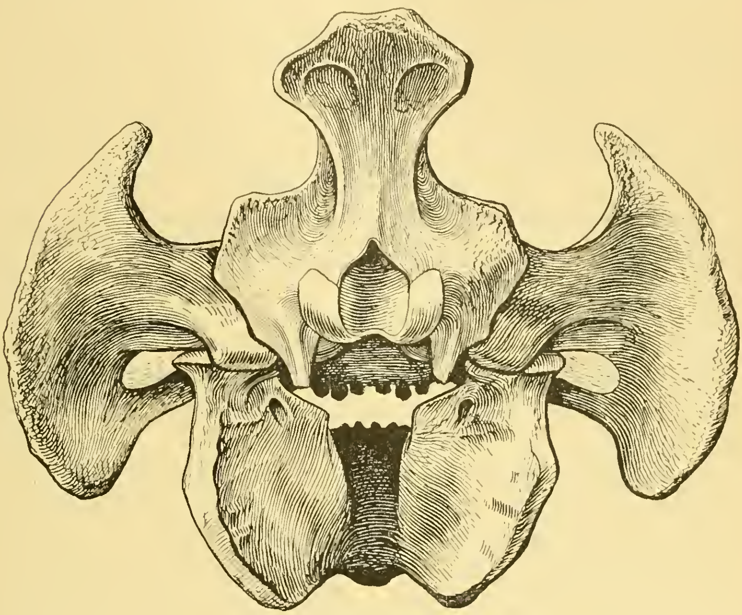


FIG. 1. Posterior view of skull of *Promerycochœrus carrikeri*, $\frac{1}{3}$ nat. size.

finally is united with the lateral border of the paroccipital process. The inferior half of the occipital plate is vertical, while superiorly it overhangs the lower portion; laterally and below the auditory meatus it is separated from the base of the zygomatic process by a deep fissure which is not unlike that in the hippopotamus, though not so completely filled up with bony structure as in the latter. The occipital condyles are of relatively small size; they are well separated from the occipital plate by the long neck of the exoccipitals; inferiorly they are separated by a regularly rounded emargination, and there are no accessory facets on the basi-occipitals for the atlas. The foramen magnum is of fairly large size and its general outline is heart-shaped. The paroccipital process is subject to considerable variations within the species. In the type this process is compressed antero-posteriorly, has broad anterior and posterior surfaces, is well separated from the occipital condyle, and is closely appressed to the postero-external part of the tympanic bulla. Sometimes this process is more trihedral. The basi-occipital is not very broad, and on the inferior surface there is a strong keel in the median line. The condylar foramen is of moderately large size and is located nearer to the tympanic bulla than to the condyle. The basicranial axis is gently curved.

Though the sagittal crest is very prominent, the parietal region as a whole has a rather small area anteio-posteriorly as well as laterally. This is due to the small size of the brain-cavity, which is a characteristic feature. The upper contour of the cranium is somewhat similar to that in *Coloreodon ferox* Cope, while the downward sweep of the zygomatic arch somewhat suggests that of the Entelodonts. The heavy zygomatic arch, with its rugose surfaces, has given rise to considerable speculation with regard to its function. It has been suggested that it supported weapons of defense,[6] but the present writer is more inclined to think that it provided attachments and support for muscles. The temporal and zygomatic fossæ in this species are certainly very capacious, due chiefly to the abnormal transverse spread of the zygomatic arch, and it is very evident that there was also a heavy masseter muscle which had a small antero-posterior extent and consequently required an extra heavy and rugose surface for its aponeurotic attachments. The zygomatic arches of the pigs are generally quite heavy and when careful comparison is made between the species under description and the recent form *Potamochœrus chœropotamus* it is seen that the zygomatic arch in the latter, though different in position and shape, is proportionally as heavy as in the fossil species and is also quite rugose, especially in fully adult specimens. The width of the sagittal crest in *Promerycochœrus carrikeri* is variable in different individuals, which perhaps is a sexual character. This broad transverse area is especially noticeable on the skull of the skeleton No. 1078 of the group mounted and on exhibition in the museum. This skeleton is regarded as that of a male. The glenoid cavity presents a large transverse and antero-posterior surface, which is

[6] Douglass, E., *Bull. Amer. Mus. Nat. Hist.*, Vol. XXIII, p. 118, 1907.

gently and regularly convex fore-and-aft and is bounded posteriorly by the heavy and truncated postglenoid process. The latter is farther separated from the paroccipital process in this species than in *Promerycochœrus chelydra* (Compare Plate XXXVIII, Fig. 2 and Plate XLI, Fig. 2).

No suture is discernible between the squamosal and the temporal bone. The latter takes up only a small area of the basi-cranial surface. The typanic bulla does not extend as low as the postglenoid process, and its antero-posterior diameter is 30 mm., while the transverse diameter is 20 mm.; its shape is thus sub-ovate with a dented and uneven external surface. In *P. chelydra* the bulla is more conical and extends downward even with the post-glenoid process. The paroccipital process extends well below the tympanic bulla and is appressed closely against the latter on its postero-lateral border. The external auditory meatus is moderately large and is directed upward and outward. The region between the bulla and the exit of the ear is well protected by the mastoid portion and the base of the paroccipital process.

The lateral diameter of the area occupied by the basisphenoid is considerable, and the under surface of this bone is without a median keel. The foramen ovale is located close to the anterior edge of the tympanic bulla and is of moderately large size. The foramen rotundum is well back and well hidden from view by the external pterygoid process of the alisphenoid. The external pterygoid fossa is narrow and deep and apparently continues uninterruptedly forward joining the orbital fossa with a very faint separating ridge of bone on the sphenoids. The median pterygoid fossa is wide, the internal surface of the pterygoid process is concave at the base, which adds considerably to the width of the fossa posteriorly. The inferior border of the pterygoid process is rounded and rather heavy, descending at a slight angle to meet the posterior part of the palatine. The posterior narial opening is narrow anteriorly, which is partly due, in the specimen (No. 109), to a slight lateral crushing in the posterior part of the palatine plate. In this specimen the anterior border of this opening is opposite the extreme posterior lobe of m^{3}. This character is apparently variable, as some individuals of the species have the anterior emargination of the posterior narial opening further back than in the specimen under description. I have not been able to locate the optic foramen.

The posterior portion of the frontal region is sharply elevated to conform with the high temporal and sagittal crests. At the junction of the latter, there is a deep triangular pit in the median line of the frontals, in which the muscles of the forehead had attachment. Over the orbit the frontal is quite inflated, which causes the eye to appear to be placed rather low. The postorbital processes of the frontal and malar meet to form a complete bony border for the orbit posteriorly, a common character of the family. The supratemporal foramina are of fairly large size and are located near the median line of the frontals. From the exit of these foramina there are grooves extending forward and downward which vary in depth. These grooves are common to most artiodactyls, but are especially prominent in the *Suidæ*. Anteriorly the frontals gradually narrow and slope downward and forward to meet the nasals. On account of the excessive lateral expansion of the zygomatic process of the jugal and the postorbital process of the frontal the eye has a forward look. The orbit is fairly large and subcircular in outline. There is a small lachrymal tubercle, and shallow notches appear above and below the eminence. The lachrymal foramen is located within the orbit, as usual in the merycoidodonts.

THE FACIAL REGION.

The palate is quite broad transversely and somewhat irregularly concave. The palatine process which meets the pterygoid is heavy and the fossa between the posterior end of the maxillary and the process is very shallow. The maxillary is massive and the lateral aspect presents an almost vertical wall from the alveolar border to the contact with the nasal base as the facial depression for the zygomato-labial, maxillo-nasal, and buccinator muscles are not deep in this individual. The infra-orbital foramen is small and is located at the posterior boundary of the canine depression, or directly over the posterior part of $P^{\underline{4}}$. There is a considerable depression or pit in front of the orbit, but no vacuity. The alveolar border is heavy, its vertical diameter small. The palatine plates are entirely fused on the median line, and the maxillary-palatine suture is also closed; nor is there any discernible suture between the maxillary and premaxillary. The maxillary apparently terminates abruptly at the canine eminence, and is succeeded by the extremely short, though broad, premaxillary. The latter is especially remarkable in this species because of its extremely truncated character. On a direct side view the alveolar border of the premaxillaries extends only very slightly in front of the anterior faces of the canines and presents nearly a straight transverse line from side to side between the canines. The alveolar border is rather weak and does not furnish much support for the incisors; consequently the latter are relatively small and peg-like. Posteriorly the premaxillaries assume an almost vertical position against the anterior portion of the maxillaries. The anterior nares are of moderately large size and their lateral borders are vertical. Inferiorly there are large anterior palatine foramina, separated by the bony rods of the palatine plates of the premaxillaries.

The zygomatic process of the jugal, though not as prominent as the zygomatic process of the squamosal, is fully as characteristic. The outline of the jugal may be regarded as sub-triangular with the most truncated point in front; the shortest and sharpest point (postorbital process) above and the longest point extending outward, backward, and downward to meet the process of the squamosal. The area below and in front of the orbit is quite smooth and is slightly concave, while further back the external face is plane, having a great vertical diameter opposite the postorbital process. The wing-like zygomatic process ends rather abruptly against the anterior portion of the heavy zygomatic process of the squamosal, forming a very prominent and well-defined border for the posterior attachments of the facial muscles. The lower border of the zygomatic process of the jugal is also quite sharp.

The lateral and posterior boundaries of the nasals cannot be determined from the material at hand. This area presents a regularly convex surface from side to side and a long shallow antero-posterior concavity in the middle. Anteriorly the nasals are greatly produced; they terminate in a rounded blunt point and are always inclined forward and downward.

THE MANDIBLE.

The ramus in this species is characterized by a heavy horizontal portion with a thick and rounded angle and a rather long ascending portion with a short and stubby coronoid process. Anteriorly the upper portion of the mandibles flares out in order to give support to the very heavy caniniform $P_{\overline{1}}$ and internally there is also a liberal space on the alveolar border for the incisiform canine and the incisors. The two rami form a broad surface across the symphysis and along the alveolar border. The anterior portion of the alveolar border has a sudden peculiar outward curvature, which is due to the outward flaring to accommodate the large $P_{\overline{1}}$ as mentioned above. Anteriorly the two rami form a rather broad square chin which terminates inferiorly in a heavy rounded swelling. The external surface of the horizontal ramus is quite plane between $P_{\overline{2}}$ and the vertical rugosity for the posterior margin of the alveolo- labialis muscles, while internally the surface is convexo-concave supero-inferiorly opposite the molar region. The under border of the horizontal ramus forms a long antero-posterior concavity due to the heavily rounded chin, and to the descending angle at the back of the jaw. The mental foramina are located well down on the jaw; one opposite the anterior part of $P_{\overline{3}}$ and the other opposite $P_{\overline{4}}$.

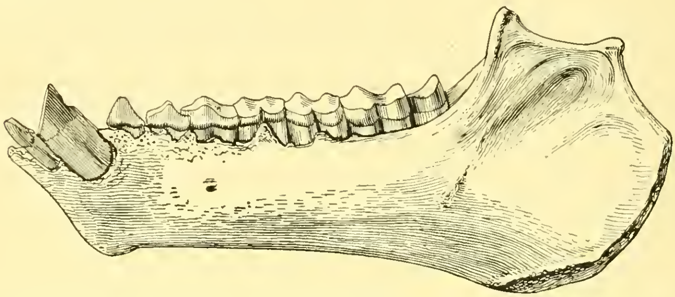


FIG. 2. Side view of left lower jaw of *Promerycochœrus carrikeri* No. 109; $\frac{1}{3}$ natural size.

The depressed appearance of the vertical ramus is due entirely to the unusually small elevation of the ramus above the horizontal line of the teeth. Thus the coronoid process is a mere blunt and short peg, very little higher than the articular condyle, and strongly directed outward. At the base of the antero-internal angle of the coronoid process there is a broad rugose area for muscular attachments, which is succeeded by an equally broad though smoother area on the postero-internal angle of the same process, which terminates at the anterior border of the articular condyle. The latter is quite broad transversely, but has a small antero-posterior diameter, while internally it greatly overhangs the pterygoid fossa. The latter fossa is extremely large, quite concave, and has many rugose ridges across it for the attachment of the internal pterygoid muscle. There is also a prominent ridge and a rugose area for the attachment of the muscles (external pterygoid) on the neck of the articulating condyle. The dental foramen is of medium size and is placed high up, on a horizontal line with the crowns of the teeth. The temporal fossa is rather shallow and occupies a small area immediately below the sigmoid notch. Below the temporal fossa the external face of the angle is gently convex supero-inferiorly; further back it is concave due to the heavy border of the angle, while anteriorly the masseter muscle seems to have been bounded by a prominent ridge, which extends almost vertically downward opposite the last lobe of $M_{\overline{3}}$ (*cf.* Pl. XXXVIII). When the lower jaws are placed in position there is a very wide space between the external face of the angle and the zygomatic arch, which indicates that the masseter muscle was thick above.

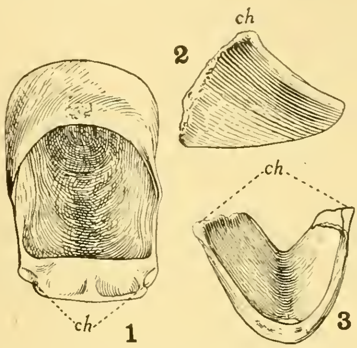


FIG. 3. Posterior view of the ossified thyroid cartilage of the larynx of *Mycetes seniculus*, C. M. Cat. Mammals No. 3579, ½ natural size; 1, posterior view; 2 and 3, side and posterior views, *Promerycochœrus carrikeri*, No. 1079. *Ch.* Articulations for the ceratohyals.

The Thyroid Cartilage of the Larynx. (Fig. 3).—In the description of the hyoid apparatus of *Mesoreodon* Professor Scott describes and figures what he regards as unmistakably the ossified thyroid cartilage of the larynx (*l. c.*, pp. 130–131, Pl. III, Fig. 9). Not far out of position and still between the angles of the lower jaws of the middle skeleton (No. 1079) of the group under discussion is found a similar spout-shaped bone which is undoubtedly the ossified thyroid cartilage of the larynx. As in *Mesoreodon* this bone is very thin on the sides and below. Posteriorly its border is thickened, not to the same extent as in *Mycetes seniculus*, but quite similarly. This bone is, however, not entirely covered over so as to form a drum or capsule, nor has it the relatively enormous size found in the howling monkey, but its shape suggests the same function.

MEASUREMENTS.

	No. 1080 (Type) Mm.	No. 109, Mm.
Skull, length from condyle to and including incisors	315	315
Skull, length from anterior border of orbit to tip of nasals	152	147
Skull, length from anterior border of orbit to condyle	174	178
Skull, length of alveolar border	175	170
Skull, length from alveolar border to condyle	132	137
Skull, greatest transverse diameter	295	285
Skull, transverse diameter of condyle	67	64
Skull, transverse diameter of occiput at mastoid plate	136	122
Skull, greatest transverse diameter of brain cavity	85	77
Skull, transverse diameter of frontals over the orbits	95	90
Skull, antero-posterior diameter of orbit	35	38
Skull, vertical diameter of orbit	35	42
Skull, greatest vertical diameter of zygomatic arch	165	158
Skull, vertical diameter of jugal below middle of orbit	40	35
Mandible, greatest length	255	260
Mandible, length of alveolar border	183	180
Mandible, vertical diameter at condyle	120	107
Mandible, vertical diameter including coronoid process[7]	118	111
Mandible, vertical diameter at M_3[7]	58	58
Mandible, vertical diameter at canine[7]	57	59

THE SUPERIOR DENTITION.

(PLATE XXXVIII).

In comparison with the skull the incisors are small, the median pair the smallest. Their position in the alveolar border is quite vertical, and the upper series especially presents a peg-like appearance with a short diastema between each tooth. The canine is very robust in this genus, and in the present species its external anterior face is convex from side to side and also from the end of the root to the apex of the crown. Antero-internally the face is less convex, and posteriorly the tooth is flat, so that a cross-section presents a sub-triangular shape not unlike that of *Hippopotamus*, though not grooved posteriorly as in the latter. The unworn crown of the canine is typical of the Merycoidodonts generally, but after wear it assumes peculiar shapes, the canines seldom being alike on the opposite sides in the same individual.

P^1 is separated from the canine and P^2 by diastemata; a longer one in front than behind. The tooth is implanted by two roots and the

[7] In the illustration (Pl. XXXVIII, fig. 1) the vertical diameter of the mandible appears less, which is due to the oblique angle of the jaw when in position.

crown is of the same simple construction as in *Merycoidodon culbertsoni*, though relatively smaller and perhaps more hypsodont. P^2 and P^3 are also like those of *M. culbertsoni*, but the apices of the crowns are shifted further forward. There is no apparent change in P^4.

The antero-posterior diameter of the molar series in *P. carrikeri* is somewhat greater in comparison with that of *Merycoidodon culbertsoni*, which is due to the slight reduction of the premolars on the one hand and the elongation of M^3 on the other. M^1 and M^2 do not seem to be greatly different in relative size when compared with *Merycoidodon*, while in *Merycochœrus* and later genera of the family the whole molar series has become elongated and otherwise modified. In *P. carrikeri* the molars are very little, if any, more hypsodont than in *Merycoidodon culbertsoni*.

THE INFERIOR DENTITION.

(PLATE XXXVIII).

The lower incisors, though larger than the upper, are short-crowned and soon become worn down in their sockets to sub-cylindrical pegs. Their position is more procumbent and they are set more closely together than those above. The incisiform canine retains its relative size, while the true incisors are reduced when compared with *Merycoidodon*. This is not only true of *P. carrikeri*, but seems to hold good in many of the later genera of this family. The canine is crowded very closely against the antero-external angle of $P_{\overline{1}}$, so that the two teeth greatly overlap one another. The caniniform $P_{\overline{1}}$ is typical of the family, but in *P. carrikeri* the position of the tooth is unusually procumbent and also large in size. From the peculiar wear on the internal face of the tooth in some individuals (Nos. 109, 1047) it seems quite possible that it was used effectively in stripping branches of their foliage, or perhaps in excavating in soft marshy places. $P_{\overline{2}}$ is isolated by short diastemata and is relatively smaller than in *Merycoidodon culbertsoni*. $P_{\overline{3}}$ and $P_{\overline{4}}$ and $M_{\overline{1}}$ and $M_{\overline{2}}$ differ very little in form from those in *M. culbertsoni*; on the other hand the antero-posterior diameter of $M_{\overline{3}}$ is equal to $M_{\overline{1}}$ and $M_{\overline{2}}$ together, in natural correspondence with the elongated upper molar. Cingula are absent on the lower molars, or very slightly developed.

MEASUREMENTS.

Superior Dentition.

	No. 1080 (Type) Mm.	No. 109, Mm.
Total length	175	175
Length from incisors to M^1	105	101
Length of molar series	75	77
Canine, antero-posterior diameter near base	16	19
Canine, transverse diameter near base	19	22
P^1 antero-posterior diameter	16	14
P^1 transverse diameter		9
P^2 antero-posterior diameter	18	20
P^2 transverse diameter		11
P^3 antero-posterior diameter	18	16
P^3 transverse diameter		13
P^4 antero-posterior diameter	16	15
P^4 transverse diameter		19
M^1 antero-posterior diameter	22	20
M^1 transverse diameter		23
M^2 antero-posterior diameter	24	24
M^2 transverse diameter		24
M^3 antero-posterior diameter	32	33
M^3 transverse diameter		25

Inferior Dentition.

	Mm.	Mm.
Total length	180	173
Length from incisors to M_1	87	80
Length of molar series	85	82
P_1 antero-posterior diameter	17	21
P_1 transverse diameter	13	14
P_2 antero-posterior diameter	17	15
P_2 transverse diameter		8
P_3 antero-posterior diameter	16	16
P_3 transverse diameter		9
P_4 antero-posterior diameter	20	22
P_4 transverse diameter		13
M_1 antero-posterior diameter	20	18
M_1 transverse diameter		16
M_2 antero-posterior diameter	22	22
M_2 transverse diameter		18
M_3 antero-posterior diameter	40	40
M_3 transverse diameter		20

THE VERTEBRAL COLUMN.

Cervicals seven, dorsals fourteen, lumbars six, sacrals seven or eight, and caudals four+?

The vertebral column of the type is complete to the caudals and lies undisturbed upon the matrix in which it was found. The caudal vertebræ are poorly preserved in all the material, only the proximal region and other scattered bones being available. Inasmuch as the type is partially imbedded in its original matrix, No. 1047 will be used in preparing a general description of the parts not accessible in the type.

The Atlas (Fig. 4).—The atlas of *P. carrikeri* presents some well-marked characters, which differ from those of the same bone in *Merycoidodon culbertsoni*. The transverse process is proportionally heavier than in *Merycoidodon*, the anterior part of the ventral surface of the process is more deeply excavated for the obliquus capitis muscle, the cotyles for the occipital condyles are more concave, and more deeply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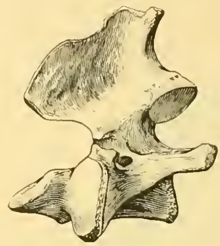
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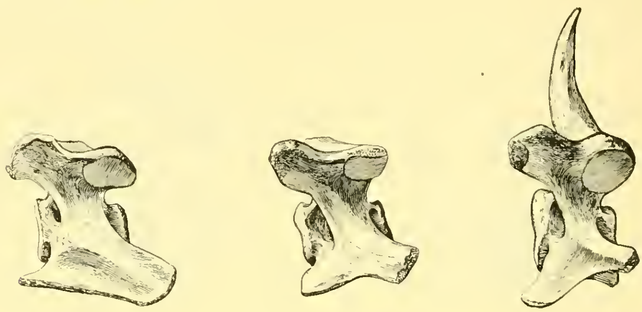
FIG. 4. Lateral view of atlas of *Promerycochœrus carrikeri* No. 1047; $\frac{1}{3}$ nat. size.
FIG. 5. Lateral view of axis of *Promerycochœrus carrikeri* No. 1047; $\frac{1}{3}$ nat. size.

separated below, and the posterior superior exit of the arterial canal has disappeared,[8] while further forward at the base and on the superior face of the transverse process is usually found a small venal foramen (See Fig. 4). On the internal posterior part of the arch, above the articulation for the axis is a large, round opening, which undoubtedly functions as the arterial canal, and is apparently characteristic of this species. The rugose neural spine occupies a considerable area on the top of the arch.

The Axis (Fig. 5).—The axis is unusually shortened antero-posteriorly when compared with that of *Merycoidodon*. The neural spine also overhangs more in front, while the articulation for the atlas

[8] The presence or absence of this canal is a matter of individual variation in the Oligocene genus. In the mounted skeleton of *Merycoidodon culbertsoni* (No. 1391) in the Carnegie Museum this canal is present, as is also true of some specimens which Professor Scott studied (*Morphologisches Jahrbuch*, Vol. XVI, 1890, p. 322), while Dr. Wortman (*Bull. Amer. Mus. Nat. Hist.*, Vol. VII, 1895, p. 149), did not find a true canal in the material at hand, when he wrote his description.

extends further below the odontoid process, and is divided from the pedicle by a deep round notch, which is sometimes bridged over by a bony process, as in the peccary. The inferior keel of the centrum has a straighter axis. The posterior border of the neural spine is slightly excavated, and displays a broad transverse rugose surface, terminating in the overhanging process. The transverse process is directed more outwardly and the entire bone is more robust than in *Merycoidodon*, showing that it supported heavier muscles and a thicker neck. The foramen for the vertebral artery is large and pierces the base of the transverse process parallel with the long axis of the centrum.



6 7 8

FIG. 6. Lateral view of the third cervical vertebra of *Promerycochœrus carrikeri* No. 1047; $\frac{1}{3}$ nat. size.

FIG. 7. Lateral view of the fourth cervical vertebra of *Promerycochœrus carrikeri*, No. 1047; $\frac{1}{3}$ nat. size.

FIG. 8. Lateral view of the fifth cervical vertebra of *Promerycochœrus carrikeri*, No. 1047; $\frac{1}{3}$ nat. size.

The Third Cervical Vertebra (Fig. 6).—The centrum of the third cervical is slightly opisthocœlous, short, and depressed. Below there is a strong median keel with deep excavations on either side. The pedicle is low, the neural canal rather small, and the superior surface of the arch rugose with heavy anterior and posterior zygapophyses. The articulation of the postzygapophysis faces more obliquely outward and upward than in *Merycoidodon*, and the transverse process is proportionally longer and more robust, especially in the postero-lateral direction.

The Fourth Cervical (Fig. 7).—This vertebra corresponds in nearly all respects with the one preceding it and need not here be described in detail.

The Fifth Cervical (Fig. 8).—The fifth cervical has a longer neural spine, more delicate transverse processes, and a larger foramen for the vertebral artery than the two preceding vertebræ. In all other characters it is very similar to these.

The Sixth Cervical (Fig. 9).—The inferior lamella of the transverse process of this vertebra extends somewhat lower down, but apparently has not the relative antero-posterior diameter, which obtains in *Merycoidodon culbertsoni*. The superior branch of the transverse process, however, is more robust and extends outwards and backwards. The median keel on the inferior face of the centrum is less strongly developed than on the anterior vertebræ, the centrum is more depressed, and the arterial canal larger than in any of the other vertebræ in the cervical series. The neural spine is robust and of considerable height.

9

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FIG. 9. Lateral view of the sixth cervical vertebra of *Promerycochœrus carrikeri*. No. 1047; $\frac{1}{3}$ nat. size.

FIG. 10. Lateral view of the seventh cervical vertebra of *Promerycochœrus carrikeri*. No. 1047; $\frac{1}{3}$ nat. size.

The Seventh Cervical (Fig. 10).—This vertebra is characterized by its high and heavy neural spine, its depressed and strong pedicles, and the presence of a small arterial canal, which pierces the transverse process at the base near the inferior border. The centrum is much depressed, and is broad on the under face, especially behind, opposite the facet for the head of the rib. The posterior intervertebral notch is deep, and a deep groove continues downward upon it between the transverse process and the sharp border of the capitular facet for the rib, disappearing on the concave area on the inferior lateral part of the centrum.

FIG. 11. Lateral view of first dorsal vertebra of *Promerycochœrus carrikeri.* No. 1047; $\frac{1}{3}$ nat. size.

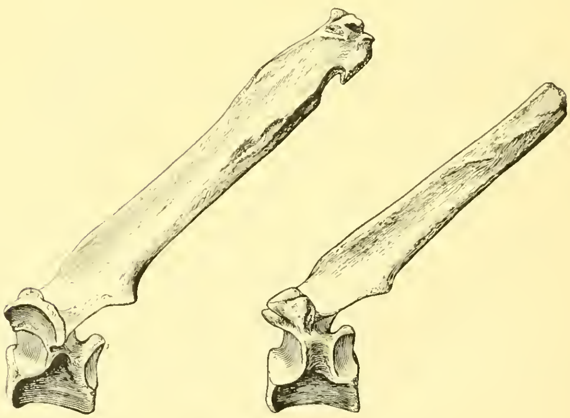

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FIG. 12. Lateral view of second dorsal vertebra of *Promerycochœrus carrikeri.* No. 1047; $\frac{1}{3}$ nat. size.

FIG. 13. Lateral view of the third dorsal vertebra of *Promerycochœrus carrikeri.* No. 1047; $\frac{1}{3}$ nat. size.

The First Dorsal (Fig. 11).—The most conspicuous part of the first dorsal is the enormously large neural spine, the heaviest in the vertebral column. The centrum of this vertebra is depressed and in general similar to that of the seventh cervical. The inferior surface of the centrum is not so broad behind, but the anterior articulation is nearly as hemispherical as in the vertebra preceding it. The capitular and tubercular facets are large and separated only by a sharp bony ridge on the under surface near the base of the heavy transverse process. The posterior intervertebral notch is deep, and is continued as a deep groove back of the capitular facet for the second rib, terminating suddenly on the rugose inferior lateral face of the centrum. The large neural spine has the transverse diameter of the posterior border comparatively greater and more roughened for muscular attachments than in the Oligocene genus.

The Second Dorsal (Fig. 12).—The centrum of the second dorsal is much less depressed than that of the first, and the keel begins to become sharp as is the case further back in the thorax of *Merycoidodon culbertsoni*. In the latter genus the keel of the first, second, third, and fourth dorsals is broader and on the anterior part of the ventral face there are two keels, one on either side of the median line which is faintly indicated. On the inferior lateral surface of the centrum of the second dorsal in *Promerycochœrus carrikeri* there is a round deep pit, from which a deep groove leads in a supero-lateral direction, curving backward at the base of the transverse process behind the capitular facet to the posterior intervertebral notch, as in the preceding vertebra. The capitular facets are larger and deeper, but the transverse process is not so large as in the first dorsal. The second dorsal has the highest neural spine in the vertebral column, but its antero-posterior diameter and width are less than those of the first dorsal vertebra.

The Third Dorsal (Fig. 13).—This vertebra differs chiefly from the one before it in having a smaller and more backwardly inclined neural spine. The transverse process is also smaller. Otherwise there are no differences of importance between these two vertebræ.

The Fourth, Fifth, and Sixth Dorsals (Fig. 14).—These vertebræ are so similar that the description of one suffices for all. The centra gradually increase in length and weight, while they decrease in width. The ventral and lateral surfaces increase in convexity fore-and-aft, and the transverse processes and neural spines decrease in size. The summits of the spines are enlarged into rounded rugose knobs, in which the antero-posterior exceeds the transverse diameter.

In the paratype, No. 1081, the third, fourth, and fifth dorsals are represented only by the neural spines. The latter when found were lying in their relative position, while the centra and neural arches were

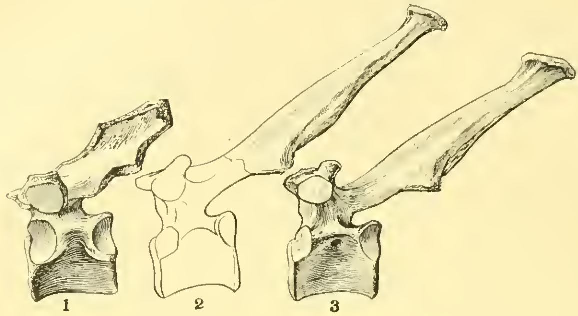
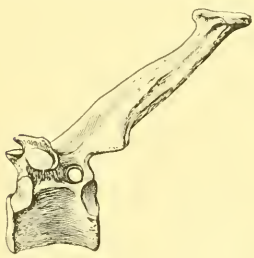


FIG. 14. Lateral views of anterior dorsal vertebræ of *Promerycochœrus carrikeri.* $\frac{1}{3}$ nat. size. 1, fourth dorsal, No. 1047; 2, outline of centrum and neural arch of the fifth dorsal vertebra, No. 1081; 3, sixth dorsal vertebra, No. 1081.

weathered away. The centrum and neural arch of the fifth dorsal are restored, while the vertebral column anterior to this vertebra is that of No. 1047.



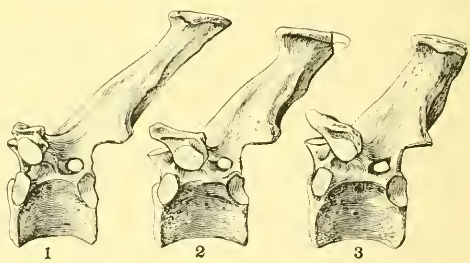


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FIG. 15. Lateral view of the seventh dorsal vertebra of *Promerycochœrus carrikeri.* No. 1081; $\frac{1}{3}$ nat. size.

FIG. 16. Lateral views of vertebræ from the middle dorsal region of *Promerycochœrus carrikeri,* No. 1081; $\frac{1}{3}$ nat. size. 1, eighth dorsal, No. 1081; 2, ninth dorsal, No. 1081; 3, tenth dorsal, No. 1081.

The Seventh Dorsal (Fig. 15).—The most characteristic feature of this vertebra in the paratype is the tendency of the posterior intervertebral notch to be transformed into a foramen, like that found in *Bos.* On the right side the foramen is complete, while on the left there is a considerable exit posteriorly. The height of the neural spine is less, but the antero-posterior diameter, especially near the neural arch, is greater than in the preceding vertebra.

The Eighth, Ninth, and Tenth Dorsals (Fig. 16).—This series of thoracic vertebræ are similar to one another. Their centra are long, narrow, and high; their lateral concave faces slope gradually from above downward and inward, meeting in the median ventral line to form a sharp keel. The transverse processes are shorter and the capitular and tubercular facets for the ribs are closer together. Above the tubercular facet on the transverse process is a heavy rugose tubercle pointing upward and forward similar to that in the peccary. The spine, especially on the eleventh dorsal, is more vertical and otherwise begins to assume characters like those of the lumbar vertebræ. These vertebræ have distinct intervertebral foramina, which are nearly like those in cattle. In *Merycoidodon culbertsoni* the centra of the vertebræ in the thoracic and lumbar region are distinctly more depressed than in *Promerycochœrus carrikeri.*

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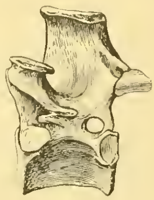

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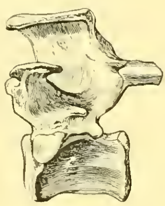
FIG. 17. Lateral view of the eleventh dorsal vertebra of *Promerycochœrus carrikeri.* No. 1081; $\frac{1}{3}$ nat. size.

FIG. 18. Lateral view of the twelfth dorsal vertebra of *Promerycochœrus carrikeri.* No. 1081; $\frac{1}{3}$ nat. size.

The Eleventh Dorsal (Fig. 17).—This vertebra is characterized by the rounded and interlocking postzygapophysis and the usually vertical or nearly anticlinal neural spine. The prezygapophysial facet of this vertebra in the present species is quite small. The transverse process is short and the ascending accessory process above the tubercular facet is more robust and roughened than in the preceding vertebræ. The intervertebral foramen is present.

The Twelfth Dorsal (Fig. 18).—The twelfth dorsal has an anticlinal neural spine, complete interlocking pre- and postzygapophyses and only a trace of the rib-facet on the transverse process. The ascending or mammillary process over the prezygapophysial articulation is entirely separated from the transverse process of this vertebra. In *Merycoidodon culbertsoni* this separation is already established in the eleventh dorsal. The intervertebral foramen is present; it is of large size and separated from the posterior intervertebral notch only by a thin partition of bone. The neural spine is low and has a much greater antero-posterior diameter than in the preceding vertebra.



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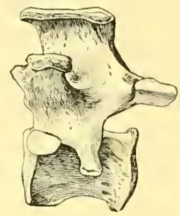

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FIG. 19. Lateral view of the thirteenth dorsal vertebra of *Promerycochœrus carrikeri*. No. 1081; $\frac{1}{3}$ nat. size.

FIG. 20. Lateral view of the fourteenth dorsal vertebra of *Promerycochœrus carrikeri*. No. 1081; $\frac{1}{3}$ nat. size.

The Thirteenth Dorsal (Fig. 19).—This vertebra is very similar to the one preceding it, but is characterized by the absence of tubercular facets for the ribs and the distinct transverse process which is located well back. The posterior border of this process is continuous with the anterior border of the posterior intervertebral notch. The centrum is strongly keeled and presents a triangular outline, especially behind. The mammillary process over the prezygapophysis has a more upward, outward, and backward position than in the preceding dorsals. The neural spine is similar to those of the lumbar series. The intervertebral notch is not developed into a foramen in this vertebra.

The Fourteenth Dorsal (Fig. 20).—This vertebra differs from the one preceding it in having a longer and heavier transverse process, a greater and more rugose keel, and the ventral face of the centrum convex. The facet for the last rib is almost entirely confined to the side of the centrum of this vertebra. Except in the matter of the latter facet it agrees quite well with the first lumbar in *Merycoidodon*.

The dorso-lumbar series in *Merycoidodon* and *Promerycochœrus* are equal in number, but the older genus has only thirteen dorsals while there are seven lumbar vertebræ, a difference of considerable importance, as we shall presently see.

The First Lumbar.—In the type and also in No. 1079 the lumbar vertebræ are all in position and all interlocked by their zygapophyses. Furthermore, they are interlocked with the dorsal and the sacrum (see Pl. XXXIII). The transverse process of the first lumbar vertebra is longer and broader than on the last dorsal. The latter feature together with the absence of a facet for a rib on the centrum are the only characters worthy of mention.

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FIG. 21. Lateral view of the second lumbar vertebra of *Promerycochœrus carrikeri.* No. 1081; $\frac{1}{3}$ nat. size.

FIG. 22. Lateral view of the third lumbar vertebra of *Promerycochœrus carrikeri.* No. 1081; $\frac{1}{3}$ nat. size.

The Second Lumbar (Fig. 21).—The anterior part of the keel on the ventral face of the centrum of this vertebra is particularly deep and rugose. It rapidly decreases in prominence behind, thus causing a sharp emargination on the under surface and terminates posteriorly in a small tubercle. The transverse process is thin and is broadened distally so that it projects outward, forward, and backward. The posterior face of the right transverse process has formed a strong sutural contact with the anterior face of the process in the succeeding vertebra, which is purely a pathological character. The mammillary process is directed upward, outward, and backward and the neural spine is slightly inclined forward, which is true of all the lumbar vertebræ.

The Third Lumbar (Fig. 22).—The third lumbar vertebra is similar to the second in nearly all particulars and needs no further description.

The Fourth and Fifth Lumbars (Fig. 23).—The centra of these vertebræ are more compressed laterally and the ventral keels, especially in the fifth, are more regular than in the two preceding vertebræ.

The transverse processes are branched distally, the larger portion projecting outwards and forwards and the smaller portion outwards and backwards.

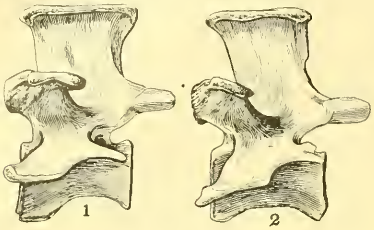

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FIG. 23. Lateral views of the fourth and fifth lumbar vertebræ of *Promerycochœrus carrikeri*. No. 1081; $\frac{1}{3}$ nat. size. 1, fourth; 2, fifth lumbar.

FIG. 24. Lateral view of the sixth lumbar vertebra of *Promerycochœrus carrikeri*. No. 1081; $\frac{1}{3}$ nat. size.

The Sixth Lumbar (Fig. 24).—The centrum of the last lumbar vertebra is, as usual, more depressed and has a greater transverse diameter than those preceding it. The ventral surface of the centrum is broader with the keel not so sharp as in the preceding vertebræ. The transverse process is relatively much longer than in the corresponding vertebra of *Merycoidodon culbertsoni;* it is also much expanded distally and there is a protuberance on the posterior extremity which articulates with a corresponding surface on the anterior extremity of the pleurapophysis of the first sacral vertebra not unlike what is seen in the hippopotamus. An entirely different arrangement is observed in the transverse process of the last lumbar in *Merycoidodon*, in which the process is much reduced when compared with those in front of it. This reduction in size does not appear to be brought about in order to unite with the sacrum by forming the usual articular surfaces between the process and the ilium, but is simply an adjustment to the limited space which exists between the anterior portion of the ilium and the centrum of the vertebra. On the posterior extremity of the process is a protuberance, which abuts against the pleurapophysis of the first sacral as in *P. carrikeri*. The neural spine of the sixth lumbar vertebra of the latter species is smaller than on the vertebræ immediately preceding it, but the antero-posterior diameter is relatively greater than in *Merycoidodon*. In general the centra of the lumbar vertebræ of Promerycochœrus are less depressed and the neural spines are lower, but with a greater antero-posterior diameter, and greater forward inclination than in *Merycoidodon.*

The Sacrum (*Cf.* Figs. 28, 29, 30).—In the type-specimen, No. 1080, and also in its companion skeleton No. 1079 the sacra have seven coössified vertebræ; specimen No. 1081, also one of the three originals, has eight (see Fig. 28); on the other hand in *Merycoidodon culbertsoni* there are usually but four. The sacrum of the species under description is very robust and its antero-posterior diameter is nearly twice that of its transverse. It extends back of the ischial tuberosity and the lateral mass, or united transverse processes, approach close to the upper borders of the ilium, thus forming a nearly complete arch over the long and comparatively narrow pelvic cavity. The ventral face of the centrum of the first sacral is slightly keeled and a rugose band across the body indicates the line of coalescence with the succeeding vertebræ. The sacral foramen is large, helping to form the arch lateral to the postzygapophysis. The latter coalesces with the prezygapophysis of the succeeding vertebra, the union being marked by a rough suture, while the united articular processes further back show little or no separation from one another in old individuals. The neural spine of the first sacral is separated from the succeeding spines by a considerable space. The pleurapophysis is very heavy and forms the principal support for the ilium, while that process of the second sacral is much smaller, though its entire lateral mass is also in contact with the ilium. The neural spines of the second, third, and fourth sacrals coalesce, are moderately high, and taper gradually backward. The united transverse processes form a broad plate of bone, curving upward at the lateral borders and perforated by the dorsal foramina. The transverse processes of the last three sacrals are more or less separated while the articular processes and the centra are firmly united. The centrum of the last sacral vertebra is broad transversely and much flattened vertically; the neural spine is of moderate size and has an enlarged rugosity at the summit, while the transverse process is broad antero-posteriorly and is sometimes united with that of the preceding sacral vertebra forming a large sacral foramen.

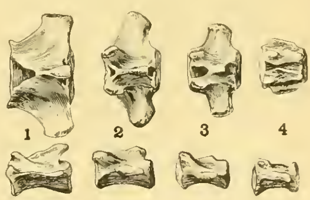


FIG. 25. Dorsal and lateral views of caudal vertebræ of *Promerycochœrus carrikeri.* No. 1081; $\frac{1}{3}$ nat. size. 1, first caudal; 2, second caudal; 3, third caudal; 4, fourth caudal.

The Caudals (Fig. 25).—The caudal vertebræ which were discovered with the material under discussion belong to the proximal series and conform in shape to the posterior sacrals. The gradual tapering indicates a moderately long tail, which, however, was perhaps shorter than in *Merycoidodon culbertsoni.*

MEASUREMENTS.

	No. 1080 (Type) Mm.	No. 1081, Mm.
Length of vertebral column from atlas to end of sacrum approximately		1,320
Length of cervical region	258	265[9]
Length of dorsal region, approximately	480	535[9]
Length of lumbar region, approximately	270	300
Length of sacrum	245	270
Atlas, greatest antero-posterior diameter	77	78[9]
Atlas, greatest transverse diameter	176	180[9]
Atlas, greatest vertical diameter		60[9]
Atlas, greatest transverse diameter of cotyles for occipital condyles	75	78
Atlas, greatest vertical diameter of cotyles		35[9]
Axis, greatest vertical diameter	90	90[9]
Axis, greatest transverse diameter	94	94[9]
Axis, antero-posterior diameter of centrum with odontoid process		65[9]
Axis, antero-posterior diameter of odontoid process		20[9]
Axis, vertical diameter of centrum, approximately		28[9]
Axis, transverse diameter of centrum		34[9]
Axis, transverse diameter of centrum, including articulations for atlas	72	72[9]
Third cervical, greatest antero-posterior diameter		62[9]
Third cervical, transverse diameter across transverse processes	110	102[9]
Third cervical, antero-posterior diameter of centrum, posteriorly		35[9]
Third cervical, transverse diameter of centrum		34[9]
Third cervical, vertical diameter of centrum		29
Seventh cervical, greatest height including neural spine, approximately	145	145[9]
Seventh cervical, antero-posterior diameter of centrum		32[9]
Seventh cervical, transverse diameter of centrum, anteriorly		26[9]
Seventh cervical, vertical diameter of centrum, anteriorly		26[9]
First dorsal, greatest height when in position in the skeleton	194	197[9]

[9] Indicates that the measurements were taken from No. 1047.

	No. 1080 (Type) Mm.	No. 1081, Mm.
First dorsal, antero-posterior diameter of centrum.......		32[9]
First dorsal, transverse diameter across transverse processes	85	90[9]
First dorsal, vertical diameter of centrum of first dorsal, anteriorly....................................		25[9]
Eighth dorsal, greatest height when in position in skeleton	108	110
Eighth dorsal, antero-posterior diameter of the centrum..		36
Eighth dorsal, transverse diameter across transverse processes..		55
Eighth dorsal, vertical diameter of centrum, anteriorly...		28
Eighth dorsal, transverse diameter of centrum across capitular facets for the ribs......................		39
Fourteenth dorsal, greatest height....................	73	77
Fourteenth dorsal, antero-posterior diameter of centrum..	43	43
Fourteenth dorsal, transverse diameter including transverse processes..	98	96
Fourteenth dorsal, vertical diameter of centrum, anteriorly		31
Fourteenth dorsal, transverse diameter of centrum, posteriorly..		32
Fourth lumbar, greatest height.......................	75	85
Fourth lumbar, antero-posterior diameter of centrum....	48	46
Fourth lumbar, transverse diameter including transverse processes..	152	130
Fourth lumbar, vertical diameter of centrum, anteriorly..		31
Fourth lumbar, transverse diameter of centrum, anteriorly		28
Sixth lumbar, greatest height........................		84
Sixth lumbar, antero-posterior diameter of centrum above		45
Sixth lumbar, transverse diameter including transverse processes above.................................	150	154
Sixth lumbar, transverse diameter of centrum, anteriorly.		32
Sixth lumbar, vertical diameter of centrum, anteriorly....		28
Sacrum, greatest height, anteriorly, neural spine included.		74
Sacrum, greatest transverse diameter including pleurapophyses..		148
Sacrum, transverse diameter of centrum, anteriorly......		40
Sacrum, vertical diameter of centrum, anteriorly........		21
Sacrum, transverse diameter including united transverse processes opposite fifth sacral vertebra..............	82	78
Sacrum, transverse diameter including united transverse processes opposite seventh sacral....................	82	68
Sacrum, transverse diameter of centrum of seventh sacral.		13
Sacrum, transverse diameter of centrum of seventh sacral.		23

[9] Indicates that measurements were taken from No. 1047.

THE RIBS.

(PLATES XXXIII AND XXXV).

The ribs are remarkably well preserved, their symmetry and original curvatures being in most cases retained. In the type nearly the entire series is present, while the paratype has all of the right (fourteen) and ten of the left side.

The chief characteristics of the ribs in this species are the comparatively small curvature of the shafts and the low position of the tubercular facet on the angle, which give an expanded position of the ribs when in position, thus imparting breadth to the body. The costal facet on the ventral end of the rib, when present, is enlarged, indicating a strong attachment for the costal cartilage. The latter undoubtedly was long.

In *Merycoidodon culbertsoni* the shaft of the first rib is rod-like near the angle, while in *Promerycochœrus carrikeri* it is flatter; it is noticeably heavy and rugose at the crest of the angle in the latter. The first five ribs are flat and their antero-posterior diameter increases gradually distad. The shafts of all the ribs back of the fifth are more rounded, the last suddenly is shortened, has no tubercular facet, and the curvature of the shaft is sinuous.

THE STERNUM.

There are three sternebræ belonging to the type (No. 1080) imbedded in the sandstone slab. These are heavy, flat, broad, and quite deep, with rugose surfaces, indicating thick cartilaginous attachments. The presternum, if present, is buried in the slab underneath the main mass of the skeleton.

THE FORE LIMB.

Although the fore limbs of the type are complete, the different bones, especially of the forearm, were found so folded upon one another that they cannot be studied in all of their details. In the following description, therefore, use will be made of the paratypes as well as of the type.

The Scapula (Fig. 26).—When compared with *Merycoidodon culbertsoni* the scapula of *P. carrikeri* is seen to have the suprascapular border broader, imparting a more perfectly triangular outline to the bone. One of the most noticeable features of the scapula is the median position of the spine, so that the supra- and infraspinous fossæ are subequal, more as in *Sus* and *Hippopotamus* than in the ruminants. The acromion process, however, is very strongly developed, unlike that in *Sus* and even more prominent than in the most of the recent selenodont Artiodactyls, but it has not attained the great development seen in the hippopotamus. The spine is prominent, quite heavy, and greatly overhangs the infraspinous fossa. The metacromion process is as well developed and points downward and backward fully as much as in *Mesoreodon chelonyx* Scott and *Merycoidodon culbertsoni* Leidy, here used for comparison.[10] The acromion process points in the opposite direction at least equally as much as in the latter species, *i.e.*, the metacromion process points downwards and backwards, while the acromion process is recurved from the main axis of the spine and points downwards and forwards (see Fig. 26). The glenoid cavity is comparatively large, the coracoid is heavy, quite rugose, and has a somewhat large coracoid process, which, however, is not relatively as robust as in the hippopotamus. The neck is also longer than that in the latter, and is more nearly as in *Sus*. The glenoid border is heavy and the upper half of its length is curved outward, thus forming together with the curved posterior face of the spine, a very concave, deep, and subtriangular infraspinous fossa somewhat as in *Sus*. Superiorly

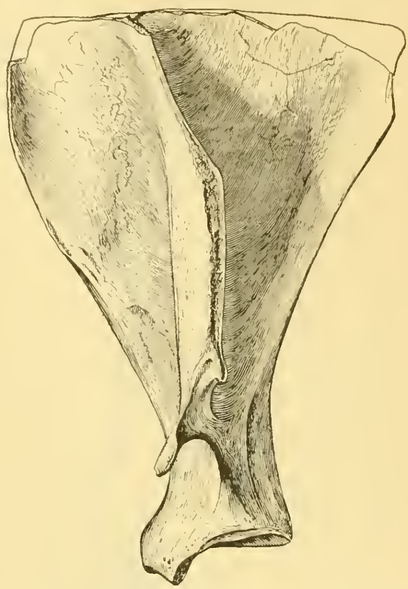


FIG. 26. External view of left scapula of *Promerycochœrus carrikeri*. No. 1047; $\frac{1}{3}$ nat. size.

[10] The metacromion process of *Merycoidodon* perhaps varies in its development. Scott states ("The Mammalia of the Deep River Beds," *Trans. Amer. Philos. Soc.*, Vol. XVII, 1893, p. 135): "No other genus of the family [besides *Mesoreodon*] has yet been found in which a metacromion occurs. . . . In *Oreodon* there is no metacromion." Wortman speaks of a metacromion in *Merycoidodon*. *Bull. Amer. Mus. Nat. Hist.*, Vol. VII, 1895, p. 152.

the glenoid border terminates in an enlarged tuberosity, indicating a heavy attachment for the cartilaginous prolongation of the scapula, which was probably larger. The coracoid border is thin and one third of its middle portion is curved inwardly. This internally directed area of the coracoid border and the ridge for the tendinous insertion near the glenoid border are the only eminences on the otherwise flat subscapular face. Some 20 mm. above the head there is a distinct and widely open groove extending obliquely across the subscapular neck

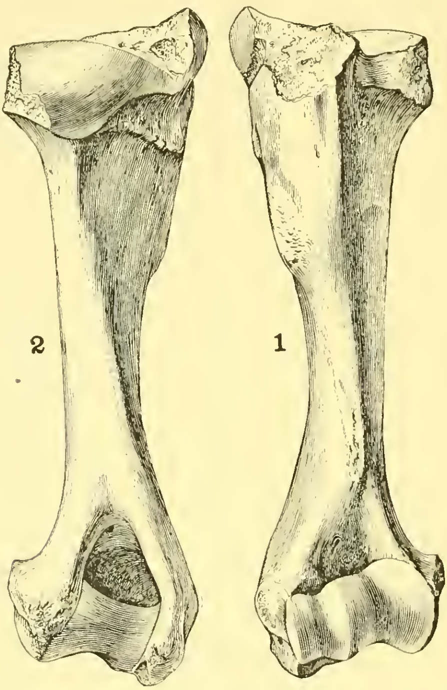


FIG. 27. Anterior and posterior views of humerus of *Promerycochœrus carrikeri.* No. 1047; $\frac{1}{3}$ nat. size. 1, anterior; 2, posterior.

which perhaps is due to the unusually close contact of the scapula with the ribs in this region. In *Merycoidodon* there is also a faint trace of a similar groove.

That the clavicle persisted in *P. carrikeri* is highly probable, inasmuch as *Merycoidodon culbertsoni* (No. 1391), with no greater developed spine and acromion process, has a clavicle of considerable size, which is almost identical, so far as comparisons can be made, with that in *Mesoreodon chelonyx* described and figured by Professor Scott (*l. c.*, p. 136, Pl. IV, Fig. 34). In smaller species of *Merycoidodon* the spine and the acromion process are apparently slightly smaller, but probably supported a clavicle. It thus seems that at least in one family of the Artiodactyla the clavicle persisted, and was represented until well into the Miocene.

The Humerus (Fig. 27).—The humerus is rather short and heavy, the proximal and distal ends being expanded and the distal trochlea quite oblong, somewhat as in the hippopotamus. The head is very large, well rounded, but not so hemispherical as in *Merycoidodon culbertsoni*. The greater tuberosity extends across the entire anterior face of the head, and is well produced above the articular surface, terminating radially in a robust hook, which overhangs the deep and well-formed bicipital groove. The lesser tuberosity is rather small, when compared with that of *Merycoidodon*, but, as in that form, it terminates in a short curved tubercle, so as to nearly enclose the bicipital groove. The anterior face near the proximal end is broad and rugose, the radial face is smooth and even, the ulnar face is more convex antero-posteriorly, and the posterior face is rapidly rounded, so that a cross-section of the shaft is triangular with the apex behind. The deltoid ridge is heavy, extending well down upon the shaft, and terminating in a rough, prominent ridge. Below the termination of the deltoid ridge the antero-posterior diameter of the shaft decreases rapidly, so that in cross-section it would be more oval in outline at this point. The shaft is short and heavy in comparison with that of *Merycoidodon*.

As stated above, the distal end of the humerus is much expanded, especially transversely, the diameter being proportionally even greater than in *Merycoidodon*. The intercondylar ridge is prominent and broad, but the external division of the trochlea is smaller and not so deep as in *Merycoidodon*.[11] The internal epicondyle is also less prominent than in the latter genus, but the tuberosity on the internal side is large, indicating liberal attachments for ligaments and muscles. The anconeal fossa is low and broad and there is no supratrochlear foramen.

[11] In *Agriochœrus latifrons* the external division of the trochlea is even smaller than in the species under consideration (Wortman, *Bull. Amer. Mus. Nat. Hist.*, Vol. VII, 1895, p. 154).

The Radius and Ulna.—The radius and ulna are reduced in length, but otherwise not modified so as to differ in any important particular from those of the earlier species of this family. The most noteworthy difference is the shortness, and perhaps the flatness of the shaft of the radius, which in this species has an oval cross-section half-way between the proximal and distal ends, much as in the later ruminants. The head of the radius has the usual great transverse expanse, and is in all important particulars characteristic of the family. The shaft is rather straight, and, as stated above, compressed antero-posteriorly and expanded transversely; the radial face is straight, while the ulnar and posterior faces are slightly concave vertically. On the ulnar side of the shaft, above the articulation for the ulna, is a sharp ridge, which extends half-way to the proximal end, where it fades away gradually so that the border becomes more rounded; a character quite similar to that in *Sus*, while the tubercle for the biceps tendon above is much more prominent and more like that in the ruminants. Distally the radius is expanded fully as much transversely, and much more antero-posteriorly, than the proximal end. The scaphoid facet is perhaps even more oblique than in *Promerycochœrus montanus*, but, as in the latter, it is strongly concave transversely and rapidly flexed back high up upon the radial angle of the bone. The lunar facet is subtriangular in outline with the apex directed backward, and its surface is saddle-shaped, *i.e.*, convex from side to side and concave from before backwards.

The ulna is, as usual, not reduced and very heavy, especially above. The olecranon is strongly produced above the sigmoid cavity, but the free end, which is very heavy, is not grooved by a tendinal sulcus as in some of the smaller species of *Merycoidodon*.[12] *Agriocochœrus latifrons* is another Oligocene form which has this tendinal groove;[13] and in later forms (*Mesoreodon chelonyx*[14] and *Promerycochœrus montanus*) the groove is quite distinctly formed.

The humeral articulation of the sigmoid cavity is broad above and rapidly contracts below, the lip of the inferior articular surface ex-

[12] In the articulated skeleton of *Merycoidodon culbertsoni* in the Carnegie Museum the tendinal sulcus is not present, while smaller species of that genus have the groove present.

[13] Wortman, *Bull. Amer. Mus. Nat. Hist.*, Vol. VII, 1895, p. 156.

[14] Although Scott does not speak of this groove in the olecranon of the ulna of this species, it is well shown in the illustration, Pl. X, Fig. 38, *Trans. Amer. Philos. Soc.*, Vol. XVII, 1893.

tending well downwards and inwards to nearly the internal face of the head of the radius, when the latter is in position. The shaft is trihedral in section, the posterior border very prominent proximally and gradually decreasing distad. The postero-radial border has a characteristic sharp and curved ridge, which extends from near the distal end upwards, one-third the length of the shaft, and overlaps the shaft of the radius when the fore-arm is in position. The distal end of the shaft is bent backwards and outwards giving it a sinuous curve. The cuneiform facet is much expanded, slightly concave laterally, and compressed antero-posteriorly with a convex surface. The pisiform articulation is rather small and confined chiefly to the border near the external angle.

The Manus (Plate XXXIX, figs. 3 and 4).—The carpals are on the whole very similar to those of *Promerycochœrus montanus* (described by Scott, *l. c.*, p. 157–159) and only the points in which they vary from that species will here be mentioned.

The scaphoid is apparently similar to that of *P. montanus* in all respects, including the absence of an articular facet for the trapezium. The lunar differs from that of *P. montanus* in having no proximal facet for the cuneiform. The superior portion of the bone is laterally contracted, and it articulates with the radius in the usual manner, but does not have proximal articular surfaces laterally for the scaphoid or the cuneiform. The facet for the magnum also differs from that of *P. montanus*, in being convex, though not as much so as in *Merycochœrus cœnopus* from later deposits. Distally the bone has the characteristic long beak, which nearly reaches the third metacarpal and effectively separates the unciform and magnum in the anterior region of the carpus (see Pl. XXXIX, fig. 3). The cuneiform differs from that of *P. montanus*, only in the absence of a proximal facet for the lunar. The pisiform is rather small, with little or no neck on the shaft separating the free end from the ulnar and cuneiform articulations. The bone as a whole is relatively smaller than in *Merycoidodon culbertsoni*. The small nodular trapezium is present and differs in no respect from that of *P. montanus* and *Mesoreodon*, except in the absence of a facet for Mc. II. There is no facet for a pollex. The trapezoid is similar in every particular to that of *P. montanus* and needs no further description. The only respect in which the magnum differs from that of *P. montanus* is in the more convex articulation for the lunar, a feature closely approaching what is seen in *Merycochœrus* *cœnopus*, a later form. There are no differences, requiring mention between the unciform in *P. montanus* and *P. carrikeri.*

The metacarpals have the same short, stout, and broad appearance as those of *P. montanus;* the lateral ones are relatively longer and perhaps somewhat heavier than in the latter species, imparting to the manus of *Promerycochœrus* as great, if not a greater breadth and shortness, suggestive of the hippopotamus, as was observed by Professor Scott. The second metacarpal, as already stated, differs from that of *P. montanus* only by being slightly longer and heavier and by the apparent absence of the small facet for the trapezium on the "postero-external angle of the head," to which Scott refers in his description. The third metacarpal is similar in all particulars to that in *P. montanus*, as is also the fourth. The fifth metacarpal is very little shorter than the second, and differs from that of *P. montanus* only in its relative length and size.

As in the latter species the phalanges are short, depressed, and flattened, the unguals are especially short, expanded laterally, and recall those of some species of the rhinoceroses. The phalanges of the third and fourth digits are of equal size, while those of the second are somewhat larger than those of the fifth digit.

MEASUREMENTS.

	No. 1080 (Type) Mm.	No. 1081, Mm.
Scapula, height	233	
Scapula, antero-posterior diameter at vertebral border	146	
Scapula, antero-posterior diameter at neck	37	
Scapula, depth of spine	38	
Scapula, antero-posterior diameter of glenoid cavity	50	
Scapula, transverse diameter of glenoid cavity	44	
Humerus, greatest length	250	
Humerus, antero-posterior diameter of head	83	
Humerus, transverse diameter of head	68	
Humerus, transverse diameter of distal end	72	60
Humerus, antero-posterior diameter of distal end	46	47
Radius, greatest length	175	
Radius, antero-posterior diameter of head, approximately	25	
Radius, transverse diameter of head, approximately	43	
Radius, transverse diameter of distal end	45	
Radius, antero-posterior diameter of distal end, approximately	25	
Ulna, greatest length	245	
Ulna, length of olecranon process	55	

	No. 1080 (Type) Mm.	No. 1081, Mm.
Ulna, transverse diameter at inferior part of the sigmoid cavity		50
Ulna, antero-posterior diameter of distal end		13
Ulna, transverse diameter of distal end		26
		No. 1228
Carpus, vertical diameter, radial side, approximately	45	40
Carpus, antero-posterior diameter, approximately		30
Scaphoid, antero-posterior diameter		30
Scaphoid, transverse diameter	21	21
Scaphoid, vertical diameter	25	
Lunar, antero-posterior diameter		23
Lunar, transverse diameter	20	19
Lunar, vertical diameter	30	31
Cuneiform, antero-posterior diameter	19	19
Cuneiform, transverse diameter		30
Cuneiform, vertical diameter	19	19
Pisiform, greatest length, approximately	34	34
Pisiform, vertical diameter at free end	18	18
Pisiform, smallest vertical diameter	15	15
Trapezium, greatest vertical diameter		12
Trapezium, greatest transverse diameter		10
Trapezoid, antero-posterior diameter	17	
Trapezoid, vertical diameter	19	
Magnum, transverse diameter	20	
Magnum, vertical diameter	14	
Unciform, greatest vertical diameter, approximately	26	
Unciform, greatest antero-posterior diameter, approximately	34	
Metacarpal II, greatest length, approximately	60	64
Metacarpal III, greatest length, approximately	82	85
Metacarpal IV, greatest length, approximately	77	77
Metacarpal V, greatest length, approximately	63	63

THE HIND LIMB.

The more important differences in the hind limb, when compared with that of *Merycoidodon*, are the proportionally shorter tibia and fibula and the backward shifting of the pelvis on the vertebral column. This deviation from the older type is distinctly analogous to the corresponding characters in the hippopotamus. We have already seen that the radius is much shorter than the humerus, that the manus is broad and short, that there is a large thoracic cavity with an additional dorsal, which carries a good-sized rib and has a prominent transverse process, and that the lumbar vertebræ all have very long and broad transverse processes. These facts together with the backward shifting of the pelvis, and the small brain, indicate (1) the relatively large size of the organs of the thorax and abdomen, and (2) the sluggish nature of the animal.

The shape and proportions of the pelvis in *Promerycochœrus* do

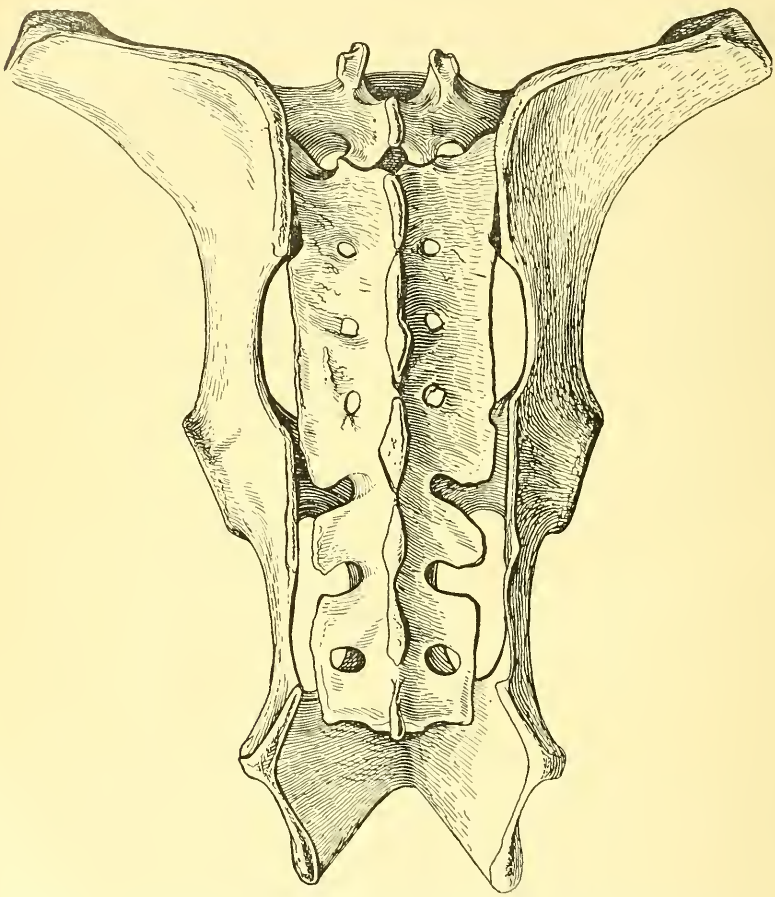


FIG. 28. Dorsal view of sacrum and pelvis of *Promerycochœrus carrikeri*. No. 1081; $\frac{1}{3}$ nat. size.

not differ much from those of *Merycoidodon*, except in size. The ilium in *Promerycochœrus carrikeri* has a slightly greater outward curve in its anterior portion, but otherwise the pelvis has the usual antero-posterior elongation and the deep, narrow pelvic cavity, characteristic of the family. The point of the ilium is rather heavy and rugose, affording extensive surfaces for muscular attachments. From this rugosity backwards to the iliosacral contact is a very prominent ridge on the internal face of the ilium, which also serves for the attachment of muscles. The spines of the sacrum when in position, rise above the superior iliac border. The latter is rounded from before backward and the ilium is rapidly contracted to a notch back of the sacro-iliac contact much as in *Merycoidodon culbertsoni*, *Mesoreodon*, and other genera of the family. The acetabular border of the ilium forms a long and gently concave sweep from the point of the ilium to the anterior border of the acetabulum. The latter is rather small, though deep, and the pit for the ligamentum teres is unusually deep. The cotyloid notch is deep, but narrow, and relatively smaller than in *Merycoidodon*, and much smaller than in *Mesoreodon chelonyx*. The ischium is elongated and robust, with a broad rough surface over the acetabulum which terminates above in a deep ridge or spine. This spine again decreases in prominence to form the lesser sacro-sciatic notch after which the ischium again suddenly rises in an upward and outward direction to form the high and robust ischial tuberosity. The broad surface of the posterior portion of the ischium is sub-triangular in outline, very high, terminating above in the large tuberosity mentioned and below in a heavy and rugose area, which is developed into a large tubercle on the posterior ventral angle of the symphysis. The ascend-

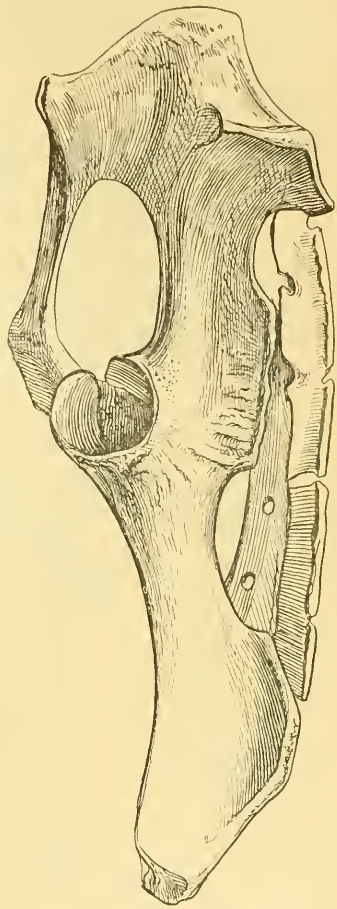


FIG. 29. Lateral view of sacrum and pelvis of *Promerycochœrus carrikeri*. No. 1081. $\frac{1}{3}$ nat. size.

ing ramus of the pubis is very short, and the ventral border is deeply grooved, while near the anterior border is a heavy and rugose tuberosity. The horizontal ramus is broad, completely coalesced with its fellow in the median line, forming a rough and transversely broad ridge on the ventral face, which terminates in tubercles in front and behind. The obturator foramen is large and ovate in outline.

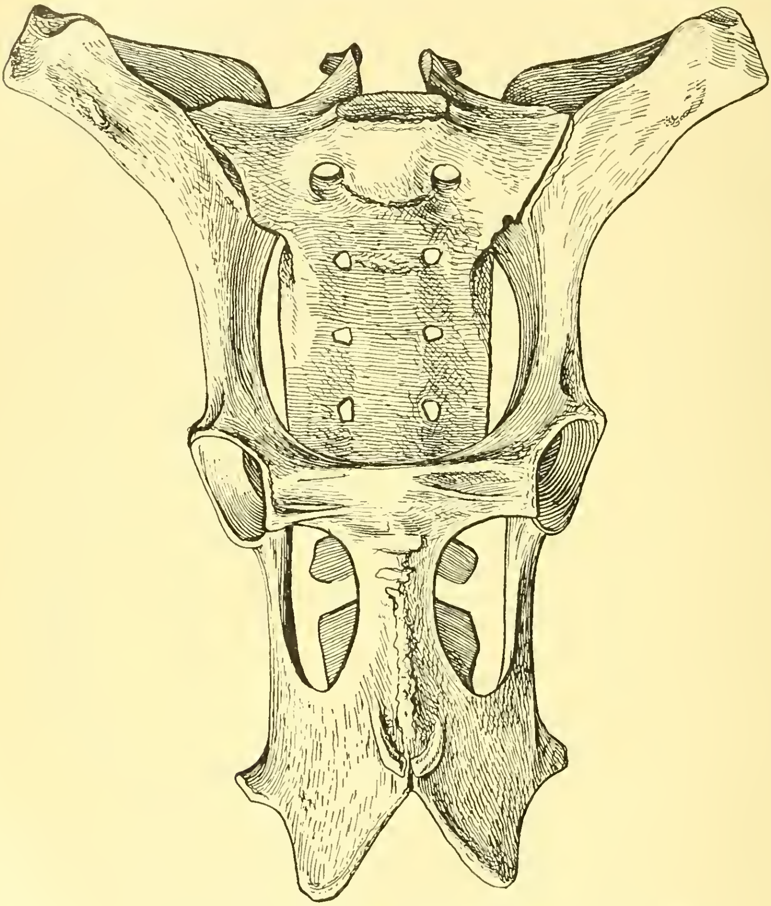
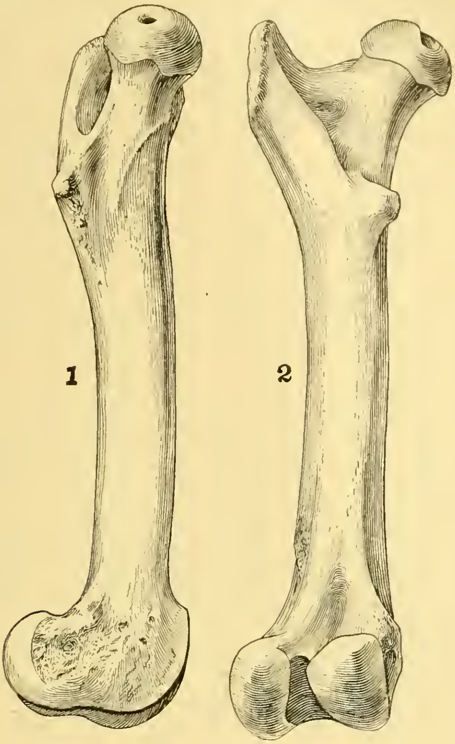


FIG. 30. Ventral view of sacrum and pelvis of *Promerycochœrus carrikeri*. No. 1081; $\frac{1}{3}$ nat. size.

The Femur (Fig. 31).—The differences between the femur of *P. carrikeri* and that of *P. montanus*, described by Professor Scott, are slight. The second trochanter, which is equally developed in *Merycoidodon* and *Mesoreodon*, is evidently larger in proportion than that of *P.*

montanus. The condyles are of nearly the same size, but the groove separating them is narrow in *P. carrikeri.* The rotular trochlea has the same asymmetry, which obtains in *P. montanus*, and is, as Scott states, a distinctly modernized character, differing from what is seen in earlier representatives of the family. Some species of *Promerycochœrus* apparently have the groove more nearly as it is in *Merycoidodon.*



31

32

FIG. 31. Internal and posterior views of femur of *Promerycochœrus carrikeri.* No. 1081; $\frac{1}{3}$ nat. size. 1, internal; 2, posterior.

FIG. 32. Anterior view of tibia and fibula of *Promerycochœrus carrikeri.* No. 1081; $\frac{1}{3}$ nat. size.

Patella (Plates XXIII and XXXV).—The patella is large, very convex and rugose on the anterior face, truncate above, and terminating in a sharp tubercle, which is bent downward and backward. The articulating surfaces for the femoral trochlea are broad, the external more convex than the internal, and the median ridge is quite concave from above downward.

The Tibia (Fig. 32).—The tibia is, as stated above, short and heavy, which is also characteristic of *Merycochœrus*, as pointed out by Matthew (*Mem. Am. Mus. Nat. Hist.*, Vol. I, p. 409, 1901). The head is much expanded both antero-posteriorly and transversely. The spine is relatively heavier than in *Merycoidodon* and the tendinal groove on the external margin of the head is smaller. The anterior face of the head has a deep, triangular, and rough excavation for ligamentary attachments, which extends well down on the cnemial crest. The latter is very prominent, extends well down, and strongly overhangs the external face, imparting a strong antero-posterior convexity to this part of the shaft. The internal malleolus is especially well-developed, much bent outward, and applied closely to a corresponding deep excavation on the internal face of the astragalus. The trochlea is otherwise of the usual *Merycoidodont*-type, *i.e.*, with the straight fore-and-aft median ridge, and the very deep external groove, which corresponds with the asymmetry of the upper trochlea of the astragalus. The tibia appears to be proportionally longer and the lateral metapodials shorter in some species.

The Fibula (Fig. 32).—The proximal end of the fibula is much expanded antero-posteriorly, very rugose externally, and entirely coössified with the tibia. The shaft is slender with a sharp peroneal ridge and the distal end expands rapidly in the antero-posterior direction. Transversely the malleolus is compressed, so as to form a broad rugose external surface, as in the hippopotamus, and internally there is an articular surface for the calcaneum. The calcaneal face is lance-shaped in outline, takes up approximately half of the internal surface near the anterior border, and is succeeded behind by a rough area of considerable extent for tendinal and muscular attachments.

The Pes (Plate XXXIX, Figs. 1 and 2).—As has already been pointed out by Professor Scott in the description of the limbs of *P. montanus*, the tarsus of *Promerycochœrus* is low, broad, and massive, but otherwise similar to that in earlier genera. The astragalus in particular is low and broad, but not so much so as in the more recent genus *Merycochœrus*. The calcaneum has a long tuber similar to that in *Merycoidodon*, but rounder in cross-section. The internal lip of the sustentaculum is prominent, and the posterior face of the shaft just above the cuboid facet is unusually excavated and rugose. The navicular is broader than ordinarily, but otherwise has all the characteristics of the Merycoidodonts generally. The cuboid is low and broad, the calcaneal facet smaller than the astragalus, the latter concave antero-posteriorly to about the same extent as in *Merycoidodon culbertsoni.* The posterior hook is more deeply excavated above the base and the rugose surface continues upwards and inwards forming a heavier angle than in *Merycoidodon.* The anterior face is quite rough distally with a more than ordinarily projecting border at the lower margin, causing a vertical concavity on this surface. Distally the cuboid is taken up almost entirely by the facet for Mt. IV, while that for Mt. V occupies a rather small portion of the external plantar border. This latter articulation is entirely distal, though with a less angular and overhanging external border than in *Merycoidodon culbertsoni.* The coössified ecto- and meso-cuneiforms are similar in all respects to those of *P. montanus.* The ento-cuneiform has considerable height, is large, irregularly rounded, and articulates with the navicular, meso, cuneiform, and Mt. II in such manner as to completely interlock the proximal end of the latter. The metatarsals are short and heavy, but longer than the metacarpals. The most striking features are the relatively small reduction in size and length of the second and fifth metatarsals, somewhat as is the case in those of *Agriochœrus major* described and illustrated by Wortman (*l. c.*, pp. 168, 170). Metatarsals II and V are subequal in length; Mt. II, which is only 12 mm. shorter than Mt. III, is slightly the longer, a reversal of what seems to be the case in *P. montanus* (*l. c.*, p. 161) and most members of this family, Mt. V being generally the longer. In *Sus scofa* also Mt. V is longer than Mt. II, while in *Hippopotamus* Mt. II is slightly longer.

The second metatarsal has a strongly curved shaft so that the distal end lies plantar to Mt. III when the bones are in position, quite like what is observed in the recent pigs and *Hippopotamus.* Proximally Mt. II is, as stated above, quite completely interlocked by Mt. III externally, by the entocuneiform internally, and by the united meso- and ecto-cuneiform superiorly. With relation to the median metatarsals the length and other proportions of Mt. II and V are, as in the manus, greater than in *Merycoidodon culbertsoni,* and perhaps more nearly approach the conditions found in the hippopotamus. Mt. III is heavy and relatively much shorter than that in *Merycoidodon.* The head has a broad plane surface for the ecto-cuneiform above, the usual interlocking facets for Mt. IV externally, and a smaller facet for Mt. II internally. The palmar process, though quite prominent, is not so large as that on Mt. IV, and, as usual, the tibial and fibular faces overhang only slightly. The shaft is flat, rather straight, and distally there are only slight tuberosities internally and externally, so that the distal end extends very slightly beyond the lateral borders of the shaft. The carinæ, especially of the lateral metatarsals, are better developed than in *Merycoidodon*, but, as in the latter, are not carried up upon the anterior face of the trochlea. Mt. IV is a little longer than Mt. III, though the two differ but slightly in this as well as other respects. The proximal articulation is large and takes up nearly the entire distal surface of the cuboid. Antero-posteriorly the bone has a greater diameter than Mt. III, which is due to the prominent ridge from the base of the large palmar process extending obliquely downward and outward across the posterior face. On the external proximal angle is the rather small articular facet for Mt. V. The latter is the shortest of the series. The bone is quite heavy with a less arched shaft than Mt. II, and a simpler proximal articulation than the latter, but the distal carina is developed fully as well. In the paratype the bone is diseased on the proximal half of the shaft.

The Phalanges (Plate XXXIX, figs. 1 and 2).—The phalanges of the pes are relatively slightly longer and not so broad as those of the manus; otherwise they differ in no important respect.

Measurements.	No. 1080 (Type) Mm.	No. 1081, Mm.
Pelvis, greatest antero-posterior diameter	355	360
Pelvis, from point of ilium to middle of acetabulum	200	200
Pelvis, from middle of acetabulum to end of ischium	170	160
Pelvis, vertical diameter of ischium posteriorly, median line-measurement	120	128
Pelvis, greatest transverse diameter from point to point of ilia when in position, approximately	308	300
Pelvis, transverse diameter of pelvic cavity opposite the acetabula	110	90
Pelvis, transverse diameter of pelvic cavity opposite the ischial tuberosity	114	95
Femur, greatest length	260	275
Femur, antero-posterior diameter of head	38	38
Femur, transverse diameter of condyles	67	68
Femur, transverse diameter of rotular trochlea	34	
Tibia, greatest length	205	225
Tibia, transverse diameter of head	65	71
Tibia, antero-posterior diameter of head	58	56
Tibia, transverse diameter of distal end with fibula in position	55	55
Tibia, antero-posterior diameter of distal end, internally	? 39	39
Calcaneum, greatest length	90	92
Calcaneum, antero-posterior diameter at sustentacular facet	? 40	40

	No. 1080 (Types) Mm.	No. 1081, Mm.
Tarsus, height	? 62	62
Tarsus, breadth	? 50	50
Astragalus, height	50	50
Astragalus, breadth	38	38
Mt. II, length	63	65
Mt. III, length	75	77
Mt. IV, length	80	79
Mt. V, length	65	61
Digit III, length of first phalanx	28	27
Digit III, length of second phalanx	18	16
Digit III, length of terminal phalanx	24	24

THE ARTICULATED SKELETON OF PROMERYCOCHOERUS CARRIKERI PETERSON.

(PLATE XXXV).

This description of the articulated skeleton is a somewhat modified restatement of the account given by the writer in the Annals, Vol. IV, pp. 28, 29.

"The skeleton No. 1081 was found on the same level, nine feet from the group [Pl. XXXIII] mounted in the Hall of Vertebrate Paleontology of the Carnegie Museum, and practically was one of them. The anterior portion of the skeleton was unfortunately eroded and lost, but from the fifth dorsal backward the skeleton is practically complete. The head of the left humerus, the distal end of the right humerus, and a small portion of both ulnæ were also found in position. Nearly all of the ribs are represented.

"The parts supplied in this restoration were taken from three different individuals of the same species, the skull and jaws from a specimen cataloged as No. 109 [somewhat too small for the skeleton]; the cervicals, anterior dorsals, first lumbar, and the left scapula (which are somewhat too large for the skeleton) were derived from the specimen cataloged as No. 1228. The humeri, radii, and ulnæ are mostly restored in plaster.

". . . The skull is short and deep, the neck short and robust, the neural spines of the dorsals are high, the lumbar vertebræ are heavy, with strong zygapophyses and thin transverse processes, which are much extended transversely at the distal extremities [those on the last lumbar longer and more extended transversely than on the vertebræ preceding it]. There are eight well coössified vertebræ in the sacrum [of this individual]. The caudal region was of medium length, judging from the four anterior caudals which are at hand. The thoracic [and abdominal cavities are] of large size. The limbs are short and heavy, . . . [the feet are short and broad] and the proportions of the skeleton recall the outlines of the hippopotamus."

MEASUREMENTS.

	Cm.
Skeleton, total length, approximately	172
Skeleton, height at first dorsal	72
Skeleton, height at points of ilia	68

MODELS OF PROMERYCOCHŒRUS CARRIKERI Peterson.[15]

(PLATES XXXVI AND XXXVII.)

Models based upon the skeletons described in the preceding pages were placed upon exhibition in the Hall of Mammals in the Gallery of Vertebrate Paleontology of the Carnegie Museum in 1909. They were made by Theodore A. Mills under the supervision of Dr. W. J. Holland and the writer. They are believed to portray with considerable accuracy the proportions, shape, and positions of these animals in life. The skull represented in Plate XXXV is too small, and another skull of more nearly the proper size was used in preparing the models. Apart from this change the articulated skeleton, and the three specimens in the original position on the sandstone slab were closely followed.

As may be gathered from the foregoing pages there are a number of features in *Promerycochœrus* which are hippopotamoid. The animal had a heavy and short neck, a long and heavy body, short legs, and broad and tetradactyl feet. The high sagittal crest, high, broad, and rugose occipital plate, together with the broad mastoid plate suggest that the muscles of the neck were heavy; while the deep supratemporal fossa, greatly expanded zygomatic arches, and deep excavations on the internal face of the angle of the lower jaw indicate thick and heavy masseteric muscles. Add to these characters the extremely heavy

[15] It is of interest to note the close similarity of the model figured on Plate XXXVI to the figure by Charles R. Knight given in Osborn's "Age of Mammals," p. 236. This paper was in manuscript, and the model in the Carnegie Museum on exhibition long before Professor Osborn's book appeared, and we had no knowledge that a restoration of *Promerycochœrus* was being made in the American Museum of Natural History. It is therefore gratifying to observe that the conclusions independently reached by our friends in New York as to the external appearance of the animal so closely agree with our own.

and rugose zygomatic arch with its posterior vertical plate, which is high and broad, extending backward nearly on an even transverse line with the posterior face of the occipital and mastoid plates, and we have warrant for the musculature adumbrated in these sketches in clay. It has been suggested by Dr. Holland in conversation that the animals might have had warty protuberances covering the superior and outer portions of the zygomatic arches. It seems, however, to the writer, more probable that the rugose zygomatic arch was intended for muscular attachments over which the epidermis was drawn as represented in the models.[16] It has already been stated that the mandible is proportionally long, deep, and heavy as in the pigs, and that the masseter muscle did not extend forward on the jugal and the mandible, as on some recent ungulates with long jaws and large teeth (*Equus caballus*); hence it would appear that the broad, heavy, and rugose zygomatic arch and the deep excavation on the inner face of the angle of the lower jaw were for the attachment of muscles sufficiently powerful to properly swing the heavy jaws, which are full of robust teeth. The position of the ear is well up on the side of the head,

[16] The opinion expressed by Mr. Peterson is one from which I am not at all inclined to dissent, and I think it is in the main absolutely correct. There is not a shadow of doubt that the enlargement of the zygomatic arch had as its primary object the supply of surfaces sufficiently large for the attachment of the powerful muscles which were required in order to the mastication of coarse and rough food, upon which these creatures probably fed. Nevertheless the development of the zygoma in this family is so remarkable, and so entirely different from that in other families in which an equal or even greater muscular power is called for, as to suggest that in addition to its use as a support for heavy musculature, it may indicate some external embellishment of the features, which may have been of use to these animals. In the mandril and some of the allied apes we have a thickening of the bones of the face, which especially in the mandril are covered with highly pigmented skin; in the wart-hog of Africa the excrescences, which impart such a hideous appearance to the animal, are coupled with corresponding thickenings of the subjacent osseous tissue. It does not appear necessary to suppose that the rounded and widened upper and outer surface of the zygoma was required to furnish attachments for the origin of the masseteric muscle in *Promerycochœrus* and its allies; it is more probable that these muscles had their attachments on the inner and lower surface of the widely expanded bone. While I do not strenuously advocate the view, which I proposed to Mr. Peterson in conversation, and in fact when helping to model the heads did not attempt to express it in the clay, it nevertheless seems to me to be worthy of consideration and highly plausible. No scheme of mere musculature applicable to the case seems to call of necessity for such a peculiar development of the zygomatic arch, especially on its upper and external surfaces, as is seen in some species of this family. W. J. HOLLAND.

more as in *Sus scrofa* than in the hippopotamus, while the eyes are nearer the nose, entirely unlike those in the latter forms. The upper part of the neck is heavy, but the lower has not the great transverse diameter seen in the hippopotamus as the angles of the lower jaws are relatively much less spread, the cervical vertebræ less depressed, and perhaps not as broad, consequently there was not the surface for the attachment of the muscles of the under portion of the neck seen in the recent forms. Although the shoulders appear heavy they are represented as having little or no superfluous flesh as the outlines of the glenoid and suprascapular borders of the shoulder blade are plainly visible through the muscles. The broad thoraco-abdominal muscle is also represented as quite thin. Posteriorly the models are lighter and recall the general characters of the pigs rather than the ruminants. The limbs are short and the feet are most nearly like those of hippopotamus.

The epidermis is represented with little or no hair for two reasons: *first* we have no means of knowing whether the animal had a thick coat of hair like the wild boar, was more thinly clad like certain species of peccaries, or whether the hair was absent as in *Hippopotamus; secondly*, the models are represented smooth in order the better to show the proportions of the different parts of their anatomy. As has been stated in the introduction to this paper and also in earlier publications the habitat of the animals discussed was most likely in low-lying land. It is not altogether unreasonable to think that they spent part of their time in marshy places, or even in the water.

2. **Promerycochœrus vantasselensis** Peterson.

ANNALS OF THE CARNEGIE MUSEUM, Vol. IV, p. 36, Pl. XI, 1907.

Type: Skull with right ramus and portions of the skeleton, Car. Mus. No. 1230.

Paratypes: Two portions of skeletons found imbedded together. Car. Mus. Nos. 1232 and 1232a.

Horizon: Miocene (Lower Harrison beds).

Locality: Vantassel Creek, Converse County, Wyoming.

SPECIFIC CHARACTERS. *Skull brachycephalic. Length of molar series slightly increased, and space for premolars shortened, nasals shorter, and anterior nares more obliquely inclined posteriorly than in other species of this genus. The zygomatic arch less robust, less downwardly extended, and the tympanic bulla larger than in P. carrikeri.*

Although this species cannot for the present be separated generically from the genus *Promerycochœrus* there are a number of characteristic features which at once separate it from the earlier forms *P. chelydra* and *P. carrikeri*. *P. hollandi* is also more nearly related to the earlier types. Two of the more significant specializations of *P. vantasselensis* are included as specific characters, viz: the lengthening of the space for the molars and the shortening of the space for the premolars as well as the shortening of the nasals. These characters suggest the condition in *Merycochœrus* found in a later horizon, but in the latter genus the cranium is shorter, the brain case is larger, the occiput is broader, the facial region entirely changed; *i.e.*, the heavy inflated longitudinal ridge separating the side of the face into two fossæ is absent, the infra-orbital foramen is further back, and the nasals are very considerably shorter and constricted in the middle antero-posterior region. These are characters which undoubtedly indicate an earlier origin (Oligocene) than those indicated in the species under description (compare fig. 1 on Plate XL with fig. 2 on Plate XLII).

A more minute study of the remains of this species reveals a great many characters which differ from those in *P. carrikeri* and other species of this genus. Some of these differences are of importance, and a detailed comparative description is therefore in order.

THE SKULL.

(PLATE XL).

The skull is not so broad proportionally as in *P. chelydra* and *P. carrikeri*, but slightly broader than in *P. hollandi* or *P. temporalis*. The high occiput is similarly constructed though possibly somewhat more overhanging than in these species, but the occipital plate is approximately the same. The condyles are quite sessile and point more downward than in *P. carrikeri*, more closely resembling those in *P. hollandi*, resulting in a more curved basicranial axis in the present species and in *P. hollandi*.

The size of the brain-case is perceptibly larger than in the earlier species, a fact which is especially noticeable in the type, while in the paratype, No. 1230, the brain-case has received lateral crushing. The sagittal crest is generally sharper than in *P. carrikeri*, and in this respect is also similar to *P. hollandi*, but the crest has a greater convexity fore-and-aft than in the latter species. The zygomatic arch is also very much less drooping than in *P. carrikeri*, but in its general construction it is otherwise quite similar and has a greater downward thrust than in either *P. chelydra* or *P. hollandi*. As in the earlier species the deep temporal fossa is surrounded by prominent borders formed above and behind by the temporal, sagittal, lamboidal, and posttemporal crests; formed below by the broadly expanded zygomatic arch, and in front by the united postorbital processes of the frontal and jugal. The external cranial wall has prominent ridges, which extend forward and downward from the posterior portion of the parietal to the lower part of the squamosal, serving for the attachment of muscles in this region. The temporal muscle was evidently of considerable size and thickness. The glenoid cavity is regularly convex fore-and-aft, and bounded on the postero-internal angle by a postglenoid process, which is thick antero-posteriorly, quite heavy as in other species, and unlike the transversely broad process in *Merycochœrus*. The paroccipital and postglenoid processes are slightly closer together than in *P. carrikeri*, and in this respect more nearly resemble those in *P. chelydra* and *P. hollandi*, in which they are still closer together. This character suggests the conditions found in the later forms *Merycochœrus* Leidy, and *Pronomotherium* Douglass, in which the postglenoid, the paroccipital, and the occipital condyle are very close together. In proportion to the large tympanic bulla the external auditory meatus is quite small, while in the older species it is larger, though the bulla is smaller.

The region of the sphenoid bones of this species does not appear to be in any respect different from that of *P. carrikeri*, except the foramen ovale, which is situated more internally in the type of the present form. The pterygoids are apparently somewhat larger and the posterior nares are further back than in *P. carrikeri*, which is also true of *P. chelydra* and *P. hollandi*, another character which approaches conditions in the later Miocene forms.

The frontal region is more convex from side to side over the orbits than in *P. chelydra* or *P. hollandi* and more like that in *carrikeri*, but the posterior portion of the frontal does not take the upward turn to meet the sudden rise of the sagittal crest as in the latter species nor are the temporal ridges of such conspicuous prominence when the skull is viewed from in front. The position of the orbit is approximately in the same position as in *P. carrikeri* and lower down on the side of the face than in *P. hollandi*. The supratemporal foramen is small and, as in the other species mentioned, situated quite close to the median line.

The palatal bones in general are like those in *P. carrikeri*, though the posterior extension of the palatine plate gives the inner nares a more backward position than in that species, as has already been pointed out.

A feature which is characteristic not only of the genus *Promerycochœrus*, but of many other genera of this family is well displayed in the present species, namely, the division of the external face of the maxillary into two fossæ by a broad and inflated ridge (a deep and large pre-orbital fossa above and a shallower depression below the ridge and above the premolars, somewhat analogous to many of the early camels) which includes the anterior portion of the jugal and extends more or less prominently to the border of the anterior nares. In *Merycoidodon* this ridge is also very prominent, but the superior fossa is confined to an area nearer the orbit (the lachrymal pit) while the inferior fossa is broad, shallow, and extends well back above the molars. In *Promerycochœrus* and *Merycoidodon* there was therefore a similarity in the arrangements of the naso-labial and maxillo-nasal muscles. In *Merycochœrus* on the other hand the facial region is, as already stated, entirely different. In the first place the nasals are laterally constricted in the median antero-posterior region, and secondly the inflated ridge referred to above is practically absent, so that the large fossa on the side of the face, though not regularly concave, is nevertheless uninterrupted from the nasals to the lower limit immediately above the alveolar border of the maxillary. This change of the facial region indicates a different distribution of the labial and nasal muscles, the animal having perhaps had a lip with considerable power of prehension or possibly a proboscis as was originally suggested by Leidy.

As in *P. carrikeri* the infra-orbital foramen is small and located above $P^{\underline{4}}$. The premaxillaries are slightly more produced beyond the anterior faces of the canines than in the latter species and, as stated before, the borders which form the sides of the anterior nares are more oblique upwards and backwards. The large anterior palatine foramina are separated in the median line of the premaxillaries by a heavy bony septum, their lateral borders nearly reaching the internal face of the canines, thus the two foramina together display a pear-shaped outline. As stated above, the jugal is much inflated anteriorly and the postorbital and zygomatic processes are of the same shape as in *P. carrikeri.*

One of the chief characters of this species is the shortening of the nasals and the obliquity of the anterior nares. This is a constant feature of all the specimens of this species at hand, and is distinctly different from what is seen in *P. carrikeri.* The anterior free ends are rounded to a blunt point and overhang the nares much in the same way, though further back than in *P. chelydra*, *P. hollandi*, and *P. carrikeri.*

THE MANDIBLE.

The right ramus of the type is preserved. In addition to this we possess other lower jaws and fragments of the jaws of other individuals of the same species. The incisor alveolar border is more produced and rounded so that the incisors and canines form a more curved line from side to side between the first premolars than in *P. carrikeri.*

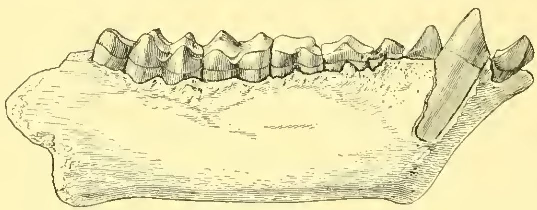


FIG. 33. Lateral view of mandible of *Promerycochœrus vantasselensis.* No. 1230; $\frac{1}{3}$ nat. size.

The symphysis is quite strong, but the chin is not nearly as wide as in the latter species. The ramus of the type, No. 1230, unfortunately lacks the angle and coronoid process, but No. 1232 has the lower jaws nearly complete and shows no other important differences from *P. carrikeri*, except those stated above.

MEASUREMENTS.

	No. 1230 (Type) Mm.
Skull, total length	320
Skull, length from occipital condyle to and including incisors	305
Skull, length from anterior tip of nasals to anterior border of the orbit	115
Skull, length from anterior border of orbit to condyles	172
Skull, length of alveolar border from incisors to back of molar three.	170
Skull, length from end of alveolar border of maxillary to occipital condyle	127

	No. 1230 (Type) Mm.
Skull, greatest transverse diameter	225
Skull, transverse diameter of occipital condyles	53
Skull, transverse diameter of occiput at mastoid plate	130
Skull, vertical diameter of tympanic bulla	33
Skull, antero-posterior diameter of tympanic bulla	30
Skull, transverse diameter of tympanic bulla	24
Skull, greatest transverse diameter of brain cavity	93
Skull, transverse diameter of the frontals over the orbits	100
Skull, transverse diameter of muzzle at anterior nares	45
Skull, greatest transverse diameter of muzzle at base of the canines	91
Skull, transverse diameter of palate at the base of incisors	46
Skull, transverse diameter of palate at p^1	60
Skull, transverse diameter of palate at m^1	51
Skull, transverse diameter of palate at m^3	54
Skull, transverse diameter at base of postglenoid processes	134
Skull, transverse diameter of postglenoid process at base	24
Skull, antero-posterior diameter of postglenoid processes at base	13
Skull, antero-posterior diameter of orbit	36
Skull, vertical diameter of orbit	34
Skull, greatest vertical diameter of zygomatic arch	95
Skull, vertical diameter of jugal below middle of orbit	30
Lower jaw, length from incisors to base of third molar	167
Lower jaw, vertical diameter of jaw at $m_{\overline{3}}$, approximately	55
Lower jaw, vertical diameter of jaw at canine	58

THE SUPERIOR DENTITION.

(PLATE XL, FIG. 2).

The crowns of the incisors are very little wider than their bases, so that after comparatively little wear they are peg-like, and resemble those of *P. carrikeri* in being each separated by diastemata. The crown of the canine is shorter (due to individual variation), and relatively more delicate than in the latter species. In the type, No. 1230, which is perhaps the skeleton of a male, the canine is heavier than in any other individual of this species at hand; it has received considerable wear on the posterior face, but was originally much stouter, though somewhat shorter than in Nos. 1232 and 1232*a*.

In the type $P^{\underline{1}}$ is separated from the canine by a short diastema and is also followed by a second very short diastema on the left, while on the right side it is close to $P_{\overline{2}}$. In Nos. 1232 and 1232*a* the molars and premolars form a closed series. $P^{\underline{2}}$ is placed in an oblique position in the alveolar border; a character which seems to be constant in all of the specimens at hand. The tooth is more robust than that in *P. carrikeri* and has the cingula better developed. Both premolars two and three have smaller antero-posterior diameters than those in *P. carrikeri*, but are transversely wider and have heavier cingula than in the latter species. $P^{\underline{4}}$ is similar in the two species. $M^{\underline{1}}$ is absent. The diameters of $M^{\underline{2}}$ are distinctly greater than those of the corresponding tooth in *P. carrikeri.* The diameters of the third molar are correspondingly large. Although the skull is more delicate in its proportions than that of *P. carrikeri*, the premolar-molar series is more robust, apparently one of the evolutionary features of the phylum. The premolar series occupies a shorter space in the alveolar border than is generally the case in older forms, an advanced [17] feature.

THE INFERIOR DENTITION.

The lower incisors of this species are more spatulate than is usual, are set close together, and have a rather procumbent position. The canine has the usual incisiform character and receives much wear on the external face of the crown by friction with the superior canine. $P_{\overline{1}}$ is robust, but not nearly as much so as in *P. carrikeri*, and its position is somewhat less inclined outward and forward than in the latter species. $P_{\overline{2}}$ has a similar oblique position immediately back of $P_{\overline{1}}$; the tooth is otherwise like that in *P. carrikeri.* All of the premolars are more compactly placed than in *P. carrikeri* which has $P_{\overline{2}}$ quite isolated. The molars are on an average larger than those in *P. carrikeri*, so that including the diastemata back and in front of $P_{\overline{2}}$ in the latter species, the length of the whole dental series is no greater that in *P. vantasselensis.*

MEASUREMENTS.

	No. 1230 (Type) Mm.
Superior dentition, total length	170
Superior dentition, length from incisors to $M^{\underline{1}}$	108
Superior dentition, length of molar series	78
Canine, antero-posterior diameter near base	16
Canine, transverse diameter near base	19
$P^{\underline{1}}$ antero-posterior diameter	14
$P^{\underline{1}}$ transverse diameter	9

[17] We should not lose sight of the fact that certain forms in the Oligocene as *Merycoidodon gracilis* have the premolar teeth reduced to very nearly as great a degree as *Merychyus* from the Upper Harrison beds.

	No. 1230 (Type) Mm.
P^{2} antero-posterior diameter	14
P^{2} transverse diameter	12
P^{3} antero-posterior diameter	15
P^{3} transverse diameter	15
P^{4} antero-posterior diameter	13
P^{4} transverse diameter	19
M^{2} antero-posterior diameter	27
M^{2} transverse diameter	26
M^{3} antero-posterior diameter	35
M^{3} transverse diameter	28
Inferior dentition, total length	175
Inferior dentition, length from incisors to M_{1}	90
Molar series, length	87
P_{1} antero-posterior diameter	17
P_{1} transverse diameter	13
P_{2} antero-posterior diameter	14
P_{2} transverse diameter	8
P_{3} antero-posterior diameter	15
P_{3} transverse diameter	12
P_{4} antero-posterior diameter	19
P_{4} transverse diameter	15
M_{1} antero-posterior diameter	20
M_{1} transverse diameter	17
M_{2} antero-posterior diameter	27
M_{2} transverse diameter	21
M_{3} antero-posterior diameter	43
M_{3} transverse diameter	22

THE VERTEBRAL COLUMN.

Unfortunately the atlas and axis are not represented in our material. The fourth, fifth, and seventh cervicals are at hand. Their neural spines are quite prominent, the centra are short, vertically compressed, and have a strong inferior keel. The transverse processes are shaped as in *P. carrikeri.*

A dorsal vertebra belonging to the type pertains to the anterior part of the column and shows the usual characters found in *P. carrikeri*, viz., a depressed centrum, deeply excavated for the heads of the ribs, keeled below, with heavy transverse processes and indications that the neural spine was robust. A vertebra, representing the middle of the dorsal series is quite similar to corresponding bones in *P. carrikeri*, though lighter, while the last dorsal (the fourteenth), has the neural spine inclined backward, the centrum with a smaller vertical diameter, and the inferior keel very much less developed.

The lumbar vertebræ, six in number, are very well represented. Besides being more delicate in their proportions, they have broader and more depressed centra, more nearly like those of *Merycoidodon culbertsoni* and the zygapophyses are less perfectly rounded than in *P. carrikeri.* The first sacral vertebra has a much broader and more depressed centrum, and the zygapophyses are wider apart than in *P. carrikeri,* while the pleurapophyses indicate that the vertebra supported the pelvis in a similar manner. The robust neural spine is isolated from the succeeding sacrals as in *P. carrikeri,* but has a greater transverse diameter.

There are no caudal vertebræ of this species in our material.

MEASUREMENTS.

	Mm.
Fourth cervical, antero-posterior diameter of centrum	28
Fourth cervical, transverse diameter of centrum, posteriorly	31
Fourth cervical, vertical diameter of centrum, posteriorly	24
Fourth cervical, greatest height including spine, approximately	50
Second ? dorsal, antero-posterior diameter of centrum	28
Second ? dorsal, transverse diameter including capitular facets for the ribs, posterior aspect	35
Second ? dorsal, vertical diameter of centrum, posteriorly	18
Fourteenth ? dorsal, antero-posterior diameter of centrum	35
Fourteenth ? dorsal, transverse diameter of centrum	27
Fourteenth ? dorsal, vertical diameter of centrum, posteriorly	18
Fourteenth ? dorsal, height including spine	68
Lumbar region, greatest length when placed in position	265
Fourth lumbar, greatest transverse diameter including transverse processes	120
Fourth lumbar, transverse diameter of centrum posteriorly	33
Fourth lumbar, vertical diameter of centrum posteriorly	20
Fourth lumbar, antero-posterior diameter of centrum	40
Fourth lumbar, greatest height including neural spine	62
Sixth lumbar, greatest transverse diameter including transverse processes	124
Sixth lumbar, transverse diameter of centrum, posteriorly	40
Sixth lumbar, vertical diameter of centrum, posteriorly	17
Sixth lumbar, antero-posterior diameter of centrum	35

THE RIBS.

There are only a few fragments of ribs belonging to the type, which are quite similar to those in *P. carrikeri,* and need not be described. There are no sternebræ with the type or with any of the material which is referred to this species.

THE FORE LIMB.

The more delicate character of the axial skeleton, when compared with *Promerycochœrus carrikeri*, is reflected in the appendicular parts.

The Scapula.—An imperfect specimen, showing the glenoid cavity, the spine, and a portion of the blade of the left scapula is preserved. The glenoid cavity indicates a more direct antero-posterior articulation with the head of the humerus than is the case in *P. carrikeri.* The spine is not so high and the metacromion tubercle was undoubtedly less developed, while the acromion apparently had about the same proportions as in the latter species. The neck is more constricted and the glenoid border is more prominent, so that the postscapular fossa was perhaps deeper than in *P. carrikeri.*

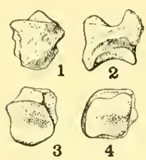
The Humerus.—The proximal end and the greater part of the shaft of the humerus are at hand. The head is quite hemispherical, but has not the antero-posterior diameter or the robustness which obtain in *P. carrikeri.* The great trochanter is apparently as heavy and the bicipital groove is wider and deeper than in the latter species. At the proximal end the shaft has received considerable lateral crushing, so that the antero-posterior diameter appears greater than it really was. The deltoid ridge is prominent and extends somewhat lower down on the shaft than in *P. carrikeri;* otherwise the humerus is similar to the earlier species so far as the material at hand enables us to judge. The distal trochlea of No. 1232, which is preserved, is apparently as oblique as in *P. carrikeri.* The anconeal fossa is broad and low. No supratrochlear foramen can be detected.

The Radius and Ulna.—Unfortunately the radius and ulna of the type are not represented. In Nos. 1232 and 1232*a*, however, these parts, especially the radius, are fairly well preserved, and again show the characteristically broad shaft which is seen in *P. carrikeri.* In the fully adult stage this broadening of the radius is especially noticeable, the external border of the shaft broadening out (especially on the distal half) into a sharp interosseous ridge, instead of being rounded as in *Merycoidodon.* The distal end is transversely expanded. There is a deep groove on the ulnar border of the scaphoid facet, and a wide, deep groove on the posterior margin between the scaphoid and lunar facets. In No. 1232*a* both radii are preserved and show more rounded shafts which may be due partly to crushing, perhaps also to immaturity.

The ulna differs little from that of *P. carrikeri*, except in being less robust.

The Manus.—Only the scaphoid, trapezoid, and the third and fifth metacarpals of the right manus are preserved in the type.

The scaphoid shows some marked differences from that of *P. carrikeri.* While the vertical[18] and transverse diameters are very nearly the same in the two species, the antero-posterior diameter of *P. vantasselensis* is very much less, the palmar protuberance being very much less developed. The articulation for the radius is more deeply concave antero-posteriorly; the anterior ridge somewhat narrower, but the antero-external angle rises in about the same manner to form the high, overhanging crest, which fits into the deep oblique groove of the scaphoid facet of the radius. The inferior facet for the lunar



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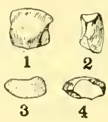

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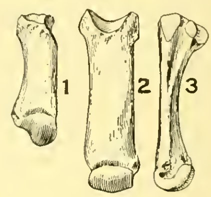

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FIG. 34. Scaphoid of *Promerycochœrus vantasselensis.* No. 1230; $\frac{1}{3}$ nat. size. 1. dorsal view; 2, radial view; 3, proximal view; 4, distal view.

FIG. 35. Trapezoid of *Promerycochœrus vantasselensis.* No. 1230; $\frac{1}{3}$ nat. size. 1, radial view; 2, dorsal view; 3, proximal view; 4, distal view.

FIG. 36. Metacarpals of *Promerycochœrus vantasselensis.* No. 1230; $\frac{1}{3}$ nat. size. 1, dorsal view of metacarpal V, right manus; 2, dorsal view of metacarpal III, right manus; 3, radial view of metacarpal III, right manus.

takes up a considerable part of the external face and above there is a small facet indicating a contact with the lunar, which is not present in *P. carrikeri.* Distally the scaphoid has the facet for the trapezoid located more laterally, causing the bone on the radial side to appear more compressed than is the case in *P. carrikeri.* There is no facet for the trapezium.

The trapezoid is relatively smaller, but otherwise there is no difference in shape from that of *P. carrikeri.* The facet for the trapezium is large, and occupies the postero-lateral angle, extending from near the proximal to the distal face, forming a sharp angle with the facet for the second metacarpal. Mc. III has the same general pro-

[18] In passing it may be noted that the vertical diameter of the scaphoid in *Mesoreodon*, though a smaller animal, is very nearly as high as in this species.

portions though somewhat more flattened than in *P. carrikeri.* The proximal end has the usual strong interlocking facets, the shaft is nearly straight, and the distal trochlea is characteristically of the Merycoidodont-type. Mc. V was also found, but presents no noteworthy features. There are no phalanges, which I can positively associate with the manus.

MEASUREMENTS.

	No. 1230 (Type) Mm.
Scapula, total height of the fragment	195
Scapula, antero-posterior diameter at glenoid cavity including coracoid	50
Scapula, greatest transverse diameter at glenoid cavity	33
Scapula, transverse diameter at neck	30
Humerus, greatest antero-posterior diameter at head including the greater tuberosity	80[19]
Humerus, greatest transverse diameter at the head, approximately	50[19]
Humerus, antero-posterior diameter of articulation of head	45
Humerus, transverse diameter of the articulation of the head	40
Humerus, total length of fragment	178
Radius, total length	115[20]
Radius, transverse diameter of head	43[20]
Radius, antero-posterior diameter of head	21[20]
Radius, antero-posterior diameter of distal end	22[20]
Radius, transverse diameter of distal end	42[20]
Scaphoid, antero-posterior diameter	22
Scaphoid, transverse diameter	20
Scaphoid, height, posteriorly	21
Trapezoid, greatest height	15
Trapezoid, antero-posterior diameter	16
Trapezoid, transverse diameter	8
Mc. III, length	71
Mc. III, transverse diameter of head	23
Mc. III, antero-posterior diameter of head	21
Mc. III, transverse diameter of the shaft in the middle	17
Mc. III, antero-posterior diameter of the shaft in the middle	8
Mc. III, transverse diameter of distal trochlea	18
Mc. III, antero-posterior diameter of distal trochlea including keel	16
Mc. V, length	52

THE HIND LIMB.

The pelvis presents a striking difference from that of *Promerycochœrus carrikeri.* Besides being lighter, it is very much shorter, and a

[19] The humerus is crushed in this region which renders these measurements unreliable.

[20] These measurements are taken from No. 1232 referred to in the text.

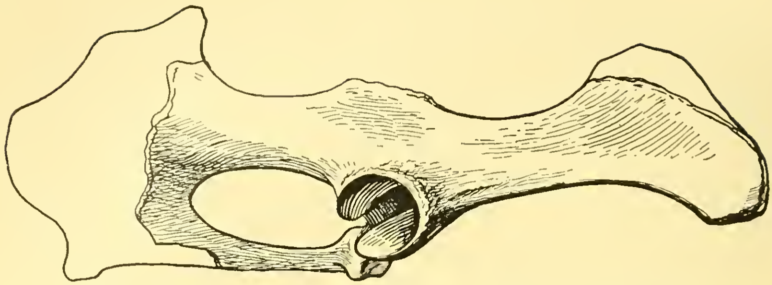


FIG. 37. Side view of pelvis of *Promerycochœrus vantasselensis.* No. 1230; $\frac{1}{3}$ nat. size.

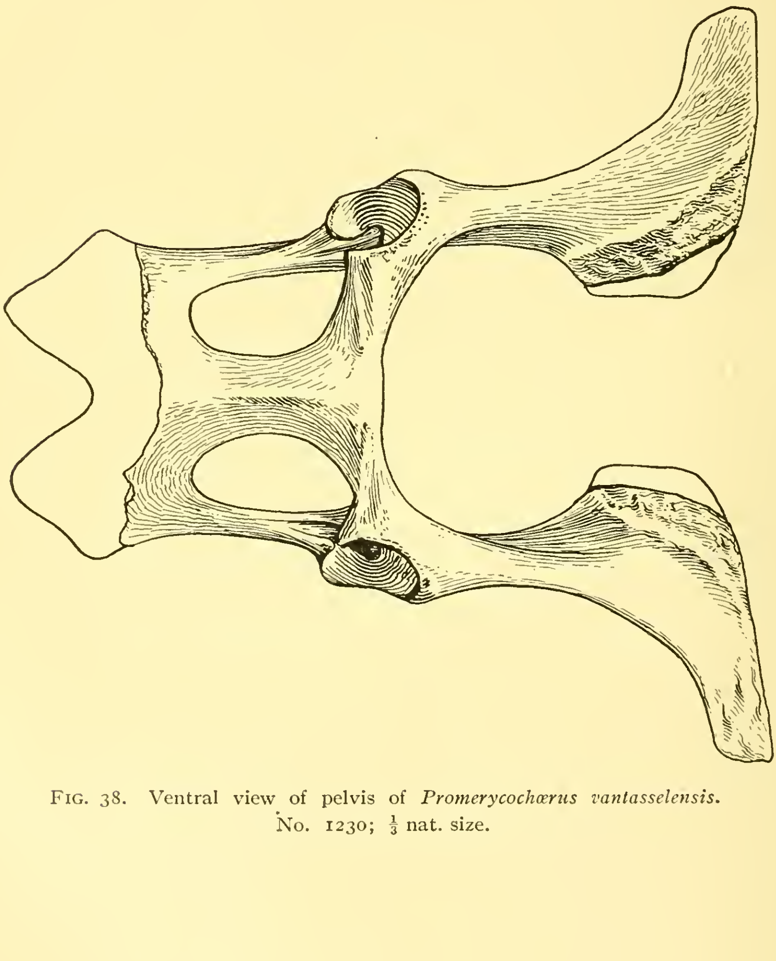


FIG. 38. Ventral view of pelvis of *Promerycochœrus vantasselensis.* No. 1230; $\frac{1}{3}$ nat. size.

great deal broader. The point of the ilium is much expanded transversely when in position, the supra-iliac border is more rounded and the ilium as a whole is shortened when compared with that of the first-named species. The acetabular border forms a greater curve from the point of the ilium to the acetabulum; the latter is nearly as large, but not so deep; the pit for the ligamentum teres is also not so

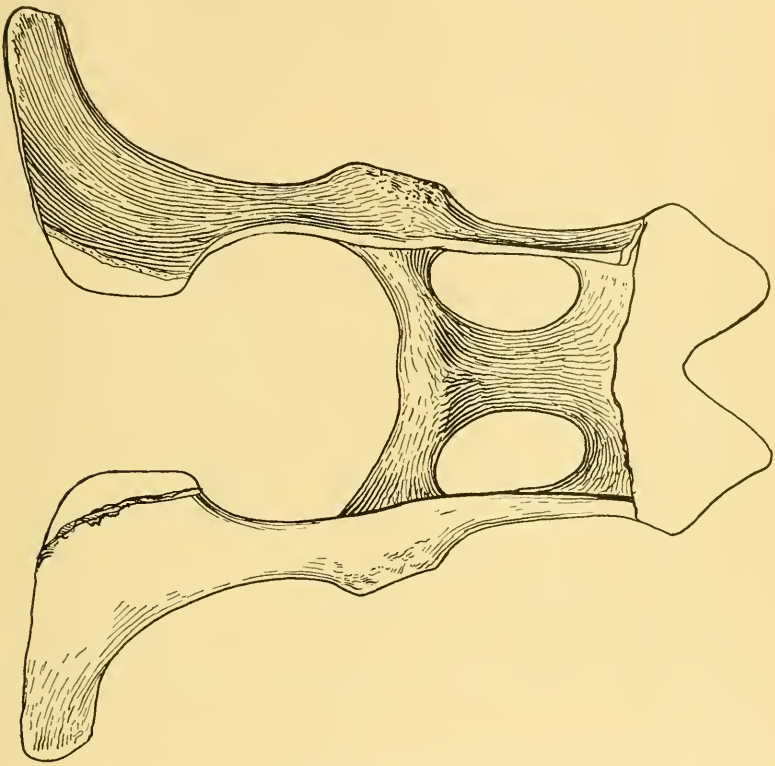


FIG. 39. Dorsal view of pelvis of *Promerycochœrus vantasselensis.* No. 1230; $\frac{1}{3}$ nat. size.

deep, but the cotyloid notch is very much broader, and is more nearly like that of *Mesoreodon chelonyx.* In fact the ilium as a whole more nearly resembles that of the latter. Unfortunately the ischium is broken off posteriorly, but, even if the broken area attained the same length as in *P. carrikeri,* it would still be a much shorter pelvis than that of the last mentioned species. The ascending ramus of the pubis is long and the horizontal ramus is broad, so that when the two innominata are in position they form a rather wide pelvic cavity, entirely unlike that of *P. carrikeri*. The obturator foramen is shorter and not so perfectly ovate as in the Merycoidodonts generally.

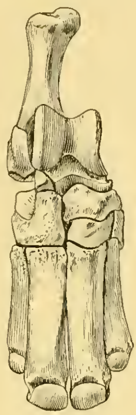
The Femur.—The femur of the type is not present. However, the distal end and the greater part of the shaft of a femur belonging to No. 1239 reveal some differences from *P. carrikeri*, *i.e.*, the shaft is more curved, the internal condyle is greater than the external, with a deeper and wider groove between the two, the external border of the rotular trochlea is more rounded and somewhat less produced upward upon the shaft.

The Tibia.—When compared with that of *P. carrikeri* the tibia is slenderer; it is however short, and has the head expanded, especially transversely. The spine is heavy especially on the postero-lateral angle. Apparently the external facet for the articulation with the femur has relatively a somewhat smaller transverse as well as antero-posterior diameter than in *P. carrikeri*. There is a small round facet for the fibula at the postero-external angle. The bone is damaged in the region of the tendinal groove on the external face of the head, but this groove was evidently large. The cnemial keel is very prominent and extends well down on the shaft, though not so low as in *Merycochœrus*. Distally the tibia is expanded, but points less outwardly than in *P. carrikeri*. The internal malleolus is not so strongly developed and does not point outward in the same way as in *P. carrikeri*, *Mesoreodon*, and many other forms.

Only a portion of the shaft of the fibula of the type was found. It is relatively as heavy as in *P. carrikeri*, but is not coössified proximally. The distal end of a fibula is preserved with No. 1232. In this the malleolus is quite heavy, the shaft rapidly contracting above. The articulation for the calcaneum is as large as in *Promerycochœrus carrikeri* and otherwise similar.

The Pes.—The tarsus is strikingly different from that of *Promerycochœrus carrikeri*. The calcaneum has a shorter sustentaculum, a relatively longer and slenderer tuber, the groove for the tendo achillis narrower, deeper, and not oblique. There is a long, rugose, and swollen area on the plantar face of the tuber, which causes an enlargement in the middle region of the shaft above the sustentacular facet. In another specimen, No. 1239, which is referred to the same species, this plantar enlargement of the middle region of the tuber calcis is very much more pronounced.

A characteristic feature of the astragalus in the type is the very shallow pit[21] on the internal face of the trochlea, partly occupied by the free end of the internal malleolus of the tibia, which in most Merycoidodonts is rather well-developed. In *P. çarrikeri* this pit is especially well-developed in order to accommodate the extra large internal malleolus. This is a condition which helps to strengthen the ankle in the earlier species, while in the present form the malleolus, as stated in the description of this bone, is not so large, the free end is not directed as strongly outwardly, and the interlocking feature is



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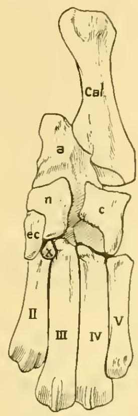

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FIG. 40. Dorsal view of pes of *Promerycochœrus vantasselensis.* No. 1230; ⅓ nat. size.

FIG. 41. Plantar view of pes of *Promerycochœrus vantasselensis.* No. 1230; ⅓ nat. size. *cal*, calcaneum; *a*, astragalus; *n*, navicular; *c*, cuboid; *ec*, entocuneiform; *x*, metatarsal I, or a lodged sesamoid; II, III, IV, V, second, third, fourth, and fifth metatarsals respectively.

consequently much less noticeable. The external condyle of the proximal trochlea is, as usual, very much higher and stronger than the internal. The latter is less rounded on its edge than in *P. carrikeri* and is more like that of *Merycoidodon culbertsoni.* The distal trochlea is rather shallow and the navicular facet is somewhat broader than in *P. carrikeri.* The astragalus as a whole is comparatively low and broad, but not to the same extent as in *Merycochœrus* from later horizons.

[21] In another individual, which has been referred to this species, there is an unusually deep and rounded tendinal pit below the malleolar articulation, which is scarcely represented in the type.

The height of the cuboid is as great as in *P. carrikeri*, while the antero-posterior and transverse diameters are considerably less. The calcaneal and astragalar facets are, as in the latter species, equally divided on the proximal face. The plantar tuberosity extends lower down and is more pointed, but not nearly so robust as in the older form.

The descending plantar hook of the navicular is very robust both fore-and-aft and laterally, while the fibular division is not as deep nor so much to one side as in the older type. The anterior lip, with which the cuboid articulates, is consequently less perfectly wedge-shaped and has a greater vertical diameter. The facets for the coössified ecto- and meso-cuneiforms vary in outline from round to oblong.

The coalesced ento- and meso-cuneiform is of relatively smaller size and has not the triangular outline, which it possesses in *Promerycochœrus carrikeri* and the Merycoidodonts generally, the posterior angle being less produced behind. On the fibular face the bone is slightly damaged, but the plantar angle is complete. Proximally there is a single large facet for the navicular. The distal surface is almost entirely taken up by the articular facet for the third metatarsal; the facet for the second metatarsal is somewhat smaller than in *P. carrikeri* and, as usual, is situated higher up, so that the head of Mt. II is above that of Mt. III, when the bones are in position.

The ento-cuneiform is an irregularly shaped sesamoid-like bone, having a considerable vertical diameter. Above it articulates, as usual, with the inferior face of the navicular, continues past the meso-cuneiform on its plantar tibial face, with which it articulates, and extends well down on the postero-internal face of the head of Mt. II, with which it also articulates by a broad concave surface.

Between the distal end of the entocuneiform and on the posterior face of the head of Mt. II was found a minute sesamoid-like nodule which has the position of a first metatarsal. This nodular bone has a perfect articular facet which rests against Mt. II as stated above, while on its internal face it is slightly damaged. Whether or not there was present an articulation for the ento-cuneiform cannot be stated. On the latter bone a rounded narrow margin on the posterior face close to the facet for Mt. II may be seen, which, however, could hardly be regarded as a true facet. While the hallux may possibly still be represented in these forms it is also quite possible that a sesamoid might have lodged in this suggestive position. At all events caution should be exercised until more material is found, proving or disproving that the condition found in the present specimen is normal.

With the exception of the lighter build and shorter length of the metatarsals these bones in *P. vantassalensis* do not greatly differ from those of *P. carrikeri*. The phalanges are broad, depressed, and short.

MEASUREMENTS.

	No. 1230 (Type) Mm.
Pelvis, diameter from point of ilium to ischial tuberosity	228
Pelvis, diameter from point of ilium to middle of acetabulum	155
Pelvis, greatest transverse diameter of both ilia when in position	285
Pelvis, transverse diameter of pelvic cavity opposite the acetabula	100
Pelvis, transverse diameter of pelvic cavity, posteriorly	95
Tibia, greatest length	198
Tibia, transverse diameter of the head	53
Tibia, antero-posterior diameter of the head, approximately	50
Tibia, antero-posterior diameter of distal end	24
Tibia, transverse diameter of distal end	34
Calcaneum, length, approximately	78
Calcaneum, antero-posterior diameter at sustentacular facet	31
Calcaneum, antero-posterior diameter at tuber calcis	24
Calcaneum, transverse diameter of tuber calcis	12
Tarsus, height	60
Tarsus, breadth	43
Astragalus, height	42
Astragalus, breadth	27

CONCLUDING OBSERVATIONS.

The foregoing pages represent an effort to elucidate the osteology of one genus of the Agriochœridæ, a family which comprised numerous genera and species exclusively North American, which became extinct in the latter part of the Tertiary. The family apparently was well established in the late Eocene (Uinta), though at that early time showing many affinities to the Tylopoda, as was true also of many other artiodactyls at that period, as has been pointed out by Scott.[22]

Before concluding it remains for the writer to present some views which he holds as to the geology of the region where these specimens were found, and to add a few remarks as to the evolution and phylogenetic relationships of the genus *Promerycochœrus* and its allies.

The Upper and Lower Harrison beds in western Nebraska and eastern Wyoming constitute two horizons, having together a thickness of less than four hundred feet. They are superimposed upon one another

[22] "Uinta Selenodonts," *Trans. Wagner Free Institute of Science*, Vol. VI, 1899, pp. 15–126.

throughout the region, occasionally revealing slight indications of non-conformity, as has been explained by the writer in earlier publications. Near the top of the Lower Harrison beds is found *Promerycochœrus vantasselensis*, while in the Upper Harrison beds *Merycochœrus* is found in considerable numbers. We have seen that the anatomical differences between the two genera are too great to allow us to regard the latter as descended from the former, unless we admit that there was a considerable lapse of time between the deposition of the two horizons. The Upper Harrison beds consequently must be regarded as of much later origin than the Lower, possibly representing the base of the Middle Miocene. This would give time enough for the evolutionary changes which are required under the hypothesis that *Merycochœrus* is descended from *Promerycochœrus*. The lithological differences in the two horizons are indeed slight, but, such as they are, they tend to support the idea of a break or hiatus between the two horizons.

The general similarity of the lithological features of the two horizons on the other hand seems to indicate that these sediments were laid down under somewhat similar conditions, and that their source was the same. If the view that there was no appreciable interval between the deposition of the Lower and Upper Harrison beds should be successfully maintained, I am puzzled to conceive in what way the general conditions of life should have been so altered in such a limited geographical locality and in a comparatively short geological period of time in such a way as to cause these animals to undergo the mutations, which we are forced to admit must have occurred in order that we may connect *Promerycochœrus* and *Merycochœrus* as members of one phylogenetic stem.

In his remarkable work, "The Age of Mammals," Professor Osborn is inclined to attribute the sediments of this region, which include the Gering, the Monroe Creek and the Lower Harrison beds, and which immediately overlie the Leptauchenia beds, to the Upper Oligocene. One of his statements is as follows: (*l. c.*, p. 232) "It would appear this mammalian assemblage of the Upper John Day, Lower Arikaree, Lower Harrison, and Lower Rosebud is still characteristically Oligocene rather than Miocene." From the view thus expressed the writer is inclined to dissent. In my opinion there is no reason to regard the faunal differences between the Lower and the Upper Harrison beds as being any greater than, if as great as, those between the Leptauchenia beds and the Gering and Monroe Creek horizons. Would it not be equally justifiable to say that the Lower Oligocene has a still characteristically Upper Eocene fauna, as to say that the Lower Harrison has a "characteristically Oligocene" fauna? Have we not in the Lower Oligocene the Hyracodonts, the Titanotheres, the Metamynodonts, the Hyænodonts, and the Anthracotheres, which do not occur in the Lower Miocene (Monroe Creek and especially the Lower Harrison beds)? Would not the absence in the Lower Miocene of these forms of the Lower Oligocene correspond to some extent to the characteristic absence in the Lower Oligocene of such forms as *Eobasileus*, *Achænodon*, *Mesonyx*, and other archaic forms found in the Upper Eocene (Uinta) and entirely absent in the Oligocene?

It is after all only in a rather vague and superficial manner that we can correlate the formations of widely separated localities. We have, indeed, as Osborn has clearly pointed out, the Lower Miocene clearly indicated in Europe by the sudden appearance of a number of strange forms, such as the proboscidians, dinotheres, short-limbed teleoceran forms of the Rhinocerotidæ, the antelopes (Protragoceras) and other forms; while in North America on the other hand the transition from the Oligocene to the Miocene, so far as evidence is afforded by their faunæ, appears to have been gradual and not marked by the sudden introduction of many new forms.

It is very well agreed among geologists as well as paleontologists that there are well-marked lithologic differences between the uppermost Oliogocene (Leptauchenia beds) and the succeeding formations (Gering and Monroe Creek beds) in western Nebraska and Wyoming; differences so great as to justify the belief in an important geologic interval. This view is not of recent origin. Although the remains supposed to have been found in Dr. Hayden's "Horizon E" of this general section do not seem to agree with material subsequently found in the Monroe Creek, Rosebud, and Lower Harrison beds, it is quite evident from his description that these deposits, especially along the upper waters of the Niobrara River, answer well to his statements. After all in many instances we are only dealing with convenient imaginary lines in separating geologic formations as well as phyletic series in paleontology. Instead of establishing the point of division between the Oligocene and the Miocene by running a line through a sedimentary mass of quite uniform character, as in the Upper and Lower Harrison, I personally prefer, being guided by lithological as well as faunal features, to regard the beds (Monroe Creek and Lower Harrison) overlying the Leptauchenia beds in Nebraska as belonging to the Lower

Miocene. It has been pointed out by Matthew and the writer that in the Lower Arikaree deposits of the plains we not only have many new genera, but those which are related to forms found in the John Day beds are always farther along in the trend of their evolutionary development, showing that they belong to a later period than the John Day. The Upper Harrison beds should be regarded as sediments representing the transition period between the Lower and the Middle Miocene. We have indeed some reason for believing that the Proboscidians were already in this country at the close of the Lower Miocene, or at the very beginning of the Middle Miocene.[23]

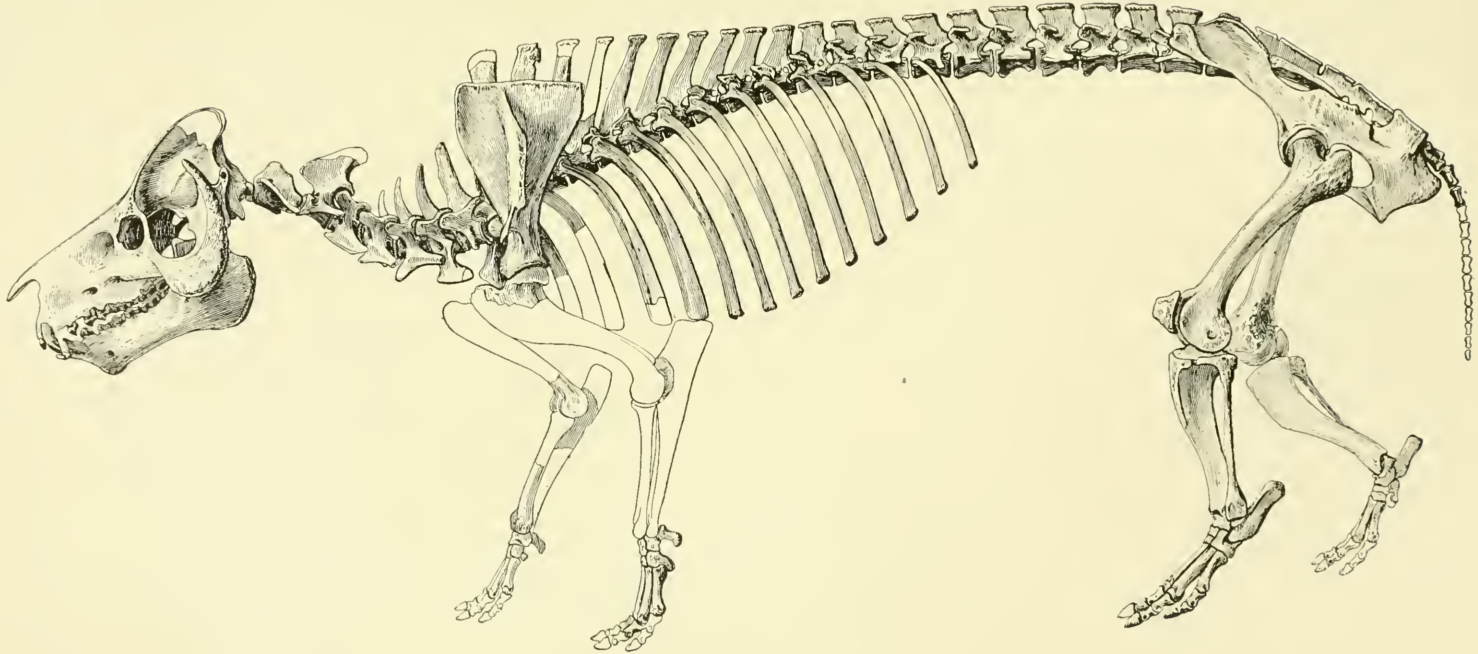
Even granting that a long time elapsed between the formation of the deposit in which *Promerycochœrus* occurs and the deposits in which *Merycochœrus* is found, we are nevertheless confronted in the anatomy of *Promerycochœrus* with features which are obstacles to our regarding this genus as the direct ancestor of *Merycochœrus*. In contending with these obstacles we might resort to an explanation based upon atrophy and hypertrophy, but such an explanation gives no idea of the *reason* why in one case an organ should have been diminished and in the other functionally increased in power, as well as in size, and amounts to little more than saying that in one case the organ was enlarged and in the other diminished.

The claim might be set up that some species of the genus *Promerycochœrus*, especially such a species as *P. vantasselensis* is to be regarded as an immediate forerunner of *Merycochœrus* and that through it the phylogenetic history of these two genera is to be explained. Against such an hypothesis is the fact that in *P. vantasselensis* there are a number of tenaciously persistent characters, which recall those of the earlier types, *P. carrikeri* and *P. chelydra*. In *P. vantasselensis* there is, for instance, no tendency in the superior incisors to become larger, no sudden contraction of the muzzle immediately in front of the jugal, no shifting backward of the infra-orbital foramen, no appreciable widening of the upper portion of the occipital plate, and a number of other minor cranial features, which should go hand-in-hand with the progressive changes of the premolar-molar dentition and the shortening of the nasals in order to completely represent the points required in a true ancestor of *Merycochœrus* (compare Plate XL with Figure 2 on Plate XLII).

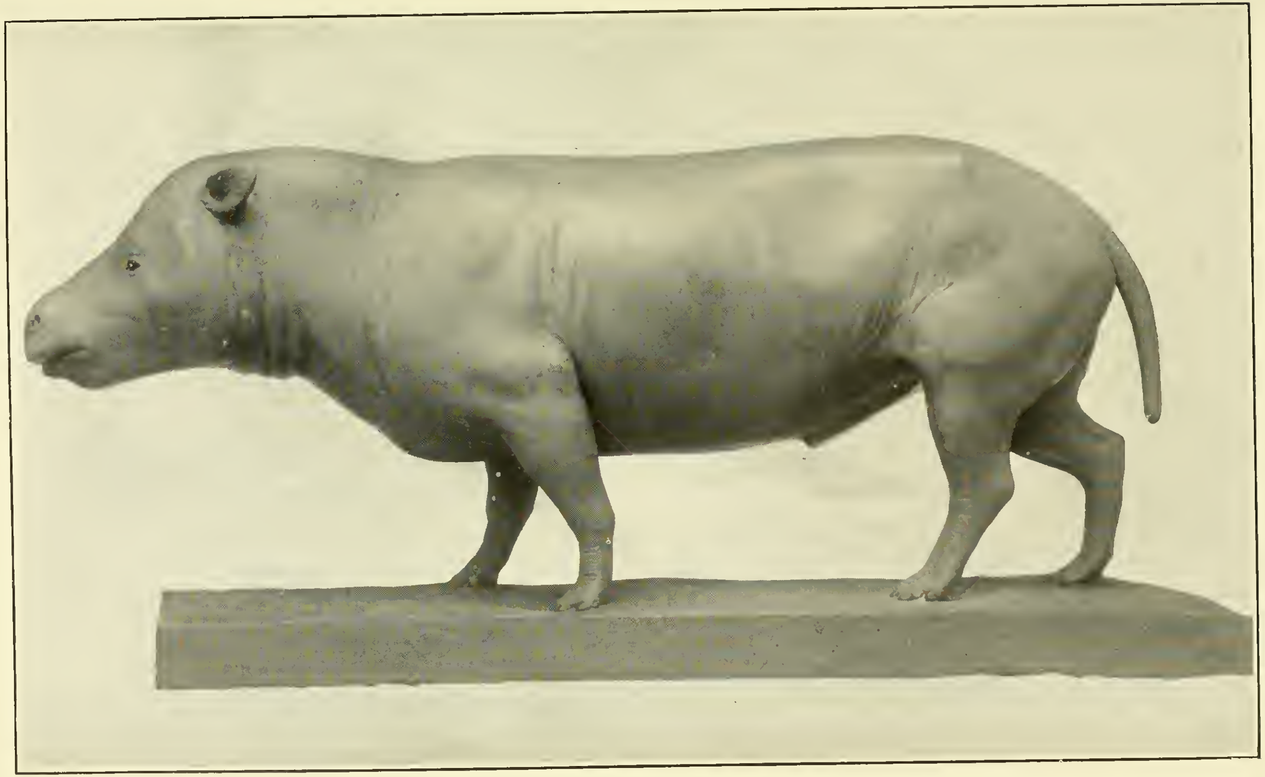
[23] Cook, Harold J., "A New Proboscidian (*Gamphotherium condon*) from the Upper Harrison beds of Nebraska," *American Journal of Science* (4), Vol. XXVIII, Aug., 1909, pp. 183–184.

Group of Skeletons Representing Three Specimens of *Promerycochœrus carrikeri* Peterson, as they were found in the matrix. The type is specimen No. 1080. The Group is installed in the Gallery of Vertebrate Paleontology in the Carnegie Museum, $\times \frac{1}{9}$. (Reproduced from Annals Vol. IV., Pl. IX.)

Diagram of quarry showing the position in which the skeletons of *Promerycochœrus carrikeri* (type and paratypes) were found

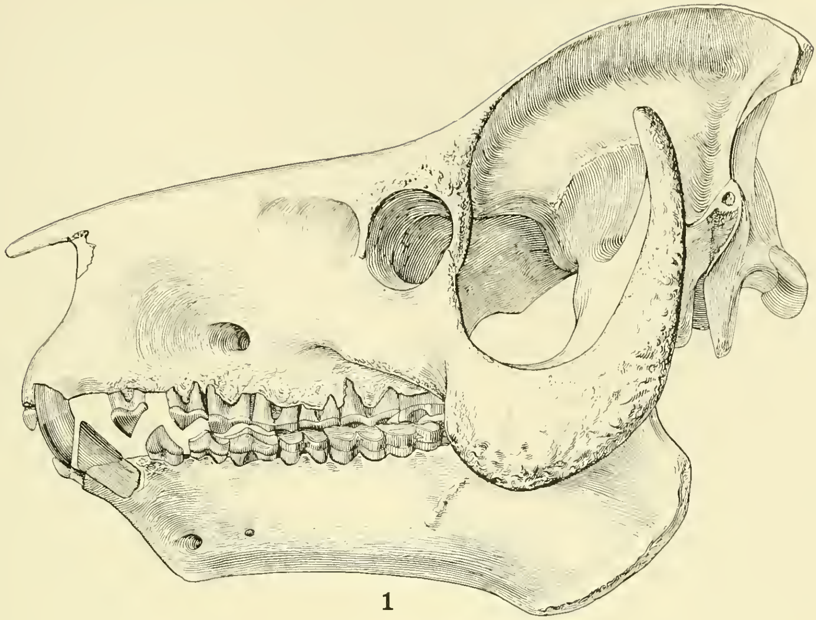


Articulated skeleton of *Promerycochœrus carrikeri* $\frac{1}{9}$ nat. size.



Full relief model of *Promerycochœrus carrikeri* about $\frac{1}{12}$ nat. size. Modeled by T. A. Mills, under the direction of W. J. Holland and O. A. Peterson.

Models of *Promerycochaerus carrikeri* from the skeletons on Plate A representing the animals at rest. About $\frac{1}{19}$ nat. size. Modeled by T. A. Mills, under the direction of W. J. Holland and O. A. Peterson.



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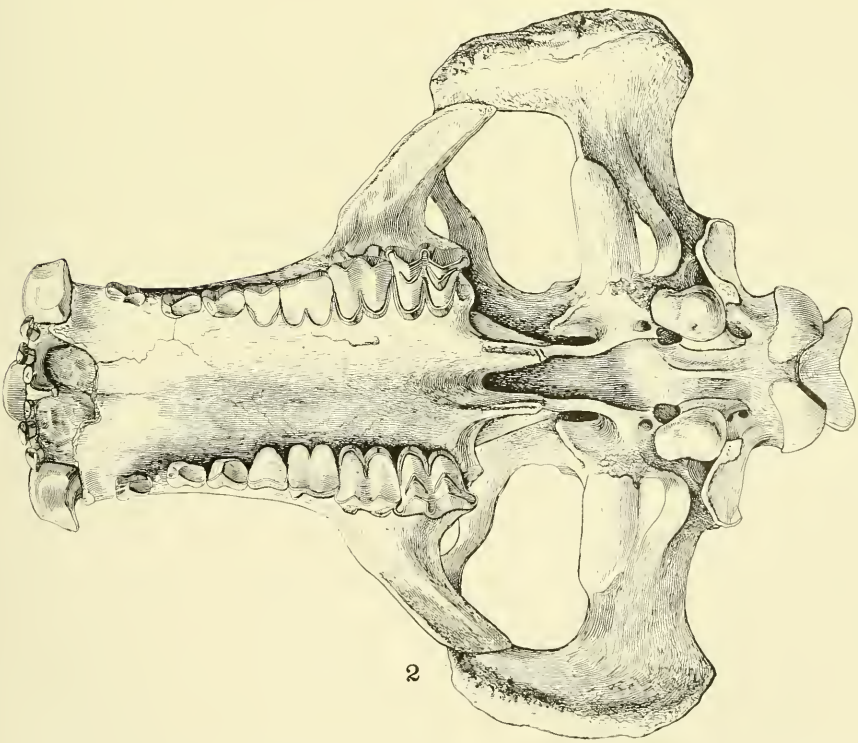
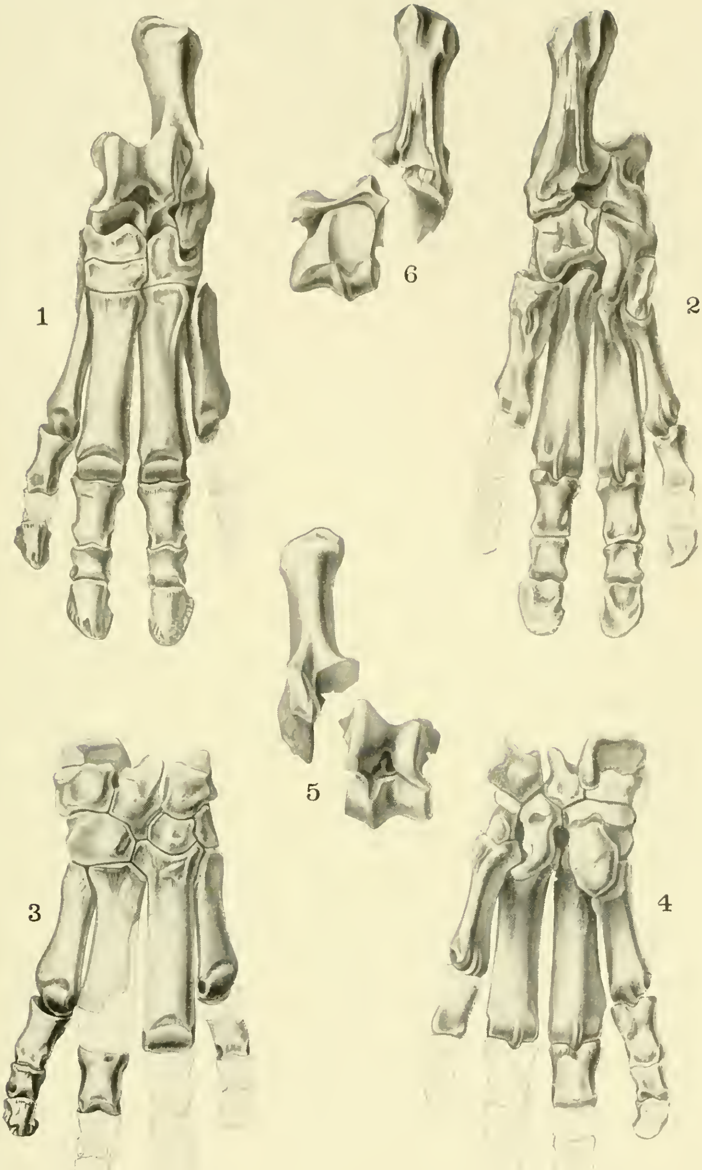
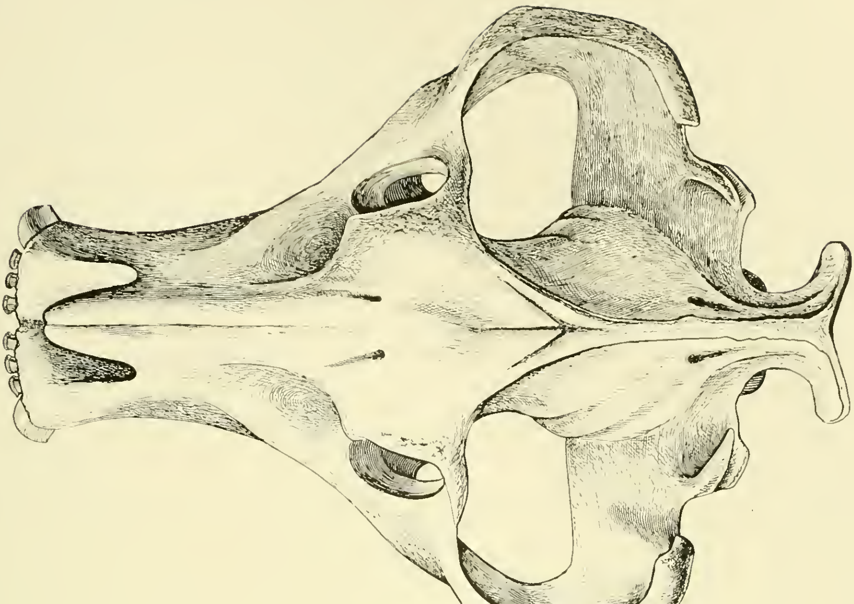


2

Skull of *Promerycochœrus carrikeri* No. 109; $\frac{1}{3}$ nat. size. 1, side view of skull; 2, palatal view of cranium.



Manus and pes of *Promerycochœrus carrikeri* $\frac{1}{3}$ nat. size. 1. dorsal view of pes; 2. plantar view of pes; 3. dorsal view of manus; 4. palmar view of manus; 5. dorsal view of calcaneum and astragalus; 6. plantar view of calcaneum and astragalus.



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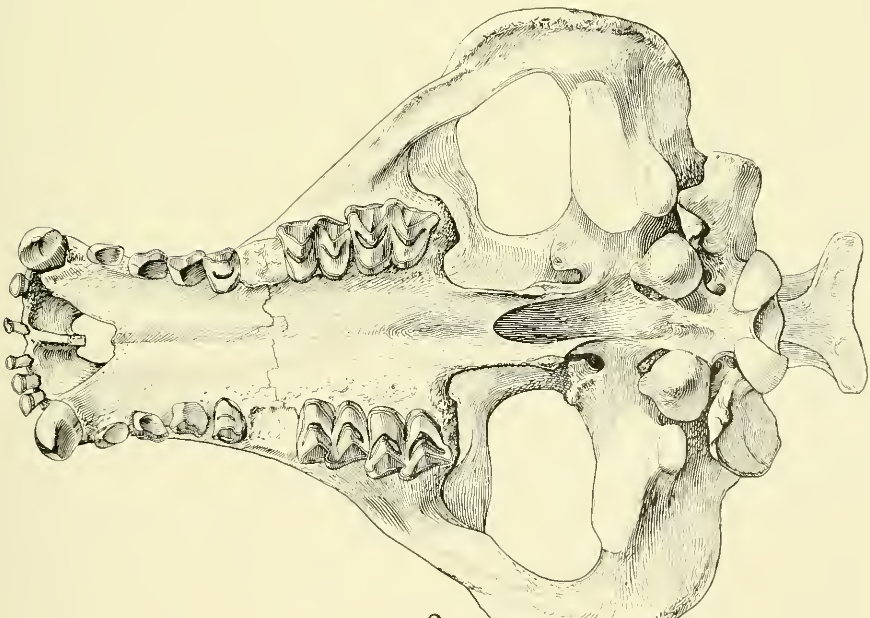
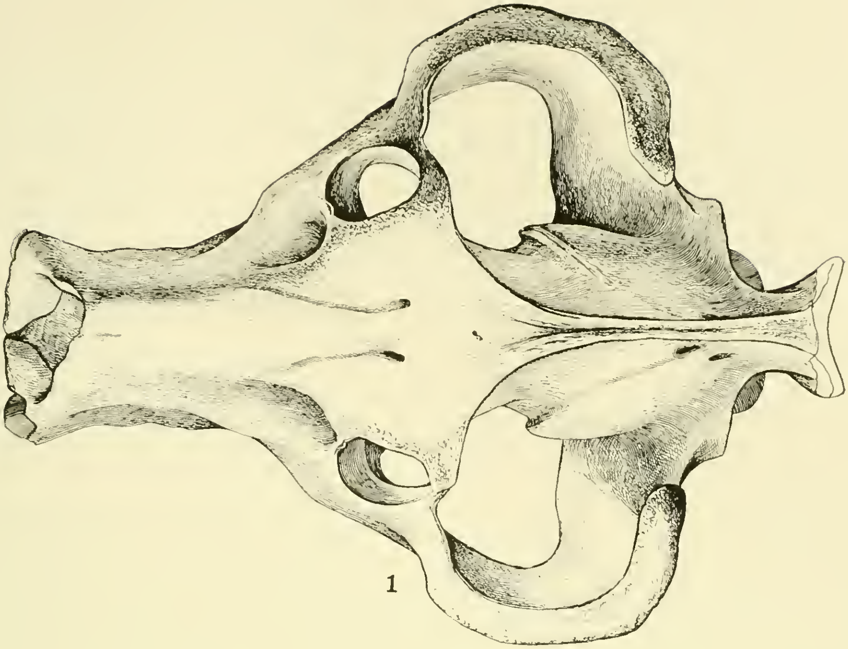


2

Dorsal and palatal views of cranium of *Promerycochœrus vantasselensis*, $\frac{1}{3}$ nat. size.



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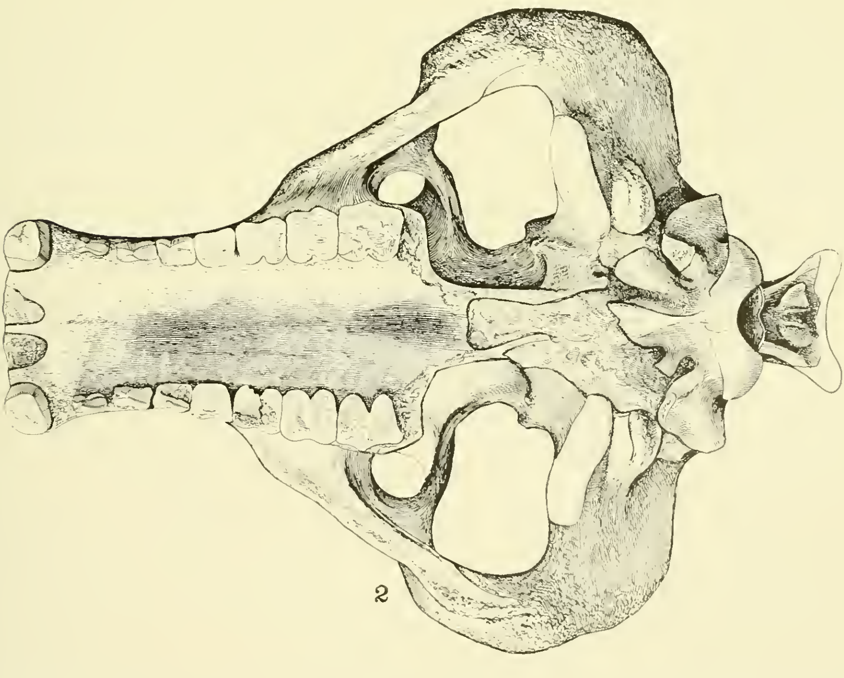

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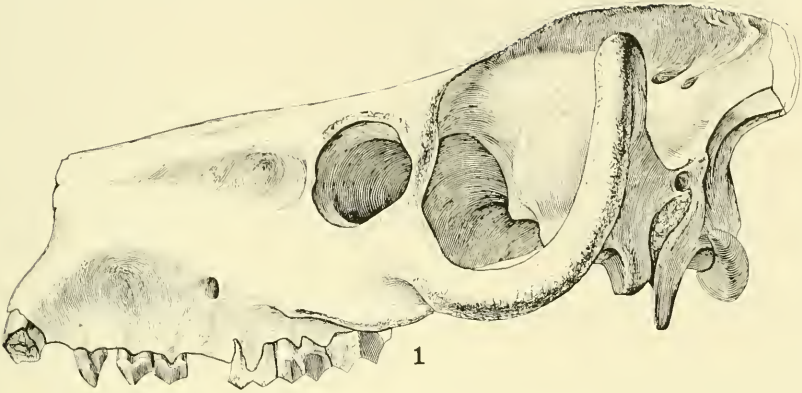
Dorsal and palatal views of *Promerycochœrus chelydra* Cope. American Museum collection, No. 7430; $\frac{1}{3}$ nat. size.



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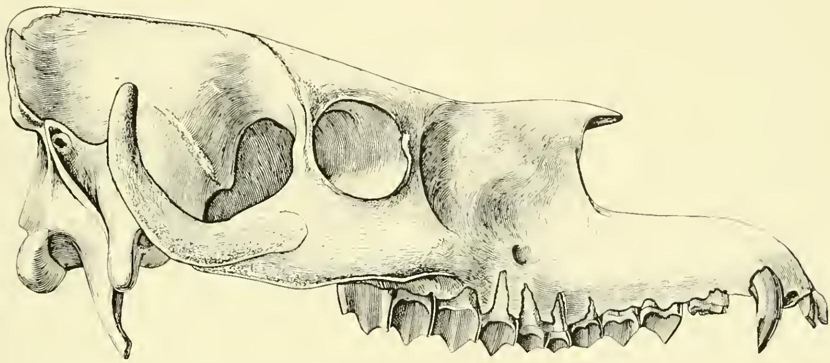

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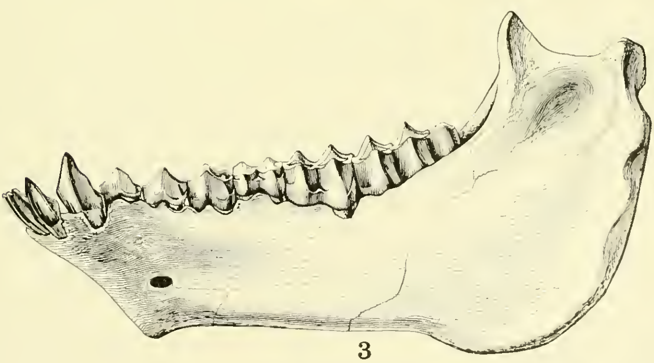

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1. Side view of cranium of *Promerycochœrus chelydra* Cope; American Museum Collection, No. 7430. 2. Side view of cranium of *Merycochœrus* (?) *proprius* Carnegie Museum Collection, No. 1399. 3. Lower jaw of *Merycochœrus* (?) *proprius*. Carnegie Museum Collection, No. 1306. All figures $\frac{1}{3}$ nat. size.

Although speculation along such lines as these is alluring, and sometimes irresistible to the student, anatomical features, which are at best rather difficult to understand, even when we have an abundance of perfect material representing the various closely related forms, should not be confidently regarded as supporting theories, which at best often prove fallacious.

Finally attention should be called to the fact that there have been already established two genera, *Merycochœrus* and *Pronomotherium*, which are quite variant, and represent two widely diverging races or phyla. It is the view of the writer that *Promerycochœrus* represents an additional phylum of the large oreodonts, which occurred in the Miocene. It has been stated elsewhere that the type of the imperfectly known form, *Merychyus major* Leidy, has the infra-orbital foramen so situated as to recall *P. vantasselensis*. Judging from the characters observed in the latter species, it belonged to a phylum which undoubtedly had a high and narrow occiput, moderately long cranium, short face, and the side of the face divided into two fossæ, which features are also found in smaller forms, such as *Merychyus*, and are survivals of characters found in earlier Oligocene forms, while other features represent a development along lines more nearly parallel with what we see in *Merycochœrus*. Whenever more nearly complete remains of *Merychyus major* from the Middle Miocene are discovered, it will probably be shown that this species belongs more nearly to the line of *P. vantasselensis*. The immediate ancestors and the manner of the evolution of *Merycochœrus* and *Pronomotherium* are as yet imperfectly known.

The sudden appearance of new forms in a given geological horizon no doubt frequently indicates that they are immigrants in the locality where they occur, and represent lines of evolution parallel to that of the indigenous forms with the remains of which they are intermingled. The species of *Promerycochœrus* found in the Lower Miocene of Nebraska and Wyoming possibly may be descended from such forms as *P. chelydra* from the John Day beds (Compare Plates XXXVIII and XL with Plate XLI and Figure 1 of Plate XLII); their descent is not, so far as we now know, traceable from any of the Oligocene forms hitherto found in the same general region in which they occur. The smaller Oligocene Oreodonts appear on the other hand to have their descendants in such forms as *Eporeodon*, *Mesoreodon*, *Phenacocœlus*, *Merychyus*, and finally in the Pliocene *Metoreodon*.

XIII. CORRECTION OF A GENERIC NAME.

By O. A. Peterson

Eotitanotherium, a New Generic Name to Replace **Diploceras** Peterson. (See Annals Carnegie Museum, Vol. IX, Article 2; published August 17, 1914).

In my article entitled "A New Titanothere from the Uinta Eocene" I employed the generic name *Diploceras*, having overlooked the fact that this name is already pre-occupied, having been employed by Conrad as early as 1844 to designate a genus belonging to the Mollusca. For this name I now substitute the name *Eotitanotherium*, which, after a diligent search of the literature, I believe is not preoccupied.

O. A. Peterson.

Sept. 12, 1914.

ANNALS

OF THE

CARNEGIE MUSEUM

Vol. IX, Nos. 3 and 4.

Editorial Notes.

The work in the Section of Paleontology during the past months has not only resulted in gratifying additions to the material obtained in the field, but in the extraction from the matrix and the assemblage of skeletons of a number of extinct animals heretofore not completely represented in any other museum.

Mr. Douglass reports from the quarries in Utah which we have been working for a number of years, that he has discovered the greater part of the skeleton of an *Allosaurus*, or allied Theropod, a number of skulls of various sauropoda in more or less perfect condition, and the remains of a huge sauropodous dinosaur, which he provisionally assigns to the genus *Barosaurus*, the centra of the cervical vertebræ of which are from three to four feet in length.

Mr. Peterson has guided Mr. Agostini in the work of restoring a skeleton of *Merychyus*, the first complete skeleton of this genus which has ever been mounted. A vast quantity of material representing the Merycoidodonts, collected by Mr. Peterson in Nebraska in former years, has been freed from the matrix and is being studied by him. The Director has devoted much of his time to the study of the skeleton of the huge sauropod which is being mounted alongside that of the Diplodocus. This skeleton, which is undoubtedly in many respects the most perfect specimen of a sauropod dinosaur which has thus far been recovered in North America, tends to show that our conceptions as to the structure of these animals require revision in some important particulars. A monographic paper upon this material will shortly appear in Volume VII of the Memoirs, fully illustrated with carefully prepared drawings executed by Mr. Prentice under the supervision of the writer.

MR. O. E. JENNINGS, accompanied by Mrs. Jennings, spent the entire summer in the region north of Lake Superior and about Lake Nipigon, continuing the botanical survey of that region which was initiated in 1912. They brought with them large collections of the plants of the region, and report many interesting observations bearing upon the geographical distribution of species. Their researches have extended the range of many eastern species westward and of many western species eastward of the points at which heretofore it was supposed their respective ranges terminated. Incidentally they made considerable collections of the insects of the region, with results which are quite gratifying.

MR. HUGO KAHL, accompanied by his wife, spent his summer vacation in Ontario. The result has been the importation into the Museum of a very large series of beautifully collected specimens of the insects found in August about Georgian Bay and in the region of the Thousand Islands on the St. Lawrence River. The collections of Insecta in the Museum are growing rapidly and a great deal of the time of the staff has been occupied in mounting as well as in classifying and arranging specimens. Valuable collections have been received from tropical West Africa, made by friends of the Director connected with the missions of the Presbyterian Church in Kamerun and in Spanish West Africa. Our collections of South American insects have also been greatly increased. An impulse toward the systematic arrangement of the latter collections was received at the time when Mr. William Schaus, accompanied by his friend, Mr. John H. Barnes, spent two weeks with us just prior to the Christmas holidays. Mr. Schaus with the most obliging kindness undertook the arrangement of the South American *Syntomidæ*. While our collection is very far from being thoroughly representative of this family as found upon the soil of the new world, nevertheless it is gratifying to know that we have many hundreds of species represented, possibly one-third of the whole number which have up to this time been described, together with a good many forms which have not as yet been named.

MR. W. E. C. TODD returned late in the fall from his expedition to the eastern shore of Hudson Bay, bringing back with him a very large collection of birds and mammals. The assemblage of specimens representing this region in our Museum is now probably the most complete in any museum, and Mr. Todd's observations as to the breeding habits and the migration of the birds of western Labrador when published will no doubt be of great interest to ornithologists. Incidentally Mr. Todd made some collections of insects, which have not yet been carefully gone over, but which tend to show that the fauna of that region is richer in species than has been supposed.

WE have acquired by purchase from Mr. Samuel Klages a very extensive collection of birds made by him in Venezuela. The collection fills many of the gaps in our series of species from that part of the world and adds a number of forms which hitherto have escaped the attention of systematists. We have also obtained from the same collector an extensive series of insects gathered by him at various localities.

MR. G. A. STEINER has very kindly placed in the possession of the Museum as a loan a magnificent collection of Indian baskets, which he has been for many years past engaged in accumulating. It is one of the choicest and most thoroughly representative collections of the basket-work of the Western Indians which has been brought together. The collection is displayed in six large cases. A complete catalog of the collection is being prepared from data which have been supplied by Mr. Steiner and Miss Steiner, who have enthusiastically coöperated to make the collection thoroughly representative.

MR. H. J. HEINZ has kindly consented to place upon view a superb collection of carvings in jade, which he has recently acquired, and which contains a number of magnificent specimens. Mr. Heinz has also added to his collection of watches and of carved ivories. These collections have proved most attractive to multitudes who resort to the Museum, and they are always surrounded by interested and admiring groups of men, women, and children.

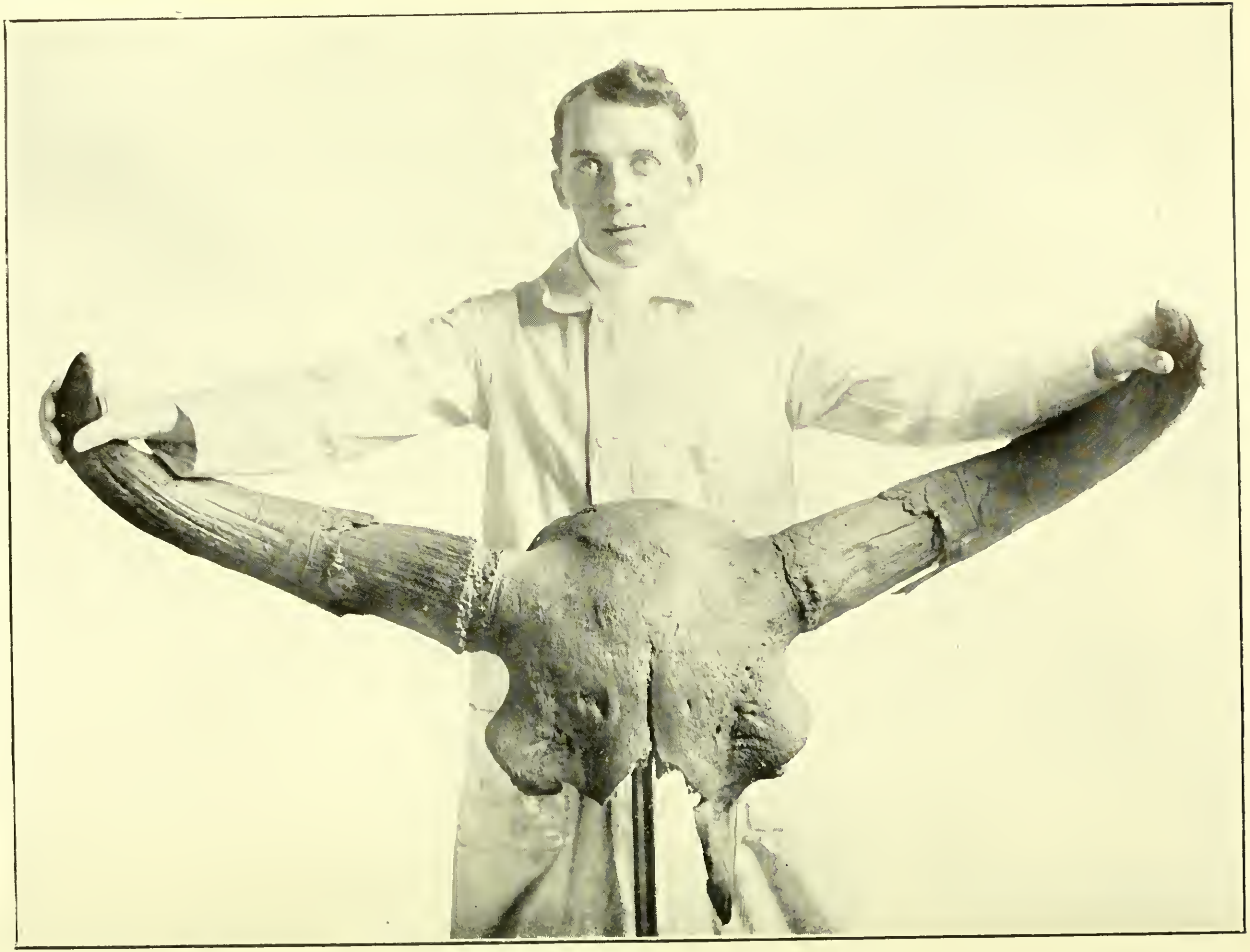
DR. GEORGE A. KENNEDY and Mrs. Mary Price Kennedy have loaned to the Museum a collection of oriental rugs dating from the fifteenth and sixteenth centuries. A portion of their large collection has been on display in the Museum of Fine Arts in Boston since the year nineteen hundred and thirteen, but those in the Carnegie Museum have been received from Berlin, where Dr. and Mrs. Kennedy have made their home for a number of years.

The most notable example in the collection is a large fragment of a so-called Ispahan or Herat carpet of the fifteenth century. There are also three Ushak rugs and numerous other beautiful examples from Asia Minor.

The entire collection, numbering twenty pieces, is displayed on the walls of the Gallery of Useful Arts. It is the intention of the owners to add some specimens as soon as they can be sent from abroad.

MR. JOHN B. REYNOLDS, manager of the Alvin Theater, of Pittsburgh, has loaned to the Carnegie Museum his personal collection of one hundred and forty-two photographs of members of the theatrical profession. These photographs have been presented from time to time to Mr. Reynolds, and for the most part are accompanied by autographs. The collection, which is attractively framed, has been placed on exhibition on the third floor of the Museum, and has caused a great deal of favorable comment. Although it is an unusual thing for a museum to have an exhibit of this character, so many people are interested in the theater either professionally or as constant visitors, that it does not seem very strange that interest should be aroused by the exhibition.

The photographs cover a wide range, including exponents of the higher drama, opera, musical comedy, and farce. There are pictures of Edwin Booth, Forbes Robertson, William Gillette, Pavlowa, Julia Marlowe, E. H. Sothern, Margaret Anglin, Julia Deane, Victor Herbert, and many others equally well known.



Skull of *Bison crassicornis* Richardson. Carn. Museum, Acc. No. 3247. Carn. Mus. Catalog of Foss. Vert. No. 1660.

XIV. A SKULL OF BISON CRASSICORNIS.

By W. J. Holland.

(Plate XLIII.)

In the spring of the year 1907 the Carnegie Museum acquired by purchase from Mr. Frank Caldwell of Indianapolis, Indiana, the cranium and horns of a specimen of *Bison crassicornis* Richardson, which had been obtained by the vendor from an excavation made near Dawson, Yukon Territory, in gold-bearing gravel. It was found at a depth of forty-four feet below the surface associated with the remains of a mastodon.

The specimen is remarkable because of the preservation on the horn-cores of the horns themselves, which for rather more than three-quarters of their length are present, as is shown in the accompanying plate. Unfortunately the dentition of the upper jaw and the lower jaw were not recovered. Whether present when the excavation was made and lost in the process of digging the remains from the soil is not now known. The maxilla is broken off just in front of the infra-orbital foramen and the premaxillaries are not present.

The dimensions of the skull and horns, so far as they can be ascertained, are as follows:

	Mm.
Length of skull from occiput to infra-orbital foramen	465
Height of skull from occipital condyle to median portion of frontals	268
Transverse diameter of skull at superior border of orbits	372
Transverse diameter of skull at inferior border of orbit	295
Transverse diameter of skull above the orbits and between the horns	317
Transverse diameter of skull below orbits	212
Antero-posterior diameter of orbits	80
Vertical diameter of orbits	77
Distance from upper margin of orbit to point of union with frontal.	55
Circumference of orbit	280
Distance between horns at base of cores	325
Circumference of cores at origin	365
Greatest length of horns measured along posterior curve	770
Greatest distance between tips of horns	1,155

As our illustration shows, the tubular orbits characteristic of the genus *Bison* are remarkably well developed.

The skull of which the foregoing is a description is believed by the writer to be one of the most perfect specimens of the species which has thus far been recovered.

XV. THE SERRASALMINÆ AND MYLINÆ.[1]

By C. H. Eigenmann.

(Plates XLIV–LVIII.)

The Serrasalminæ and the Mylinæ are highly specialized fresh-water fishes. They are members of the family of the Characidæ, ubiquitous in South America, being rather closely allied to the Tetragonopterinæ and the Bryconinæ. They are compressed, deep fishes, with a series of median spines along a greater or less part of the ventral surface. The dorsal fin is longer than in most of the other South American characins, and reaches its maximum length in *Myleus pacu*, which has twenty-seven dorsal rays. The anal fin is long and its base is usually inclined far from the horizontal. The predorsal line is naked. The adipose fin is well-developed, and in *Piaractus* of the Mylinæ and in *Pygocentrus* of the Serrasalminæ it is rayed. The mouth and teeth in all cases are highly differentiated and specialized. The number of teeth for the various species is fixed, or in some cases varies one or two teeth on each side of each jaw.

The teeth in fishes are usually small, conical, and arranged in bands. Compara[illegible]w fishes have the teeth restricted in number and with individ[illegible]aracteristics. In the Mylinæ and the Serrasalminæ the teeth [illegible] few in number and for the most part so specialized, that it would be possible, in some cases at least, to determine the location in the jaw of any individual tooth. But the dentition in related species, tooth for tooth, is often so similar that it is practically impossible to determine from which of several related species it may have come. The form of the teeth in different genera varies from molars, as in some species of Mylinæ, to incisors, which may be bicuspid, tricuspid, or multicuspid. The Serrasalminæ contain a single series of teeth in each jaw and sometimes a series on the palatines. The palatine teeth vary much more in number than the teeth of the jaws. The teeth in *Pygopristis denticulatus* of the Serrasalminæ are nearly bilaterally symmetric, with

[1] Contribution from the Zoölogical Laboratory of Indiana University, No. 142.

two small graduate cusps on each side of the large median cusp. In the other genera the teeth of one or both jaws are asymmetric, the cutting edge of one side longer than on the other, and the cusps, if present, not bilaterally symmetric.

In the species of Serrasalminæ, aside from *Pygopristis*, there is a complete gradation from slender, sharp-snouted, narrow-headed species with highly developed teeth on the palate, like *Serrasalmo elongatus*, to deeper, broad-headed, bull-dog-nosed species with the palatine teeth indifferently developed, or, in some species absent (*Pygocentrus piraya*, *Rooseveltiella nattereri*, etc.). One of the broad-headed species has the adipose fin rayed, and has been separated as representing a distinct genus, *Pygocentrus*.

All of the species of the Serrasalminæ have an evil reputation as carnivores. Those with a short upper jaw, heavy lower jaw, broad interorbital, and no palatine dentition, and which are known as peri, pirays, or piranhas (species of *Pygocentrus* and *Rooseveltiella*) are undoubtedly the worst. Stories of their depredations, from cutting the leaders of fish-lines, cutting up fish-nets, mutilating other fishes, taking off fingers or toes, or otherwise mutilating man or beast, to skeletonizing a horse and rider, who tried crossing a stream where they abound, are found in many books of travel, from that of Fray Pedro Simon in 1535 to that of Colonel Theodore Roosevelt in 1914. Credulity and "fear of the unseen terror" have undoubtedly exaggerated the real conditions, but it is certain that in some regions where they are excessively numerous they are a great nuisance. Mr. Anisits, who collected fishes for me in the upper Paraguay, reported that at one point he did not succeed in doing much, because the piranhas cut up the nets to such an extent that it required hours to patch them after every cast, and it was dangerous to life to enter the water.

Humboldt in his Observations, Zoologie, II, 1809, p. 174, quotes from two old sources as follows:

"Llevaron algunos de los soldados de Herera (mas arriba de Cabruta) unas calzas enteras de red con muy gruessos nudos, que se hallaron entre el demas pillaxe de aquella gente, que usaran dellas los Indios para entrar á pescar en las cienegas, con que se defendian de unos peces que los Españoles llamaron Caribes, por ser tan fieros y atrevidos que hacen en todo lo que topan dentro del agua: y assiendo destos nudos quando entraran los pescadores á pescar, quedaba libre la carne de sus bocas."[2] Fray Pedro Simon, Nat. Hist. de la Conquista (1726), p. 224.

The missionary Gili also says in his naïve style:

"Il Caribito chiamasi cosi por lo strano amore que porta alle umane carni. I Caribiti son piatti, del peso di una libra e più grandi. In Auvana dove si prendono con carne salata, vi sono del peso di quattro libre. Chi volesse in breve scolpato bene un cadavere, basterebbe di metterlo por qualche ore nell' Orinoco. Tanti e si famelici gli affollerebbero intorno i Caribiti, qui otterebe sicuramente l'intento."[3] —Saggio di Storia Americana, Tom. I, p. 78.

Humboldt in a foot-note states that "a young Parageni Indian, whose language appeared to me a dialect of Pareni, called the constellation of the southern cross 'Bahumedi': he added that this was the name of the fish Caribe which I had drawn."

Bancroft in his "Essay on the Natural History of Guiana," 1769, p. 189, says that the "Peri" "is extremely voracious, and bites everything which hangs in the water. The feet of ducks swimming in the creeks are frequently amputated, as have been the breasts of women, and the privities of men swimming in the rivers."

Spix (Selecta Genera et Species Piscium, 1829, p. 73) says of one species, probably the *Pygocentrus piraya:*

"Habitat in Brasiliæ æquatorialis fluviis, uti reliquiæ species, voracissimus, omnibus animalibus aquatilibus infestissimus, edulis."

[2] I am indebted to my friend Prof. A. Kuersteiner for the translation of the Spanish.

'Some of the Soldiers of Herera carried off (somewhere beyond Cabruta) some breeches made entirely of network with very big knots, which happened to be among the rest of the spoils from those people. The Indians made use of these to go fishing in the mud, and with them they defended themselves against some fishes which the Spaniards called Caribes, because they are so bold and ferocious that they attack everything they meet in the water, and as they take hold of these knots, when the fishermen go in to fish, the flesh is unharmed by their mouths.'

This originally appeared in an account of the voyage of Alonso de Herrera (1535) to the Rio Meta.

[3] Translation of the Italian.

The Caribito is so-called because of its strange liking for human flesh. The Caribitos are flat, and weigh a pound and even more. In Auvana, where they are caught with salt meat, there are some that weigh four pounds. Whoever would like to get rid of a corpse in a short time would merely have to put it in the Orinoco for a few hours. So many and such hungry Caribitos would crowd around it, he would attain his end without fail.

Schomburgk, in his "Fishes of British Guiana," I, 1841, p. 225, says of the pirai of Guiana:

"This most voracious fish is found plentifully in all the rivers in Guiana, and is dreaded by every other inhabitant or visitant of the river. Their jaws are so strong that they are able to bite off a man's finger or toe. They attack fish of ten times their own weight, and devour all but the head. They begin at the caudal fin; and the fish being thus left without the principal organ of motion, is devoured with ease, several going to participate of the meal. Indeed, there is scarcely any animal which they will not attack, man not excepted. Large alligators, which have been wounded on the tail, afford them a fine chance of satisfying their hunger, and even the toes of this formidable animal are not free from their attacks. The feet of ducks and geese, which are kept in the neighborhood where they are plentiful, are almost invariably cut off, and young ones devoured altogether; and in these places it is not safe to bathe, or even to wash clothes in the river, many cases having occurred of fingers and toes having been cut off by them. . . .

"The pirai, or huma, by which name the fish just described is generally known to the aboriginal tribes of British Guiana, inhabits the rivers which intersect that fertile colony. They are not to be found within forty miles of the coast, nor are they plentiful at the upper part of the rivers. Their favourite haunt appears to be those parts of the rivers which are between a hundred and a hundred and fifty miles from the coast, chiefly if there be large blocks of rock, about which they hover to procure themselves worms, etc. The ovary in the female is double. They deposit their spawn in the currentless inlets which form so peculiar a feature in the rivers of Guiana; this occurs during the months of January and February, at which period we found the females generally destitute of roe.

"While we ascended the river Cabalaba, a tributary of the Corentyn, from the east, we observed a river-cavia (*Hydrochærus capybara*) with five young ones, out of which number three were captured; and all were deficient in their toes, they having been bitten off by the pirais.

"Whilst we were continuing our course on the river Corentyn, one morning an object was observed to drift into the middle of the stream, around which there appeared to be a great commtion. The telescope did not assist us in coming to a conclusion what it might be;

and though we were in-shore, stemming a strong current, I ordered the corial to paddle for it. When we came near, we observed the head of a large luganani or sun-fish (*Cychla ocellaris*), which was surrounded by numerous pirais tearing off large parts of its flesh. We secured the luganani, which might have measured from twenty to twenty-six inches, and though the poor animal had been eaten off piecemeal to within its pectoral fins, it was still alive. Being deprived of its tail and lower fins, it drifted perpendicular. The corial was brought to, our hooks and lines were soon out, and we caught several of the depredators, which with the remnant of the luganani, afforded us a good breakfast.

"The ducks and geese are equally exposed to the attacks of the pirai, and those which the settlers keep near the banks of the river are generally deprived of the lower part of their feet. It is a strange sight to see them walking on mere stumps. In Wicki, a wood-cutting establishment at the river Berbice, there were two *vicissi ducks* (*Dendrocygna viduata*) which had been perfectly tamed by the Indians, and were brought from the large ponds in the interior. Unacquainted with the danger which the ravenous pirai offered them, their instinct directed them to their favourite element, and one of them paid for its first visit with the loss of its toes, and the other was similarly injured in its future visits. They now became cautious, and it was remarkable to observe how studiously they kept in-shore, and never trusted themselves beyond their depth.

"The pirai is from nature a tyrant, and connects with it the greatest voraciousness. I am almost persuaded that it surpasses the ravenous pike, though the latter, *par excellence*, is called the tyrant of the watery plain! They are caught with hook and line, and their greediness is so great, that no art is necessary to conceal the bait. The hook may be baited with a piece of fish, bird, or animal, or merely their entrails; the pirai will dart at it the instant it is thrown into the water, and seize it with eagerness; but it frequently happens that, with its sharp teeth, it bites the line and escapes with the hook in its mouth. We therefore surrounded the line, where it was fixed to the hook, the length of two or three inches, with tin or lead, and though it had a clumsy appearance, we were not less successful. Some precaution is necessary, even after the fish has been lifted out of the water, or it will inflict, in its struggles, serious wounds; the angler has therefore a small bludgeon ready, wherewith its skull is broken."

Roosevelt, in the account of his recent travels, tells of the voracity and depredations of the piranhas of the Paraguay. He says of *Rooseveltiella nattereri:*

At Concepcion . . . "We caught many fish.

"They belonged to one of the most formidable genera of fish in the world, the piranha or cannibal fish, the fish that eats men when it can get the chance. Farther north there are species of small piranha that go in schools. At this point on the Paraguay the piranha do not seem to go in regular schools, but they swarm in all the waters and attain a length of 18 inches or over. They are the most ferocious fish in the world. Even the most formidable fish, the sharks, or the barracudas, usually attack things smaller than themselves. But the piranhas habitually attack things much larger than themselves. They will snap a finger off a hand incautiously trailed in the water; they mutilate swimmers—in every river town in Paraguay there are men who have been thus mutilated; they will rend and devour alive any wounded man or beast; for blood in the water excites them to madness. They will tear wounded wild fowl to pieces; and bite off the tails of big fish as they grow exhausted when fighting after being hooked. Miller, before I reached Asuncion, had been badly bitten by one. Those that we caught sometimes bit through the hooks, or the double strands of copper wire that served as leaders, and got away. Those that we hauled on deck lived for many minutes.

"Most predatory fish are long and slim, like the alligator and pickerel. But the piranha is a short, deep-bodied fish, with a blunt face and a heavily undershot or projecting lower jaw which gapes widely. The razor-edged teeth are wedge-shaped like a shark's, and the jaw muscles possess great power. The rabid, furious snaps drive the teeth through flesh and bone. The head with its short muzzle, staring malignant eyes, and gaping, cruelly armed jaws, is the embodiment of evil ferocity; and the actions of the fish exactly match its looks.

"I never witnessed an exhibition of such impotent, savage fury as was shown by the piranhas as they flapped on deck. When fresh from the water and thrown on the boards they uttered an extraordinary squealing sound. As they flapped about they hit with vicious eagerness at whatever presented itself. One of them flapped into a cloth and seized it with a bulldog grip. Another grasped one of its fellows; another snapped at a piece of wood, and left the teeth-marks deep therein. They are the pests of the waters, and it is necessary to be exceedingly cautious about either swimming or wading where they are found. If cattle are driven into, or of their own accord enter, the water they are commonly not molested; but if by chance some unusually big or ferocious specimen of these fearsome fishes does bite an animal—taking off an ear, or perhaps a teat from the udder of a cow—the blood brings up every member of the ravenous throng which is anywhere near, and unless the attacked animal can immediately make its escape from the water it is devoured alive. Here on the Paraguay the natives hold them in much respect, whereas the caymans are not feared at all. The only redeeming feature about them is that they are themselves fairly good to eat, although with too many bones. . . .

"I happened to mention that one of our naturalists, Miller, had been bitten by a piranha, and the man-eating fish at once became the subject of conversation. Curiously enough, one of the Brazilian taxidermists had also just been severely bitten by a piranha.

"My new companions had story after story to tell of them. Only three weeks previously a twelve-year-old boy, who had gone in swimming near Corumba, was attacked, and literally devoured alive by them. Colonel Rondon during his exploring trips had met with more than one unpleasant experience in connection with them. He had lost one of his toes by the bite of a piranha. He was about to bathe and had chosen a shallow pool at the edge of the river, which he carefully inspected until he was satisfied that none of the man-eating fish was in it; yet as soon as he put his foot into the water one of them attacked him and bit off a toe.

"On another occasion while wading across a narrow stream one of his party was attacked; the fish bit him on the thighs and buttocks, and when he put down his hands tore them also; he was near the bank and by a rush reached it and swung himself out of the water by means of an overhanging limb of a tree; but he was terribly injured, and it took six months before his wounds healed and he recovered.

"An extraordinary incident occurred on another trip. The party were without food and very hungry. On reaching a stream they dynamited it, and waded in to seize the stunned fish as they floated on the surface. One man, having his hands full, tried to hold one fish by putting its head into his mouth; it was a piranha and seemingly stunned, but in a moment it recovered and bit a big section out of his tongue. Such a hemorrhage followed that his life was saved with the utmost difficulty.

"On another occasion a member of the party, a brother of the Lieutenant Barbosa who was with us, was off by himself on a mule. The mule came into camp alone. Following his back track, they came to a ford, where in the water they found the skeleton of the dead man, his clothes uninjured, but every particle of flesh stripped from his bones. Whether he had drowned, and the fishes had then eaten his body, or whether they had killed him it was impossible to say. They had not hurt the clothes, getting in under them, which made it seem likely that there had been no struggle.

"These man-eating fish are a veritable scourge in the waters they frequent. But it must not be understood by this that the piranhas—or, for the matter of that, the new-world caymans and crocodiles—ever become such dreaded foes of man as for instance the man-eating crocodiles of Africa. Accidents occur, and there are certain places where swimming and bathing are dangerous; but in most places the people swim freely, although they are usually careful to find spots they believe safe or else to keep together and make a splashing in the water." (Extracted from a letter published in various daily papers, 1914.)

John D. Haseman, on the labels accompanying specimens collected for the Carnegie Museum, states that one of the specimens of *Pygocentrus piraya* from the Rio San Francisco, had bitten him on the thumb, and that another specimen of *Rooseveltiella nattereri* nearly severed one of his fingers. I dragged nets, and otherwise caught many pirayas in Guiana, in a region where they are reported as being very bad, without any mishap either to myself or to any of my assistants, but I lost numerous hooks, which were neatly severed by the saw-teeth of some species of piraya.

The Mylinæ have two series of teeth in the front of the upper jaw and mostly use vegetable food. Some of them browse on the vegetation on the rocks, especially about rapids, and have the front teeth developed as incisors; *Myloplus micans* is one of these. Others have molars developed, and feed in large part on fruits, which drop into the rivers.

Different species of the Mylinæ vary from small, thin, pompano-shaped fishes, with prolonged dorsal and anal fins and a weight, when full sized, of a few ounces, to large, heavy species, shaped like the marine sunfish, *Mola*, reaching many pounds in weight. The "pacu" is the most famous, and is one of the principal food-fishes of the Indians of Guiana. *Myleus pacu* reaches a length of two feet and a weight of ten pounds.

Many of the characins have a black spot at the end of the caudal peduncle extending to and partly covering the base of the caudal. The Serrasalminæ and Mylinæ have this spot, which develops normally in the young, but becomes modified with age. The portion on the caudal peduncle fades and the caudal portion sends out arms along the outer part of the caudal lobes, so that the spot becomes <-shaped. The rest of the caudal may remain clear of markings, although there may be a distinct increase in pigmentation with age. In other species chromatophores accumulate either along the margin of the fin, or they may form a band at some distance within the margin. A shoulder-spot is also found in very many species of characins. Usually it lies above the lateral line and at some distance from its origin. It may consist of a general concentration of chromatophores from neighboring regions, which in consequence are left free from chromatophores, or the spot may take on a definite form characteristic of the species. The development of this definite form is probably a secondary manifestation. The cause of the primary congregation of chromatophores on the shoulder may either be due to positive chemotaxis causing the migration of the chromatophores to a definite point, or to negative chemotaxis causing them to migrate away from certain regions. I have been inclined to attribute it to positive chemotaxis, which causes the chromatophores to aggregate over or near a pseudotympanum over the anterior air-bladder. A triangular area of the sides over the first air-bladder is free from muscles in the young, the skin and peritoneum forming the only covering of the body-cavity. The spot forms near this delicate membrane. But the fact, that there is frequently an accumulation of pigment-cells behind the unpigmented area surrounding the spot, is strong evidence that the migration of the cells is at least in part due to negative taxis.

In the Serrasalminæ and Mylinæ the shoulder-spot, if developed, is diffuse, and lies just back of the opercular margin at the origin of the lateral line. It varies very greatly in different species, and even in the same species it may be totally absent or well-developed.

Small circular spots on the upper half of the sides, or over the entire body, are very frequently developed in the Serrasalminæ and Mylinæ. These are as characteristic as the spots on the young of thrushes (*Turdidæ*). These spots begin to appear when the young have reached a length of between one and two inches. They are probably most prominent when the fish is between four and eight inches long, and they become obscured or disappear entirely in old age. The juvenile color is different from the adult color in some other ways. In *Mylosoma ocellatus*, for instance, there are cross-bars and an ocellus on the sides, and in *Colosoma* there are cross-bars without an ocellus. As in other fishes, the obliteration of the juvenile markings is in part due to the development with advancing age of more superficially located pigment.

The Serrasalminæ and Mylinæ are for the most part lowland fishes. So far as recorded they reach the maximum elevation in the Rio das Velhas of the San Francisco basin. They are not found in the upper Potaro river, the Iguassú above the falls, nor in the Magdalena or elsewhere beyond the Andes, nor in the coastwise streams between the Rio Itapicurú and Rio Grande do Sul.

The Serrasalminæ can readily be distinguished from the Mylinæ by the teeth. The former have a single series of teeth in each jaw. The latter have two series of teeth in the premaxillary and frequently a pair of teeth behind the front series of the lower jaw.

The interneural, the upper end of which carries the predorsal spine, lies between the sixth and seventh neural spines. The vertebræ, counting on the radiographs as abdominal those from the first which carries a neural spine to the last which carries ribs, and as caudal all those behind these, number as follows:

Pygopristis denticulatus	14 + 20
Serrasalmo rhombeus	14 + 20
Myleus ellipticus	16 + 19
Catoprion mento	14 + 22
Metynnis maculatus	14 + 19

This count does not take into consideration the coalesced vertebræ immediately adjacent to the head.

Subfamily SERRASALMINÆ.

Compressed, deep; ventral surface with serræ; premaxillary and mandible each with a single series of notched or lobate teeth; palate sometimes with teeth; dorsal comparatively long; ventrals minute, anal variously developed; a procumbent predorsal spine.

I have been unable to assign a place to *Salmo undulatus* and *Serrasalmo scotopterus* of Schomburgk, *Fishes of British Guiana*, Vol. I, pp. 232 and 233. The former was taken in the Padauiri and the latter in the Rio Branco, both of the Amazon basin.

KEY TO THE GENERA OF THE SERRASALMINÆ.

a. Teeth symmetric, notched, or denticulate; no teeth on the palate; adipose fin not rayed, anal long, naked . . . . *Pygopristis* Müller & Troschel. I.

aa. Teeth oblique; asymmetric incisors, with a cusp on one or both sides near the base of the large median cusp; successive teeth interlocking so as to form a continuous serrate cutting edge.

b. Palatines smooth, without teeth; second suborbital covering all, or nearly all, of the cheek; snout short, mouth wide; margin of upper jaw very oblique; lower jaw very heavy, the teeth pointing backward and upward, larger than those of the upper jaw. Interorbital 2–2.25 in the head; depth 1.8–2 in the length.

c. Anal short, with fifteen rays, its origin below the space between dorsal and adipose; no teeth on the palate. . . . *Gastropristis* gen. nov. II.

cc. Anal with twenty-three to thirty-eight rays; its origin below the dorsal.

d. Adipose fin rayed in the adult (normal in the young and half-grown) . . . . *Pygocentrus* Müller & Troschel. III.

dd. Adipose fin not rayed . . . . *Rooseveltiella* gen. nov. IV.

bb. Palate rough, or with obsolescent teeth (see under *aureus*); second suborbital leaving a very wide naked area; margin of upper jaw not very oblique; interorbital 2.25; depth 1.4–1.8 in the length to the end of the lateral line . . . . *Pristobrycon* gen. nov. V.

bbb. A series of well-developed teeth on the palate; gape long, second suborbital leaving a variable naked area, or completely covering the cheek; upper jaw not very oblique . . . . *Serrasalmo* Lacépède. VI.

I. Genus PYGOPRISTIS Müller & Troschel.

Pygopristis MÜLLER & TROSCHEL, Horæ Ichthyol., Vol. I, 1845, p. 21, tab. ix, figs. 2*a* and 2*b* (*fumarius*).

Type, *Pygopristis fumarius* Müller & Troschel, = *Serrasalmo denticulatus* Cuvier.

Characters of the Subfamily.—No teeth on the palate, those of both jaws serrate or lobed; anal naked.

Distribution.—Guiana to Paraguay.

KEY TO THE SPECIES OF PYGOPRISTIS.

a. D. 19; A. 35; depth 1.66; head 4; snout obtuse, as long as eye; second suborbital reaching about half-way to the pre-opercle; about thirty to thirty-four abdominal serræ; adipose 3.5 in the dorsal . . . . . . *denticulatus* (Cuvier). 1.

aa. D. 16; A. 33; depth 1.66; adipose fin small; vertical fins with blackish margins. *serrulatus* Cuvier & Valenciennes. 2.

1. **Pygopristis denticulatus** (Cuvier).

Serrasalmo denticulatus CUVIER, Mem. Mus. Paris, Vol. V, 1819, p. 371; GÜNTHER, Cat. Fish. Brit. Mus., Vol. V, 1864, p. 367 (British Guiana).

Pygopristis denticulatus MÜLLER & TROSCHEL, Horæ Ichthyol., Vol. I, 1845, pp. 21 and 34, tab. ix, fig. 1 (Guiana); *in* SCHOMBURGK, Reisen, Vol. III, 1848, p. 637 (Essequibo; Takutu; Rupununi); CUVIER & VALENCIENNES, Hist. Nat. Poiss., Vol. XXII, 1848, p. 297 (Essequibo); EIGENMANN & EIGENMANN, Proc. U. S. Nat. Mus., Vol. XIV, 1891, p. 59; ULREY, Ann. N. Y. Acad. Sci., Vol. VII, 1895, p. 296 (Lower Amazon); EIGENMANN, Reports Princeton Univ. Exp. Patagonia, Vol. III, 1910, p. 441; Mem. Carnegie Mus., Vol. V, 1912, p. 385 (Lama Stop-off).

Pygopristis fumarius MÜLLER & TROSCHEL, Horæ Ichthyol., Vol. I, 1845, pp. 21 and 35, tab. 9, fig. 2; SCHOMBURGK, Reisen, Vol. III, 1848, p. 637 (Rupununi; Essequibo); KNER, Characinen, Vol. II, 1859, p. 27 (Rio Branco).

? *Serrasalmo punctatus* SCHOMBURGK, Fishes Guiana, Vol. I, 1841, p. 223.

FIG. 1. Dentition of *Pygopristis denticulatus* (Cuvier). $\frac{2}{1}$.

Distribution.—Guianas to Amazon.

It is quite possible that Schomburgh's drawing represents *Pristobrycon scapularis* instead of this species.

2. **Pygopristis serrulatus** Cuvier & Valenciennes.

Pygopristis serrulatus CUVIER & VALENCIENNES, Hist. Nat. Poiss., Vol. XXII, 1848, p. 300 (Amazon); CASTELNAU, Anim. Amer. Sud, Poiss., 1855, pl. 38, fig. 3 (Araguay; Amazon); EIGENMANN & EIGENMANN, Proc. U. S. Nat. Mus.; Vol. XIV, 1891, p. 59; ULREY, Ann. N. Y. Acad. Sci., Vol. VII, p. 297 (Brazil), EIGENMANN, Reports Princeton Univ. Exp., Patagonia, Vol. III, 1910, p. 441.

Serrasalmo serrulatus GÜNTHER, Cat. Fish. Brit. Mus., Vol. V, 1864, p. 367. BOULENGER, Trans. Zool. Soc. London, Vol. XIV, 1867, p. 37 (Paraguay); Boll. Mus. Univ., Torino, Vol. XII, 1897 (Mission de San Francisco).

Distribution.—Amazon; Matto Grosso; Paraguay.

The type of this species is about 150 mm. long.

II. Genus GASTROPRISTIS gen. nov.

Type, *Serrasalmo* (*Pygocentrus*) *ternetzi* Steindachner.

This genus is very similar to *Pygocentrus* from which it differs in the length of the anal. It is possible that the single specimen known, 150 mm. long, has met with some accident. If not, the species is certainly the type of a new genus.

Characters of *Pygocentrus*, but the origin of the anal on the vertical from a point midway between the dorsal and adipose fins. Adipose fin not rayed in the adult.

Range that of the single species.

3. **Gastropristis ternetzi** (Steindachner).

Serrasalmo (*Pygocentrus*) *ternetzi* STEINDACHNER, Anz. K. Acad. Wiss. Wien., 1908, p. 359 (Descalvados on the Paraguay).

Known only from the following description of Steindachner.

"Head 2.6; depth 1 4/7; D. II, 15; A. III, 12; scales 38 to 40–86 + 7–40 to 43; serræ in front of anus 27; eye 5 in the length of the head; interorbital 2.25; snout 2.33; base of anal 2.25; height of anal 2.33; base of dorsal 1.6; height of dorsal 2.25; length of pectoral 1.6; ventral 3; depth of caudal peduncle 2.75.

"Snout short, blunt; lower jaw heavy as in *piraya;* second suborbital leaving a narrow naked margin behind; origin of dorsal midway between snout and caudal, behind the vertical from the front of the ventrals; adipose fin about 6 in the length of the head; pectoral not reaching ventral; anal scaled at its base, its margin convex; last anal ray about half as high as the first divided ray. Upper half of body with obscure dark, round spots." (*Translation.*)

III. Genus PYGOCENTRUS Müller & Troschel.

Pygocentrus MÜLLER & TROSCHEL, Horæ Ichthyol., Vol. I, 1845, p. 20.

Type, *Serrasalmo piraya* Cuvier.

Compressed, ventral surface with serræ from below the pectoral to the anal; teeth compressed asymmetric incisors, more or less notched, in a single series in each jaw. Palate without teeth; interorbital very broad, the snout short, sometimes appearing abnormally so, lower jaw short and very heavy; cheeks more or less completely armed by the suborbitals; adipose fin rayed in the adult (over 125 mm.); anal long, with over twenty-five rays, its origin below the dorsal.

Distribution.—Guiana, Amazons, Rio San Francisco, (and to Paraguay?).

As far as known this genus contains one species, the type. I am not sure whether all of the references cited in the synonymy below really belong to this species. My identification of specimens from Guiana as belonging to this species was wrong.

4. **Pygocentrus piraya** Cuvier. (Plate XLIV.)

Piraya MARCGR., Nat. Hist. Bras., 1648, p. 164.

Serrasalmo piraya CUVIER, Mem. Mus. Paris, Vol. V, 1819, p. 368, pl. 28, fig. 4; GÜNTHER, Cat. Fishes Brit. Mus., Vol. V, 1864, p. 368 (Brazil; River Cupai; Demerara); COPE, Proc. Am. Philos. Soc., Phila., Vol. XI, 1869–70, p. 566 (Pará); STEINDACHNER, Flussfisch. Südam., Vol. II, 1881, p. 13 (Teffé, Rio Puty); PERUGIA, Ann. Mus. Civ. Storia Nat., Genova, Ser. 2a, Vol. X, 1891, p. 51 (Villa Maria, Matto Grosso, Rio Paraguay).

Pygocentrus piraya MÜLLER & TROSCHEL, Horæ Ichthyol., Vol. I., 1845, p. 20; CUVIER & VALENCIENNES, Hist. Nat. Poiss., Vol. XXII, 1848, p. 291; MÜLLER & TROSCHEL, *in* Schomburgk, Reisen, Vol. III, 1848, p. 636 (Brit. Guiana); ? CASTELNAU, Anim. Amer. Sud Poiss., 1855, p. 72, pl. 38, fig. 2 (Goyaz; Amazon); Kner, Characinen, Vol. II, 1859, p. 28; EIGENMANN & EIGENMANN, Proc. U. S. Nat. Mus., Vol. XIV, 1891, p. 59; ULREY, An. N. Y. Acad. Sci., Vol. VII, 1895, p. 297 (Trocera on Tocantins). FOWLER, Proc. Acad. Nat. Sci., Phila., 1906, p. 468 (Pará); EIGENMANN, Reports Princeton Univ. Exp. Patagonia, Vol. III, 1910, p. 442.

Serrasalmo (*Pygocentrus*) *piraya* LÜTKEN, Velhas-Flodens Fiske, 1875, p. 233, and p. xvii (Rio das Velhas).

Serrasalmo piranha AGASSIZ, Selecta Genera et Spec. Pisc. Bras., 1829, p. 71, tab. 28 (Rio San Francisco); SCHOMBURGK, Fish. Brit. Guiana, Vol. I, 1841, p. 221, pl. xvi (Rio Branco).

? *Serrasalmo nigricans* AGASSIZ, Selecta Genera et Spec. Pisc. Bras., 1829, p. 72, tab. 30.

? *Pygocentrus nigricans* MÜLLER & TROSCHEL, Horæ Ichthyol., Vol. I, 1845, p. 21.

Pygocentrus bidorsalis NATTERER, *MS.* in Kner, Characinen, Vol. II, 1854, p. 28.

Distribution.—Guiana, Amazon to Rio das Velhas, and ?Paraguay. It is probable that Perugia's record is for *R. nattereri.*

5698 *a–b.* C. M. 35–43 mm. Santa Rita, Jan. 24, 1909. Haseman.

5696 *a.* C. M. 60 mm. Barreiras, Lagoas of Rio Grande, Jan. 3–4, 1907. Haseman.

6521 *a–g.* C. M. 18–about 240 mm. Penedo, May 20, 1908. Haseman.

5699 *a–h.* C. M. Largest 44 mm. Boqueirão, near mouth of Rio Preto, Jan. 6, 1908. Haseman.

6522 *a–c.* C. M. 108–202 mm. Joazeiro, Nov. 28, 1907. Haseman.

6523 *a.* C. M. 122 mm. Rio das Velhas, May 11, 1908. Haseman.

6524 *a.* C. M. 190 mm. Lagoa de Porto, Dec. 24, 1907. Haseman.

Head 3–3.6 in length to end of lateral line; depth 1.8–2; D. 18–19; A. 30–32; serræ 22–26; interorbital 2–2.25 in the head (nearly 3 in No. 5696).

Base of anal shorter than head; distance between dorsal and caudal fulcra shorter than the dorsal, equal to, or a little shorter than, the postorbital portion of the head (postorbital portion and half the eye in No. 5696); dorsal rounded; adipose fin not rayed in specimens 130 mm. long. Sides plain in specimens 100 mm. long; entire sides profusely spotted in specimens below 60 mm. long.

Dr. J. D. Anisits has kindly furnished me with the following data on the *Pygocentrus nigricans* in the Berlin Museum.

No. 3630 Berlin Museum. Total length 122 mm., body 112 mm., height 61 mm. Head 3 in the length; eye 4.33 in the head, 2.66 in the interorbital; abdominal spines 28; D. 16; A. 31; scales 34–104–39. The photograph kindly made for me by the direction of Dr. A. Brauer, Director of the Zoölogical Museum of Berlin, shows the distance between the dorsal and caudal to be greater than the length of the dorsal and longer than the postorbital portion of the head. It seems more than probable that the *nigricans* of Müller and Troschel is distinct from *piraya* Cuvier.

Lütken (Vidensk. Medd. Nat. For. Kjöbenhavn, 1874, 238) considers the *nigricans* of Agassiz a species distinct from *piraya*.

IV. Genus ROOSEVELTIELLA[4] gen. nov.

Type, *Serrasalmo nattereri* Kner.

General characters of *Pygocentrus*, the adipose fin not rayed; palate without teeth, smooth; cheek completely or nearly completely armed in adult; profile scarcely depressed over the eye; eye comparatively small; interorbital very wide; upper jaw short, its margin very oblique; lower jaw powerful, its teeth long, with nearly symmetric cutting edges, much larger than those of the upper jaw.

Distribution.—Orinoco, Guianas, Amazons, and La Plata basin. Not in the Rio San Francisco and coastwise streams south to Rio Grande do Sul.

It is doubtful whether *niger*, *altus*, and *nattereri* are distinct. It is also quite probable that *stigmaterythræus* is a synonym of *notatus*.

[4] For Colonel Theodore Roosevelt in recognition of his arduous work in South American Exploration and his intense interest in the fauna of South America. His account of the type of this genus was quoted on previous pages.

KEY TO THE SPECIES OF ROOSEVELTIELLA.

a. Cheeks fully covered by the second suborbital except in the young.

b. Abdominal serræ 40; depth about 2 in the length; interorbital a little less than one-half the length of the head; *second infra-orbital touches the pre-opercle;* distance between dorsal and upper caudal fulcra much longer than base of dorsal; gill-rakers of the outer branch very short and broad. D. 18; A. 33–35; lat. line 105 . . . . . *niger* (Schomburgk). 5.

bb. Abdominal serræ fewer than 40.

c. Distance between dorsal and upper caudal fulcra less than the base of the dorsal, equal to the postorbital portion of the head, or shorter; origin of dorsal about equidistant between anterior margin of eye and end of lateral line; base of anal shorter than head; D. 16–19; A. 27–31; serræ 22–38; interorbital 2.1 in head; depth 1.87–2. *nattereri* (Kner). 6.

cc. Distance between dorsal and upper caudal fulcra equal to, or a little greater than, the base of the dorsal, equal to the postorbital portion of the head; origin of dorsal equidistant between end of lateral line and snout or origin of eye; base of anal equal to length of head in the younger; equal to head without opercle in the old; interorbital 2–2.23 in the head; head 3.3–3.25; depth 1.8–2.2. *notatus* (Lütken). 7.

aa. Cheeks with a very narrow naked margin.

d. No well defined humeral spot; distance between dorsal and upper caudal fulcra about equal to the length of the base of the dorsal, a little greater than the postorbital portion of the head; origin of dorsal nearer base of upper caudal rays than eye; base of anal equal to length of head less half of the opercle; D. 17; A. 23; serræ 26; interorbital 2.2 in the head; depth 1.8 . . . . *altus* (Gill). 8.

dd. A large conspicuous humeral spot; space between dorsal and caudal longer than the dorsal, equal to head without opercle; base of anal shorter than head; second suborbital as high as long; D. 18 or 19; A. 30; serræ 28; interorbital 2.25 in the head; head 3.33; depth 1.9; sides spotted, caudal margined with dark. *stigmaterythræus* (Fowler). 9.

5. **Rooseveltiella niger** (Schomburgk). (Plate XLV.)

Serrasalmo niger SCHOMBURGK, Fishes Brit. Guiana, Vol. I, 1841, p. 222, tab. 18 (in streams between forty and fifty miles from coast); GÜNTHER, Cat. Fishes Brit. Mus., Vol. V, 1864, p. 369.

Pygocentrus niger MÜLLER & TROSCHEL, Horæ Ichthyol., Vol. I, 1845, p. 21, tab. 2, fig. 3; ? CUVIER & VALENCIENNES, Hist. Nat. Poiss., Vol. XXII, 1848, p. 286 (Corentyn); MÜLLER & TROSCHEL, *in* Schomburgk, Reisen. Vol. III, 1848, p. 636 (upper courses of all streams of Guiana); EIGENMANN & EIGENMANN, Proc. U. S. Nat. Mus., Vol. XIV, 1891, p. 59; EIGENMANN, Reports Princeton Univ. Exp. Patagonia, Vol. III, 1910, p. 442; Mem. Carnegie Mus., Vol. V, 1912, p. 384.

Distribution.—Upper courses of all streams of Guiana.

In spite of the many references, the only authentic specimen of this species is the type in the Berlin Museum, which I examined, and which has forty abdominal serræ.

Dr. J. D. Anisits has kindly reëxamined the type, No. 3631 Berlin Museum, and has given me the following data. Total length 365 mm., body 335, height 180. Head 3 in the total length; eye 5 in the head, 3 in the interorbital; abdominal serræ 40–41; D. 17, A. 34; scales about 40–130–42. I owe to Director Dr. A. Brauer the photograph of the type, which is reproduced in Plate XLV.

6. **Rooseveltiella nattereri** (Kner).

Serrasalmo nattereri KNER, Characinen, Vol. II, 1859, p. 28, taf. 3, fig. 8 (Matto Grosso; Cuyabá); GÜNTHER, Cat. Fishes Brit. Mus., Vol. V, 1864, p. 369; COPE, Proc. Acad. Nat. Sci., Phila., 1871, p. 292 (between Rio Negro and Ucayale); PETERS, Mb. Ak. Wiss. Berlin, 1877, p. 472 (San Fernando de Apuré); PELLEGRIN, Bull. Mus. d'Hist. Nat., 1899, p. 406 (Manaos); BOULENGER, Boll. Mus. Univ., Torino, Vol. XV, 1900 (near Corumbá); FOWLER, Proc. Acad. Nat. Sci. Phila., 1906, p. 468 (Peruvian Amazon).

Serrasalmo (Pygocentrus) nattereri STEINDACHNER, Flussfisch. Südam., Vol. III, 1881, p. 12 (La Plata).

Pygocentrus nattereri EIGENMANN & EIGENMANN, Proc. U. S. Nat. Mus., Vol. XIV, 1891, p. 60; BERG, An. Mus. Nat. Buenos Aires, Vol. V, 1897, p. 283 (San Pedro on Rio Paraná; Martin Garcia; Boca de Riachuela on Rio de la Plata); EIGENMANN & OGLE, Proc. U. S. Nat. Mus., Vol. XXXIII, 1907, p. 35 (Paraguay; Brazil); EIGENMANN, Ann. Carnegie Mus., Vol. IV, 1907, p. 141 (Porto Murtinho; Corumbá); EIGENMANN, Reports Princeton Univ. Exp. Patagonia, Vol. III, 1910, p. 442.

Distribution.—La Plata and Amazon basins; ?Orinoco.

6528 *a–b*. C. M. 118–126 mm. San Joaquin, Bolivia, Sept. 4, 1909. Haseman.

6529 *a*. C. M. 173 mm. about. Santarem, Dec. 6, 1909. Haseman.

6526 *a–b*. C. M. 149 mm. to end of lateral line. Villa Hays, April 13, 1909. Haseman.

6533 C. M. 1.15 mm. Rio Jauru, June 4, 1909. Haseman.

6527 *a*. About 24 mm. Corumbá, April 28, 1909. Haseman.

D. 17–19; A. 28–31; serræ 24–28; interorbital 2–2.1 in the head; depth 1.87–2; anal shorter than head, even in small, equal to head without opercle in large individuals; origin of dorsal equidistant from anterior margin of orbit and end of lateral line. Base of dorsal equal to head without mouth or without snout and half eye. Distance between dorsal and upper caudal fulcra equal to, or a little shorter than, the postorbital portion of the head, shorter than the base of the dorsal or rarely equal to it; ventral spines with broad transverse basis.

7. **Rooseveltiella notatus** (Lütken).

FIG. 2. Premaxillary and mandibular teeth of *Rooseveltiella notatus* (Lütken).

Serrasalmo (*Pygocentrus*) *notatus* LÜTKEN, Vid. Med. Nat. For. Kjöb., 1874, p. 238 (Venezuela).

Pygocentrus notatus EIGENMANN & EIGENMANN, Proc. U. S. Nat. Mus., Vol. XIV, 1891, p. 60; EIGENMANN, Reports Princeton Univ. Exp. Patagonia, Vol. III, 1910, p. 442.

Pygocentrus piraya (*non* CUVIER) EIGENMANN, Mem. Carnegie Mus., Vol. V, 1912, p. 384 (Twoca Pan).

Distribution.—Orinoco, Essequibo, and Amazon basins.

6530 *a*. C. M. About 215 mm. over all. Manaos, Nov. 17, 1909. Haseman.

6531 *a*. C. M. About 230 mm. Lagoa de Paranagua, Jan. 16, 1908. Haseman.

?5695 *a–b*. C. M. 20–46 mm. Lagoa de Paranagua, Jan. 17, 1908. Haseman.

6532 *a–c*. C. M. About 125–145 mm. Santarem, Dec., 1909. Haseman.

These specimens may represent *Pygocentrus notatus* Lütken.

Lütken states that the origins of the dorsal and ventral fins are equidistant from the snout. In all of the specimens enumerated above the distance between the ventrals and the snout is less by at least an orbital diameter than the distance from the snout to the dorsal. In other respects they are like *notatus* as far as Lütken's description goes.

Head 3.29–3.25 in length to end of lateral line; depth 1.8–2.2; D. 16–18, usually 17, counting everything; A. 28–31, of which the first is minute and the third very large; serræ 26–28; interorbital 2–2.23 in the head; eye 4.5–5.5 in the head; origin of dorsal equidistant from tip of snout and end of lateral line; space between dorsal and caudal fulcra equal to the base of the dorsal or a little longer, equal to the head less the opercle or shorter; second suborbital in the adult in contact with the pre-opercle, leaving a naked border at the angle in the younger specimens; depth of caudal peduncle 2.5–2.75 in length of head in the smaller specimen, 3.33 in the larger; adult with a faint humeral spot, otherwise without spots; young with the sides profusely spotted. Caudal margined with dark, its base with a V-shaped dark area; in the smallest from Lagoa de Paranagua, there is a dark band on the end of the caudal peduncle.

Very similar to *Serrasalmo maculatus*, but without traces of teeth on the palate, the snout shorter, the interorbital wider, the serræ fewer.

8. **Rooseveltiella altus** (Gill). (Plate XLVI.)

Pygocentrus altus GILL, Proc. Acad. Nat. Sci. Phila., 1870, p. 93 (Marañon or Napo River); EIGENMANN & EIGENMANN, Proc. U. S. Nat. Mus., Vol. XIV, 1891, p. 80; EIGENMANN & OGLE, Proc. U. S. Nat. Mus., Vol. XXXIII, 1907, p. 35 (Napo or Marañon); EIGENMANN, Reports Princeton Univ. Exp. Patagonia, Vol. III, 1910, p. 442.

Distribution.—Marañon basin.

D. 17; A. 33; depth .8; head 2.75; snout obtuse, less than diameter of eye, which is 4.5–5 in the head; interorbital 2.2 in the head; a narrow naked area between suborbital and pre-opercle; fourteen teeth in each jaw; origin of dorsal nearer base of upper caudal rays than eye, its height about half the length of the head; origin of anal under last half of dorsal; pectorals scarcely to ventrals; gill-rakers pointed, a little less than half the length of eye; twenty-six abdominal serræ. Grayish iridescent, tinged with bluish; sides with traces of very hazy round spots; dorsal spotted; anal and caudal dusky; scales 34–90–37.

Known only from the type in the U. S. National Museum, No. 21432. Collected by Orton in the Napo or the Marañon, for a photograph of which I am indebted to the authorities of the United States National Museum. (*Cf.* Plate XLVI.)

9. **Rooseveltiella stigmaterythræus** (Fowler).

Pygocentrus stigmaterythræus FOWLER, Acad. Nat. Sci. Phila., 1911, p. 424, fig. 3 (La Pedrita, on the Cano Uracoa, Venezuela).

Known only from the specimens respectively 4 and 5 inches long in the collections of the Philadelphia Academy. They differ from the smaller specimens of *notatus* in the large black humeral spot.

V. Genus PRISTOBRYCON gen. nov.

Type, *Pygocentrum calmoni* Steindachner.

Intermediate in technical characters between the fierce *Rooseveltiella* without palatine teeth, and the less blood-thirsty *Serrasalmo*, with a series of permanent teeth along the palate. They are the least destructive of the piranhas. Head short and deep, the snout short; palate with few or no teeth in the adult, the teeth sometimes, as in *aureus*, more fully developed in the young; cheeks only partly armed; mouth rather narrow, the upper jaw not very oblique, the lower jaw not very prominent.

Distribution.—Orinoco, Guiana, and Lower Amazon basin.

KEY TO THE SPECIES OF PRISTOBRYCON.

a. Sides variously spotted.

b. Margin of caudal pale.

c. Depth 1.6–1.8; head 3.12–3.66; D. 15–17; A. 32–34; serræ 27–33; interorbital 2.25–2.5 in the head; profile but little depressed over eye; distance from dorsal to caudal equal to length of head, much longer than dorsal; upper half of sides with numerous very small black spots; .2–.4 of the cheek naked.

scapularis (Günther). 10.

cc. Depth 1.6–1.7; head 3.1–3.75; D. 15–17; A. 32–37; serræ 22–35; interorbital 2.16 in the length of head; profile more depressed over eye; distance from dorsal to caudal longer than head; upper half of sides with larger, more or less prominent spots; .25–.5 of the cheek naked.

aureus (Agassiz). 11.

ccc. Depth 1.33; head 3.66; D. 17; A. 40. .*emarginatus* (Schomburgk). 12.

bb. Margin of caudal dark. Depth 1.4–1.5; head 3.4–3.66; D. 15–16; A. 32 or 33; serræ 32–33; nearly half of the cheek naked; a small, obscure, humeral spot; small, dark spots on the upper half of body.

calmoni (Steindachner). 13.

aa. Numerous dark brown cross-bands dividing below the lateral line into narrow stripes; second suborbital but little higher than eye, its length 1.5 in its height; greatest width of naked area of cheek equal to about one-half the length of the suborbital; head 3.33; depth 1.66; D. 17; A. 31 or 32; serræ 32; interorbital 2.75; origin of dorsal an orbital diameter nearer to snout than the base of the caudal . . . .*striolatus* (Steindachner). 14.

10. **Pristobrycon scapularis** (Günther).

Serrasalmo scapularis GÜNTHER, Cat. Fishes Brit. Mus., Vol. V, 1864, p. 368 (British Guiana); PELLEGRIN, Bull. Mus. d'Hist. Nat., 1899, p. 157 (Apuré).

Pygocentrus scapularis EIGENMANN & EIGENMANN, Proc. U. S. Nat. Mus., Vol. XIV, 1891, p. 69; ULREY, Ann. N. Y. Acad. Sci., Vol. VII, 1895, p. 297 (Marajo); EIGENMANN & OGLE, Proc. U. S. Nat. Mus., Vol. XXXIII, 1907, p. 35 (South America).

Serrasalmo coccogenis FOWLER, Proc. Acad. Nat. Sci. Phila., 1911, p. 428, fig. 4 (La Pedrita, on the Cano Uracoa, Venezuela).

Habitat.—British Guiana, Orinoco, Amazon to Para.

5799 *a–b*. C. M. 140–197 mm. Manaos, Dec. 9, 1910. Haseman.

Very similar to *Serrasalmo aureus*, but not so deep, and to *calmoni*, which has a black bordered caudal.

Head 3.4–3.66 to end of lateral line; depth 1.7–1.8; D. 16 or 17; A. 32 or 33; serræ 26 + 1 and 28 + 1; interorbital 2.25–2.5 in the length of the head. Distance from dorsal to caudal fulcra equals length of head, much greater than base of dorsal; origin of dorsal about equal to distance from tip of snout to end of lateral line; base of anal a little longer than head; suture between first and second suborbitals vertical; second suborbital leaving a naked area nearly half as wide as bone in the larger and but little narrower than the bone in the smaller specimen; palatines roughened more or less and with a tooth-like tubercle. Caudal pale-edged; upper parts of sides with small spots.

In the suture between the first and second suborbitals these specimens differ from the specimens from Guiana in which it extends downward and forward.

11. **Pristobrycon aureus** (Agassiz).

Serrasalmo aureus AGASSIZ, Selecta Genera et Spec. Pisc., 1829, p. 72, tab. 29; CUVIER & VALENCIENNES, Hist. Nat. Poiss., Vol. XXII, 1848, p. 282; CASTELNAU, Anim. Amer. Sud, Poiss., 1855, p. 71 (Goyaz); ? MÜLLER & TROSCHEL, *in* Schomburgk's Reisen, Vol. III, 1848, p. 637 (Essequibo, Rupununi); KNER, Characinen, Vol. II, 1859, p. 35 (Rio Vaupé, Matto Grosso).

Serrasalmo gymnogenys GÜNTHER, Cat. Fishes Brit. Mus., Vol. V, 1874, p. 371. (River Capin, British Guiana); EIGENMANN & EIGENMANN, Proc. U. S. Nat. Mus., Vol. XIV, 1891, p. 60; ULREY, Ann. N. Y. Acad. Sci., Vol. VII, 1895, p. 298 (Marajo); ? PERUGIA,[5] Ann. Mus. Civ. Stor. Nat. Genova, 2a, Vol. X, 1891, p. 650 (Resistencia, Chaco Centrale): PELLEGRIN, Bull. Mus. d'Hist. Nat., Vol. V, 1899, p. 157 (Apuré); EIGENMANN, Reports Princeton Univ. Exp. Patagonia, Vol. III, 1910, p. 442; Memoirs Carnegie Mus., Vol. V., 1912, p. 381 (Rockstone; Wismar; Tumatumari; Crab Falls below Packeoo).

[5] It is very probable that Perugia had either *Serrasalmo marginatus*, or *humeralis*.

Habitat.—Guiana, Orinoco, Amazons, and ?Paraguay.
5770 *a.* C. M. 158 mm. Santarem, Dec. 15, 1909. Haseman.
5800 *a–b.* C. M. About 150 and 182 mm. Manaos. Haseman.

Head 3.66–3.75; depth to end of lateral line 1.55–1.6; D. 16–17; A. 33–35; serræ 34 or 35; snout 1.5 in the eye; eye 3 in the head; interorbital 2.16; margin of second suborbital rounded, but leaving a naked area equal to one-fourth to one-third of the total width of the cheeks; space between dorsal and caudal longer than head; head 1.3–1.4 in the length of the anal; spots sometimes arranged in transverse rows, merging into irregular cross-bands in the largest specimen.

12. **Pristobrycon emarginatus** (Schomburgk).

Salmo emarginatus SCHOMBURGK, Fishes Brit. Guiana, Vol. I, 1841, p. 231, plate 19. (Locality?)

Schomburgk's figure represents a fish shaped like *P. aureus* or a *Metynnis.* It differs from the latter in having a short adipose fin. It is quite possible that the figure is that of *aureus.*

13. **Pristobrycon calmoni** (Steindachner). (Plate XLVII.)

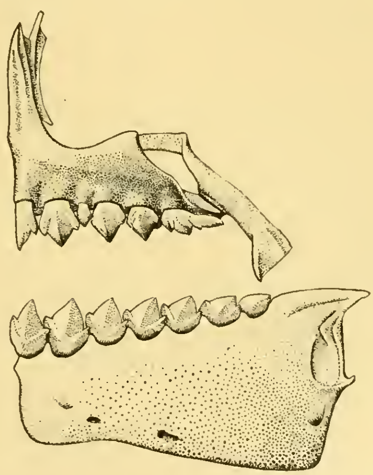


FIG. 3. Dentition of *Pristobrycon calmoni* (Steindachner). $\frac{4}{1}$.

Serrasalmo calmoni STEINDACHNER, Ann. K. Acad. Wiss. Wien, 1908, p. 361 (Pará).

Pygocentrus bilineatus EIGENMANN, Ann. Carnegie Mus., Vol. V, 1909, p. 47; Reports Princeton Univ. Exp. Patagonia, Vol. III, 1910, p. 442; Mem. Carnegie Mus., Vol. V, 1912, p. 385, pl. LVI, fig. 2 (Aruka River, Mora Passage).

5797 *a–b*. C. M. 66–132 mm. Santarem, Dec. 11, 1909. Haseman.
5798 *a–c*. C. M. 105–125 mm. Pará, Jan. 17, 1910. Haseman.

Head 3.7–3.9; depth 1.5–1.6; D. 17; A. 32–34; serræ 30–33; interorbital 2.33–2.25; cheeks with a naked area equal in width to the suborbital; head 1.5 in the length of the base of the anal; palate with one or two teeth.

This species, greatly resembling *gymnogenys* = *aureus*, is readily distinguished by its black caudal border. The specimens from Pará differ from *P. calmoni*, for the most part as described by Steindachner, in only insignificant details; but the eyes in the specimens are certainly longer than the snout, the end of the upper jaw does not reach below the middle of the eye, and the origin of the ventrals is a little nearer the tip of the snout than the end of the anal. In the types of *bilineatus*, on the contrary, it is a little nearer the end of the anal.

14. **Pristobrycon striolatus** (Steindachner).

Serrasalmo (*Pygocentrus*) *striolatus* STEINDACHNER, Anz. K. Acad. Wiss. Wien, 1908, p. 360.

Known only from the types, 180–200 mm. long, coming from tributaries of the Rio Pará.

VI. Genus SERRASALMO Lacépède.

Serrasalmo LACÉPÈDE, Hist. Nat. Poiss., Vol. V, 1804, p. 283.

Type, *Salmo rhombeus* Linnæus.

Body deep, compressed; a series of serræ from below the pectorals to the anus. Teeth in the premaxillary in a single series, trenchant; usually a series of teeth on the palate, but in this respect grading through the heavier jawed, short-nosed species, like *maculatus*, into *Rooseveltiella;* second suborbital covering all or most of the cheek; tongue narrow, free, anal partly scaled; predorsal line naked.

Distribution.—Orinoco, and Guianas south to the Rio San Francisco and the La Plata basin. Not occurring in the Magdalena, on the Pacific slope, nor in the short rivers draining into the Atlantic between the Itapicurú and the Uruguay.

KEY TO THE SPECIES OF SERRASALMO.

a. Depth more than 2 in the length to the end of the lateral line. See also *S. humeralis gracilior*.

b. Interorbital 2.5–2.7 in the head; snout, which is acutely pointed, longer than the eye; chin sharply pointed, entering the profile; lower jaw 2 in the head. D. 15; A. 32–33; abdominal serræ 31–35; head 3; depth 2.66; eye 5 in the head, 2 in interorbital; profile nearly straight; lateral line 100; predorsal line naked; a dark humeral spot; sides with dark spots; back sometimes with parallel bands; dorsal, anal, and adipose with light base and dark margin........*elongatus* Kner. 15.

bb. Snout blunt, about equal to the eye in length; D. 16; A. 30; abdominal serræ about 27; head 3.2; eye 4 in the head; profile but slightly concave. Caudal with a dark margin............*gibbus* Castelnau. 16.

bbb. Snout not very blunt, longer than eye; one-third of cheeks naked in the types; D.16; A.32; serræ 37. Caudal with a light margin.
hollandi Eigenmann. 17.

aa. Depth 2 or less than 2 in the length, rarely 2.1 or 2.33 in *humeralis gracilior*.

c. Caudal with a submarginal black band, the margin hyaline; interorbital 2.5 in the length of the head; snout blunt.

d. Depth 1.6 to end of lateral line; bright yellow; a humeral shade, otherwise unspotted........................*æsopus* Cope. 18.

dd. Depth 1.75–1.92; sides spotted.............*spilopleura* Kner. 19.

cc. Caudal in adult with a marginal black band; anal with a dusky margin.

e. Snout blunt; interorbital 2.33–2.5 in the length of the head (nearly 3 in small specimens); margin of second suborbital convex.

f. Snout shorter than the eye; interorbital 2.5 in the head, even in specimens but 120 mm. long. Depth 1.8–1.9; D. 15 or 17; A. 31–33; serræ 31–34; cheeks entirely or nearly entirely covered; lower jaw heavy. (Palatine teeth sometimes wanting?)...............................*maculatus* Kner. 20.

(*ff.* Snout shorter than eye; interorbital 2.4 in the head. Depth 1.7; D. 17; A. 32; serræ 33; cheeks with a wide naked area; lower jaw not very heavy; palate with teeth? See *Pristobrycon scapularis* and *calmoni*.)

fff. Snout longer than eye; D. 16 or 17 rarely 19; A. 31–36; serræ, rarely 28 or 36; lateral line 87–91; depth 1.8–2.
rhombeus Linnæus. 21.

ffff. Snout longer than eye; interorbital 2.8–nearly 3 in the length of the head; D. 15 or 16; A. 32–33; serræ 30–31; depth 1.8; head 3–3.2. Snout about 3 in the length of the head; eye 5–5.4; second suborbital leaving but a narrow naked strip below.........................*paraënse* Steindachner. 22.

ee. Snout more acute; head compressed, interorbital 3 or more in the length of the head (3 in the largest).

g. Anal slightly falcate, the third ray heavy; second suborbital more or less truncate, leaving a wider naked space than in *rhombeus* or *brandtii*; ventral serræ very strong, 26–33, most frequently 30; depth 2, rarely 1.7; D. 15–18, usually 17; A. 32–36, usually 33 or 34.
humeralis Cuvier & Valenciennes. 23.

gg. Characters of *humeralis* but the depth 2.33 in the length to end of lateral line...................*gracilior* Eigenmann. 24.

ggg. Anal rounded in front, or the third ray, which is but little heavier than the following one, slightly prolonged, milk-white; second suborbital convex below; ventral serræ much more feeble than in *humeralis*, 30–35, most frequently 34; depth 1.8; D. usually 16 or 17; A. 33–37, most frequently 35.

brandti Reinhardt. 25.

ccc. Margin of caudal light, no submarginal black band.

h. Margin of anal light; snout blunt, six tenths as long as eye, or equal to the eye; a considerable naked area on the cheek; D. 15 or 16, A. 32–37; serræ 22–33 ....(See *Pristobrycon aureus* Agassiz,)

hh. Margin of anal dark in the adult; snout pointed, longer than snout of *aureus*, young slenderer than young of *aureus*.

marginatus Valenciennes. 26.

15. **Serrasalmo elongatus** Kner.

FIG. 4. Dentition of *Serrasalmo elongatus* Kner. (Enlarged.)

Serrasalmo elongatus KNER, Characinen, Vol .II, 1859, p. 36, taf. v, fig. 12 (Rio Guaporé, Matto Grosso); GÜNTHER, Cat. Fishes Brit. Mus., Vol. V, 1864, p. 371; STEINDACHNER, Flussf. Südam., Vol. IV, 1882, p. 16 (Huallaga); EIGENMANN & EIGENMANN, Proc. U. S. Nat. Mus., Vol. XVI, 1891, p. 60; EIGENMANN, Reports Princeton Univ. Exp. Patagonia, Vol. III, 1910, p. 442.

Distribution.—Rios Guaporé and Amazon.

5757 *a–c.* C. M. Three, 164 to about 200 mm. Santarem, Dec. 8, 1909. Haseman.

Head 3.3–3.6; depth 2.3–2.44 in the length to the end of the lateral line. D. 15; A. 30 in two, 31 in one; serræ 34, 35, 36; eye about 1.5 in the snout, 5–5.5 in the head, 2–2.2 in the interorbital; lower posterior margin of the second interorbital subtruncate, leaving a segment of a circle of the cheek naked. Gill-rakers minute.

5796 *a*. C. M. 40 mm. Bastos on the Rio Alegre, a tributary of the Guaporé. June 26, 1909. Haseman.

Head 2.75; depth 2.25; D. 17; A. 35; serræ 26; eye 3 in the head; interorbital 4. Distal half of dorsal and caudal, distal half of anal lobe and anal margin jet black; sides spotted.

This specimen differs conspicuously from the adult of *elongatus*. Many of its characters are, however, undoubtedly due to its youth, and in all likelihood it is the young of *elongatus*.

16. **Serrasalmo gibbus** Castelnau.

Serrasalmo gibbus CASTELNAU, Anim. Am. Sud, Poiss, 1855, pl. 38, fig. 1 (Araguay); EIGENMANN & EIGENMANN, Proc. U. S. Nat. Mus., Vol. XIV, 1891, p. 60.

Serrasalmo gibbus GÜNTHER, Cat. Fishes Brit. Mus., Vol. V, 1864, p. 366; EIGENMANN, Reports Princeton Univ. Exp. Patagonia, Vol. III, 1910, p. 442.

Habitat.—Araguay.

Known only from Castelnau's figure. It is probably a synonym of *elongatus*.

17. **Serrasalmo hollandi**[6] Eigenmann, sp. nov. (Plate XLVIII.)

5792 *a*. C. M. About 130 mm., 109 mm. to end of scaled portion of caudal. Maciél, Rio Guaporé, July 23, 1909. Haseman.

Depth 2.16; head 3.33; D. 16; A. 32; serræ 37; scales 31–86–27; eye 3.66 in head, snout 4, interorbital 2.6; depth of caudal peduncel 3.33. Origin of dorsal about an orbital diameter nearer snout than end of lateral line; distance of dorsal from upper caudal fulcra equals length of head; base of dorsal equals length of head less snout and half the orbit, but little greater than its distance from the adipose; origin of anal equidistant from the base of the last ray and the middle of the pectoral; origin of ventrals a little nearer tip of snout than the distance between snout and predorsal spine.

Elongate, compressed; dorsal and ventral profiles about equally curved; dorsal profile but little depressed over eye, snout not very blunt, the lower jaw scarcely entering profile; occipital process about

[6] Named for my friend, Dr. W. J. Holland, Director of the Carnegie Museum. *C. H. Eigenmann*.

2.7 in the distance from its base to the dorsal; palatines with five well developed teeth; about one-third of the cheek naked at its widest.

Serræ well developed; dorsal elevated in front; anal slightly emarginate in front; ventrals about 2 in the head without the opercle, equal to the longest anal ray.

Sides with numerous circular spots about the size of the pupil; an angular humeral spot, larger than the other spots; a V-shaped basal caudal spot; anal and distal portion of caudal hyaline.

18. **Serrasalmo æsopus** Cope.

Serrasalmo æsopus COPE, Proc. Acad. Nat. Sci., Phila., 1871, p. 269 (Amazon between Rio Negro and the Huallaga); EIGENMANN & EIGENMANN, Proc. U. S. Mus., Vol. XIV, 1891, p. 60; FOWLER, Proc. Acad. Nat. Sci., Phila., 1906, p. 469, fig. 53 (note, and figure of the type from the Amazon between Rio Negro and Huallaga); EIGENMANN, Reports Princeton Univ. Exp. Patagonia, Vol. III, 1910, p. 442.

Distribution.—Upper Amazon.

This species is known only from the type, five and seven-eighths inches long, in the collection of the Philadelphia Academy. It may prove to be synonymous with *spilopleura*.

19. **Serrasalmo spilopleura** Kner. (Plate XLIX.)

Serrasalmo spilopleura KNER, Characinen, Vol. II, 1859, p. 35, taf. v, fig. ii (Matto Grosso, Guaporé, ? Bogota); GÜNTHER, Cat. Fishes Brit. Mus., Vol. V, 1864, p. 370 (River Capin); Ann. & Mag. Nat. Hist., 1880, p. 13 (La Plata); EIGEN-

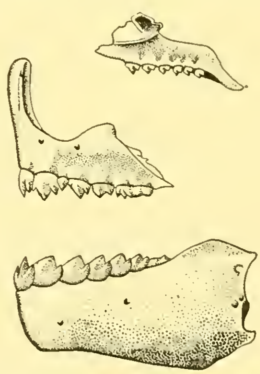


FIG. 5. Dentition of *Serrasalmo spilopleura* Kner. $\frac{2}{1}$.

MANN & EIGENMANN, Proc. U. S. Nat. Mus., Vol. XIV, 1891, p. 60; ULREY, Ann. N. Y. Acad. Sci., Vol. VII, 1895, p. 297 (Tocantins, Brazil); PERUGIA, Ann. Mus. Civ. Stor. Nat. Genova, Ser. 2, Vol. VIII, 1897, p. 26 (Bolivia); BOULENGER, Trans. Zool. Soc. London, Vol. XIV, 1896, p. 37 (Descalvados and

Paraguay); Boll. Mus. Univ. Torino, Vol. XV, 1900 (near Corumbá); EIGENMANN & OGLE, Proc. U. S. Nat. Mus., Vol. XXXIII, 1909, p. 35 (Paraguay); EIGENMANN, Ann. Carnegie Mus., Vol. IV, 1907, p. 141 (Rio Otuquis, Ascuncion; Porto Murtinho)—Reports Princeton Univ. Exp., Patagonia, Vol. III, 1910, p. 442.

Pygocentrus dulcis HECKEL *MS.* in Kner.

Distribution.—Basin of Amazon and La Plata.

The record of "Bogota," if by this is meant the capital of Colombia, is certainly wrong. The species is apparently quite abundant in the Paraguay basin.

Distinguished by the intense submarginal black caudal band, and spotted sides.

5774 *a–f.* C. M. 54–165 mm. Rio Jauru, June 4, 1909. Haseman.
5775 *a–b.* C. M. 44–49 mm. Caceres, May 26, 1909. Haseman.
5776 *a.* C. M. 90 mm. Rio San Francisco, June 10, 1909. Haseman.
5795 *a.* C. M. 37 mm. Bastos, June 26, 1909. Haseman.
5777 *a–d.* C. M. 45–120 mm. San Joaquin, Bolivia, Sept. 4 and 5, 1909. Haseman.
5778 *a–d.* C. M. 44–154 mm. Cacequy, Feb. 1, 1909. Haseman.
5779 *a–i.* C. M. 46–83 mm. Uruguayana, Feb. 5, 1909. Haseman.
5761 *a–c.* C. M. 104 mm. Riberão Azul, 22 miles northeast of Salto das Cruzes, tributary of the Rio Tieté. Oct. 7, 1908. Haseman.
5780 *a–b.* C. M. 113 mm. Pará, Jan. 17, 1910. Haseman.
5781 *a.* C. M. 44 mm. Corumbá, April 27, 1909. Haseman.

The counts of a number of specimens are: D. $\frac{15}{4}$[7], $\frac{16}{6}$, $\frac{17}{4}$; A. $\frac{30}{1}$[7], $\frac{32}{4}$, $\frac{33}{1}$, $\frac{34}{1}$[7].

20. **Serrasalmo maculatus** Kner.

Serrasalmo maculatus KNER, Characinen, Vol. II, 1859, p. 33, taf. iv, fig. 10 (Rio Guaporé); GÜNTHER, Cat. Fishes Brit. Mus., Vol. V, 1864, p. 371; COPE, Proc. Am. Philos. Soc., Vol. XI, 1870, p. 566 (Pará); STEINDACHNER, Flussf. Südam., Vol. IV, 1882, p. 16 (Huallaga); EIGENMANN & EIGENMANN, Proc. U. S. Nat. Mus., Vol. XIV, 1891, p. 60; ULREY, Ann. N. Y. Acad. Sci., Vol. VII, 1895, p. 298 (Tocantins); PERUGIA, Ann. Mus. Civ. Stor. Nat., Genova, Ser. 2, Vol. VIII, 1897, p. 26 (Rio Madidi, Bolivia); PELLEGRIN, Bull. Mus. d'Hist. Nat., 1899, p. 406 (Manaos); FOWLER, Proc. Acad. Nat. Sci., Phila., 1906, p. 469 (Pará, notes on Cope's specimen); EIGENMANN, Reports Princeton Univ. Exp. Patagonia, Vol. III, 1910, p. 442.

[7] The denominator indicates the number of specimens having the given character.

Pygocentrus melanurus HECKEL, Ms. in Kner, l. c.
Pygocentrus nigricans HECKEL Ms. in Kner, l. c.
Serrasalmo brandti ULREY (not Lütken), Ann. N. Y. Acad. Sci., Vol. VII, 1895, p. 298 (Brazil).

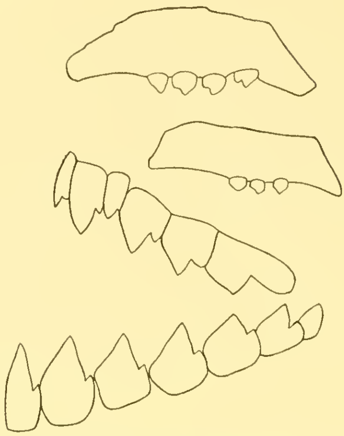


FIG. 6. Dentition of *Serrasalmo maculatus* Kner. The upper cut represent. the palatines of a specimen 177 mm. long, the others are from a specimen 147 mm. long. (Greatly enlarged.)

Distribution.—Amazons to Bolivia.

5790 *a–d*. C. M. 120–188 mm. Manaos, Dec. 9 and 11, 1909. Haseman.

Depth 1.74–1.8; D. 16 or 17; A. 31–34; serræ 32–34; interorbital 2.52–2.66 in the head. Origin of dorsal nearer tip of snout than end of lateral line in the two smaller specimens equidistant from anterior nares and end of lateral line in the largest; distance between dorsal and base of upper caudal fulcra longer than the base of the dorsal, equal to the head or the part of the head behind the anterior nares; base of anal longer than head. Caudal bordered with dark.

21. **Serrasalmo rhombeus** (Linnæus). (Plate LVIII.)[8]

Salmo rhombeus LINNÆUS, Syst. Nat. ed. XII, Vol. I, 1766, p. 514 (Surinam); PALLAS, Spicil. Zool., Vol. VIII, 1769, p. 57, tab. 5, fig. 3; GMELIN, Syst. Nat., Vol. I, 1788, p. 686, no. 28; BLOCH, Ausl. Fische, p. 112, 1794, taf. 383; BLOCH & SCHNEIDER, Syst. Ichth., 1801, p. 404.

[8] The negative of Plate LVIII was made by Dr. Raymond C. Beeler in the Laboratory of Dr. Albert M. Cole, both of the gentlemen being residents of Indianapolis. I am greatly indebted to them for their kindness. The Author.

Serrasalmo rhombeus LACÉPÈDE, Hist. Nat. Poiss., Vol. V, 1804, p. 284; CUVIER, Mém. Mus. d'Hist. Nat., Vol. V, 1819, p. 367; CUVIER & VALENCIENNES, Hist. Nat. Poiss., Vol. XXII, 1848, p. 272 (Araguay); MÜLLER & TROSCHEL, *in* Schomburgk. Reisen, Vol. III, 1848, p. 637 (Rupununi, Takutu); CASTELNAU, Anim. Amer. Sud, Poiss., 1855, pl. 37, fig. 3; GÜNTHER, Cat. Fishes Brit. Mus., Vol. V, 1864, p. 369 (Essequibo, Surinam, Demerara); EIGENMANN & EIGENMANN, Proc. U. S. Nat. Mus., Vol. XIV, 1891, p. 60; ? BOULENGER, Ann. Mus. Civ. Stor. Nat. Genova, Ser. 2, Vol. XIX, 1898 (Puerto 14 Mayo); EIGENMANN, Reports Princeton Univ. Exp., Patagonia, Vol. III, 1910, p. 442;—Memoirs Carnegie Mus., Vol. V, 1912, p. 382 (Wismar, Crab Falls, Packeoo, Twoca Pan, Tumatumari, Rockstone).

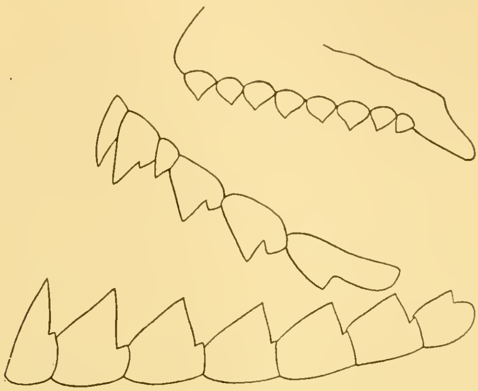


FIG. 7. Dentition of *Serrasalmo rhombeus* (Linnæus). (Somewhat enlarged.)

Serrasalmo albus VALENCIENNES in Humboldt, Recherches Poissons Fluv. Rec. d'Observ. Zoologie, Vol. III, 1821, p. 173, pl. 47, fig. 1 (Orinoco).

Serrasalmo caribe CUVIER & VALENCIENNES, Hist. Nat. Poiss., Vol. XXII, 1849, p. 279.

Serrasalmo immaculatus COPE, Proc. Amer. Philos. Soc., 1878, p. 692 (Peruvian Amazon); EIGENMANN & EIGENMANN, Proc. U. S. Nat. Mus., Vol. XIV, 1891, p. 60; FOWLER, Proc. Acad. Nat. Sci. Phila., 1906, p. 471, fig. 54 (Peruvian Amazon, notes on the types); EIGENMANN, Reports Princeton Univ. Exp. Patagonia, Vol. III, 1910, p. 442.

Distribution.—Guianas and Amazons.

The type of *immaculatus* figured by Fowler shows it to be a *rhombeus*. It is possible that the smaller cotypes are *humeralis*.

The *S. albus* is said to differ in having twenty dorsal rays. I have found nineteen in one specimen of *rhombeus* and until we find a species in the Orinoco with the characters assigned to *albus*, differing from *rhombeus*, *albus* may be put as a synonym of *rhombeus*.

5784 *a*. C. M. 174 mm. to end of lateral line. Manaos, Nov. 15, 1909. Haseman.

5785 *a–b*. C. M. 205 mm. Santarem, Dec. 11, 1909. Haseman.

5793 *a*. C. M. 305 mm. Santarem, Dec. 20, 1909. Haseman.

Haseman remarks of the last specimen "that it is jet black and goes by the name '*Piranha negro*.'"

22. **Serrasalmo paraënse** Steindachner.

Serrasalmo (*Serrasalmo*) *paraënse* STEINDACHNER, Anz. K. Acad. Wiss. Wien, 1908, p. 362 (Rio Pará).

Known only from the types.

23. **Serrasalmo humeralis** Cuvier and Valenciennes. (Plate L.)

Serrasalmo humeralis CUVIER & VALENCIENNES, Hist. Nat. Poiss., Vol. XXII, 1848, p. 279 (Amazon); KNER, Characinen, Vol. II, 1859, p. 30, taf. iv, fig. 9 (Rio Guaporé, Barra do Rio Negro, Cujaba, Villa Maria, Rio Paraguay); GÜNTHER, Cat. Fishes Brit. Mus., Vol. V, 1864, p. 370; COPE, Proc. Acad. Nat. Sci. Phila., 1871, p. 292 (Ucayale); STEINDACHNER, Flussf. Südam., Vol. IV, 1882, p. 16 (Hualaga); EIGENMANN & EIGENMANN. Proc. U. S. Nat. Mus., Vol. XIV, 1891, p. 60; PERUGIA, Ann. Mus. Civ. Stor. Nat. Genova, Ser. 2a, Vol. X, 1891, p. 50 (Resistencia, Chaco Centrale); BOULENGER, Trans. Zool. Soc. London, Vol. XIV, 1896, p. 37 (Descalvados and Paraguay); Boll. Mus, Univ. Torino, Vol. XV, 1900 (near Corumbá); FOWLER, Proc. Acad. Nat. Sci., Phila., 1906, p. 469 (notes on Cope's specimens); EIGENMANN, Ann. Carnegie Mus., Vol. IV, 1907, p. 141 (Porto Murtinho, Bahia Negra); Reports Princeton Univ. Exp. Patagonia, Vol. III, 1910, p. 442.

Serrasalmo iridopsis COPE, Proc. Acad. Nat. Sci., Phila., 1871, p. 268, pl. ix, fig. 2 (Ambyiacu); EIGENMANN & EIGENMANN, Proc. U. S. Nat. Mus., Vol. XIV, 1891, p. 60; FOWLER, Proc. Acad. Nat. Sci. Phila., 1906, p. 471 (Ambyiacu, note on the type, four and one-eighth inches long); EIGENMANN, Reports Princeton Univ. Exp. Patagonia, Vol. III, 1910, p. 442.

Distribution.—Amazons and Paraguay.

Cope in his description of *iridopsis* states that there are forty-one abdominal serræ. Fowler in his reëxamination found but thirty-one. If there are but thirty-one serræ I can see no character by which this species differs from *humeralis*.

5786 *a–c*. C. M. 68 to about 144 mm. Rio Jauru, June, 1909, p. 204. Haseman.

5787 *a–m*. C. M. 25–126 mm. Villa Hays, April 11 and 13, 1909. Haseman.

5788 *a–b*. C. M. 58 and 77 mm. San Joaquin, Sept. 5, 1909. Haseman.

5782 *a*. C. M. About 170 mm., 157 mm. to end of lateral line. Nov. 15, 1909. Haseman.

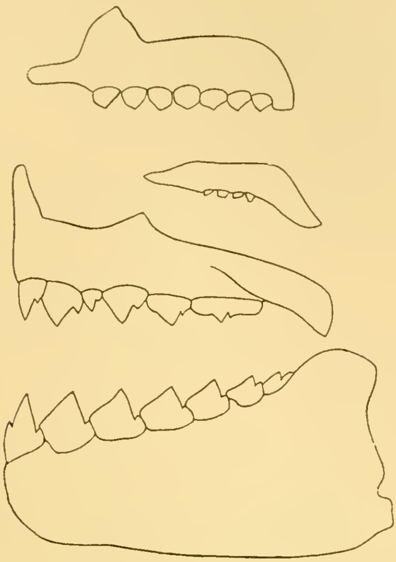


FIG. 8. Dentition of *Serrasalmo humeralis* Cuvier & Valenciennes. The upper cut represents the palatines of a specimen 170 mm. long, the rest are from a specimen 133 mm. (Greatly enlarged.)

5783 *a–g*. C. M. 62–114 mm. Santarem, Dec. 8–11, 1909. Haseman.

5769 *a–c*. C. M. 41 to about 180 mm. Lagoa de Paranagua, Jan. 16, 1908. Haseman.

The counts and measurements of a number of specimens are as follows: D. $\frac{15}{1}$, $\frac{16}{3}$, $\frac{17}{6}$, $\frac{18}{2}$; A. $\frac{32}{1}$, $\frac{33}{3}$, $\frac{34}{5}$, $\frac{35}{1}$, $\frac{36}{1}$; serræ $\frac{26}{2}$, $\frac{28}{1}$, $\frac{30}{4}$, $\frac{31}{2}$, $\frac{33}{2}$. The denominator indicates the number of specimens having the given character.

Depth in the length to end of lateral line, 1.8–2.

24. **Serrasalmo humeralis gracilior** Eigenmann, var. nov.

The following specimens are very much slenderer than typical specimens of *humeralis*.

5791 *a–b*. About 145 and 160 mm. Maciél, Rio Guaporé, July 23, 1909.

Depth 2.33–2.3 to end of scaled portion of caudal; head 3.33–3.4; D. 17; A. 33 and 34; serræ 30; eye 1 in snout, 4.5 in head; 1.5 in interorbital. A large humeral spot, caudal with a dark V-shaped basal bar and broadly margined with dark.

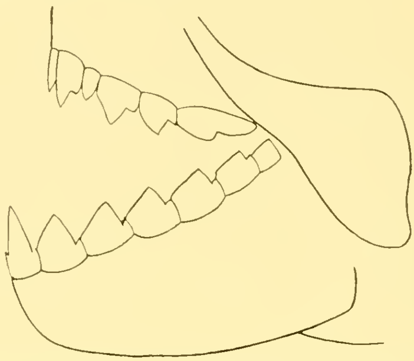


FIG. 9. Dentition of *Serrasalmo humeralis gracilior* Eigenmann. (Enlarged.)

Origin of dorsal a little nearer end of lateral line than tip of snout. Differing from typical *humeralis* by having the back less elevated, the dorsal more rounded.

25. **Serrasalmo brandti** Reinhardt. (Plate LI.)

Serrasalmo brandtii LÜTKEN, Velhas-flodens Fiske, 1875, p. 237 with fig. and p. xviii (Rio das Velhas); EIGENMANN & EIGENMANN, Proc. U. S. Nat. Mus., Vol. XIV, 1891, p. 60; EIGENMANN & OGLE, Proc. U. S. Nat. Mus., Vol. XXXIII, 1907, p. 35 (Lagoa Santa); EIGENMANN, Reports Princeton Univ. Exp. Patagonia, Vol. III, 1910, p. 442.

Distribution.—Rios San Francisco and Itapicurú. This species is abundant in the San Francisco basin from which the following were taken.

5762 *a–g*. C. M. 120–190 mm. Joazeiro, Nov. 28, 1907. Haseman.
5763 *a–h*. C. M. 27–112 mm. Penedo, March 20, 1908. Haseman.
5764 *a–h*. C. M. 26–178 mm. Barreiras, Jan. 3 and 4, 1908. Haseman.
5693 *a*. C. M. 34 mm. Barra de Penedo, April 8, 1908. Haseman.
5690 *a–s*. C. M. 18–32 mm. Boqueirão, Jan. 6, 1908. Haseman.
5765 *a–b*. C. M. 44 and 92 mm. Januaria, Dec. 12, 1907. Haseman.

5766 *a–z*. C. M. 27–112 mm. Cachoeira de Pirapora, Dec. 15, 1907. Haseman.
5767 *a–z*. C. M. 17–55 mm. Lagoa Pereira, Barra, Dec. 23, 1907. Haseman.
5768 *a–f*. C. M. 24–65 mm. Lagoa de Porto near Barra, Dec. 24, 1907. Haseman.
5692 *a*. C. M. 30 mm. Rio Grande near Cidade do Barra, Dec. 24, 1907. Haseman.

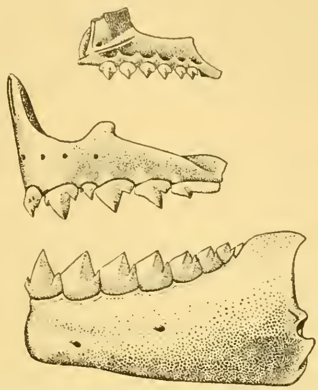


FIG. 10. Dentition of *Serrasalmo brandti* Reinhardt. $\frac{2}{1}$.

5758 *a*. C. M. 229 mm. Lagoa de Porto near Barra, Dec. 24, 1907. Haseman.
5691 *a–g*. C. M. 32–50 mm. Santa Rita, Jan. 24, 1908. Haseman.

The following specimens were taken outside the San Francisco basin:

5759 *a*. C. M. 199 mm. Rio Zinga, emptying into Itapicurú, Nov. 7, 1907. Haseman.
5760 *a–u*. C. M. 16–84 mm. Queimadas, Rio Itapicurú, March 2, 1908. Haseman.
5689 *a–h*. C. M. 24–76 mm. Rio Paqui, Baixa Grande, Nov. 14, 1907. Haseman.
5694 *a–b*. C. M. 34 to about 43 mm. Cachoeira, Rio Paraguassu, April 14 and 17, 1908. Haseman.

Anal rounded in front, or the third ray, which is but little heavier than the following one, slightly prolonged; second suborbital convex below; ventral serræ much more feeble than in *humeralis*. D. $\frac{15}{1}$,

$\frac{16}{5}$, $\frac{17}{6}$; A. $\frac{33}{2}$, $\frac{34}{2}$, $\frac{35}{4}$, $\frac{36}{1}$, $\frac{37}{2}$; serræ $\frac{30}{1}$, $\frac{31}{1}$, $\frac{32}{2}$, $\frac{33}{1}$, $\frac{34}{4}$, $\frac{35}{2}$; length to end of lateral line 1.7–2.1.

26. **Serrasalmo marginatus** Valenciennes.

Serrasalmo marginatus VALENCIENNES in d'Orb. Voy. Amer. Merid, Poiss., 1847, p. 10, pl. 10, fig. 1; CUVIER & VALENCIENNES, Hist. Nat. Poiss., Vol. XXII, 1848, p. 277 (Corrientes); KNER, Characinen, Vol. II, 1859, p. 32 (Guaporé, Cuyabá); GÜNTHER, Cat. Fishes Brit. Mus., Vol. V, 1864; Ann. & Mag. Nat. Hist., 1880, p. 13 (La Plata); EIGENMANN & EIGENMANN, Proc. U. S. Nat. Mus., Vol. XIV, 1891, p. 60; ULREY, Ann. N. Y. Acad. Sci., Vol. VII, 1895, p. 297 (Brazil); BERG, Com. Mus. Nac. Buenos Ayres, 1, 1899, p. 166 (Buenos Aires); EIGENMANN & OGLE, Proc. U. S. Nat. Mus., Vol. XXXIII, 1907, p. 35 (Paraguay).

Serrasalmo humeralis CASTELNAU (*non* Cuvier & Valenciennes), Anim. Am. Sud, Poiss., 1855, pl. 37, fig. 2; EIGENMANN & KENNEDY, Proc. Acad. Nat. Sci., Phila., 1903, p. 528 (Rio Paraguay and Arroyo Trementina); EIGENMANN, Reports Princeton Univ. Exp. Patagonia, Vol. III, 1910, p. 442.

Serrasalmo iritans PETERS, Mb. Ak. Wiss., Berlin, 1877, p. 472 (San Fernando de Apuré); EIGENMANN & EIGENMANN, Proc. U. S. Nat. Mus., Vol. XIV, 1891, p. 60; ULREY, Ann. N. Y. Acad. Sci., Vol. VII, 1895, p. 298 (Marajo).

Serrasalmo iridopsis ULREY, (*non* Cope) N. Y. Acad. Sci., Vol. VII, 1895, p. 298 (Tocantins).

Distribution.—La Plata basin, Orinoco, Amazons.

5771 *a*. C. M. 76 mm. Berlin, Rio Mamoré, Sept. 15, 1909. Haseman.

D. 15; A. 34; serræ 34.

5772 *a*. C. M. 70 mm. San Joaquin, Sept. 5, 1909. Haseman.

D. 16; A. 34; serræ 33.

5773 *a*. C. M. 62 mm. Caceres, May 26, 1909. Haseman.

D. 16; A. 34; serræ 28.

5794 *a–c*. C. M. 45–66 mm. Rio Jauru, June 2, 1909. Haseman.

These specimens are all young and the identification is more or less doubtful. They may be the young of *humeralis* in which the terminal caudal bar has not yet developed. They differ otherwise from young *humeralis* in having the opercle dark below its middle.

Subfamily MYLINÆ.

Body compressed, deep; ventral surface with serræ; teeth of the premaxillary in two series; mandible with a single series of teeth and sometimes a pair of subconical teeth behind and in contact with the symphyseal pair of teeth; no teeth on the palate or on the maxillary;

dorsal comparatively long; ventrals minute; anal long; adipose variously developed; gill-rakers well developed.

KEY TO GENERA OF MYLINÆ.

a. Teeth thorn-like, wide set and almost concealed by the lips and gums; premaxillary with two antrorse, large teeth in the front series and three smaller ones in the second series; no inner teeth in the lower jaw; mouth very oblique, lower jaw inordinately projecting; a predorsal spine; serræ along the ventral edge from below the pectorals to the anal; adipose large; cheeks entirely mailed........................*Catoprion* Müller & Troschel. 1.

aa. Teeth incisors or molars, not antrorse; lower jaw not much projecting, or the jaws equal, the mouth nearly horizontal; two teeth in the second transverse row of the premaxillary, five teeth in the front row, which may be continuous or broken, the teeth arranged stepwise from the last on the sides to the first in front.

b. Mandibles without an inner pair of teeth; abdomen serrate behind the ventrals, smooth in front of them.

c. Dorsal rays prolonged, filiform; anal in male bilobed. *Mylesinus* Cuvier & Valenciennes. 2.

cc. Dorsal rays scarcely prolonged, the margin of the fin oblique, not falcate; gill-rakers filamentous..........*Acnodon* Eigenmann. 3.

bb. Mandibles with a pair of teeth behind the symphyseal pair; abdomen with serræ in front, as well as behind the ventrals; second suborbital leaving a wide naked area.

d. No predorsal spine.

e. No supplementary scales; anal naked, as long as head or shorter, highest in front, without distinct lobes.

f. Adipose dorsal rayed; opercle with a broad membranous border; gill-rakers numerous, very fine. *Piaractus* Eigenmann. 4.

ff. Adipose dorsal not rayed. Opercle with a narrow membrane........................*Colosoma* Eigenmann. 5.

ee. Numerous supplementary scales obscuring the primary ones and giving the surface a velvety texture; free margin of anal convex, the posterior part highest; anal scaled for at least half of its height, much longer than head; opercles with a narrow lobe; gill-rakers moderate in number and size. *Mylosoma* Eigenmann. 6.

g. Abdomen not excessively pendant..(*Mylosoma* Eigenmann.)

gg. Abdomen excessively pendant, depth about 1.14. (*Starksina* Fowler.)

dd. A predorsal spine.

h. Adipose fin long, more than half the length of the dorsal; dorsal with fewer than 20 rays; free margin of anal slightly convex or with a single lobe in front..........*Metynnis* Cope. 7.

i. Gill-rakers long, setiform................(*Metynnis* Cope.)

ii. Gill-rakers equal to half the length of the eye or shorter. (*Sealeina* Fowler.)

hh. Adipose fin short; gill-rakers short, lanceolate; dorsal rays 21–31; anal in male bilobed (in all species ?), in the female falcate.

j. Individual dorsal rays of the male prolonged, filiform; teeth of the front series incisor-like and close to the posterior series. . . . . *Myleus* Müller & Troschel. 8.

jj. Individual dorsal rays not prolonged; teeth various. *Myloplus* Gill. 9.

The number of species available for study do not warrant a synopsis of the various genera.

I give below a list of the specimens in the Carnegie Museum, with descriptions of some new species and notes on some of the old species.

VII. Genus CATOPRION Müller & Troschel.

27. **Catroprion mento** (Cuvier).

5724 C. M. 117 mm. Santarem, Dec. 15, 1909. Haseman.

5725 C. M. 105 mm. Rio Boaventura, June 16, 1909. Haseman.

5726 *a–c*. C. M. 47, 57, and 107 mm. Maciél, Rio Guaporé, Aug. 10, 1909. Haseman.

5727 C. M. 87 mm. Bastos, June 28, 1909. Haseman.

5728 C. M. 67 mm. Rio Jauru, June 2, 1909. Haseman.

Head 3.5; depth 1.66–2; D. 15–18; A. 36–38.

VIII. Genus COLOSOMA Eigenmann.

28. **Colosoma mitrei** (Berg). (Plate LII.)

6536 *a*. C. M. One, 315 mm. Caceres, May 27, 1909. Haseman.

Head 3.8; depth 2; D. 17; A. 23; serræ 60 + 7; scales about 55–140–54.

29. **Colosoma bidens** (Agassiz).

5633 *a*. C. M. One, 165 mm. to end of middle caudal rays. Manaos, November 16, 1909. Haseman.

5634 *a–d*. C. M. Four, 160–220 mm. Santarem, Dec. 16, 1909. Haseman.

6535 *a*. C. M. One, 445 mm. San Antonio de Rio Madeira, Nov. 2, 1909. Haseman.

IX. Genus PIARACTUS Eigenmann.

30. **Piaractus nigripinnis** (Cope). (Plate LIII.)

Myletes nigripinnis COPE, Proc. Am. Philos. Soc., 1878, p. 693 (Peruvian Amazon); STEINDACHNER, Flussf. Südam., Vol. II, 1881, p. 25, pl. vii, fig. 1 (Teffé); EIGENMANN & EIGENMANN, Proc. U. S. Nat. Mus., Vol. XIV, 1891, p. 61; ULREY, Ann. N. Y. Acad. Sci., Vol. VII, 1895, p. 300 (Brazil).

Colosoma (*Waiteina*) *nigripinnis* FOWLER, Proc. Acad. Nat. Sci. Phila., 1906, p. 473, fig. 55 (Peruvian Amazon).

Habitat.—Amazons.

Fowler makes *nigripinnis* a new subgenus, basing it on the fact that the 'anterior and posterior series of teeth are well-separated anteriorly in the upper jaw,' but in the description, p. 474, he says, "In upper jaw five teeth in each external series approximated with our transverse annectant ones," and again, p. 475, he says, "Cope's

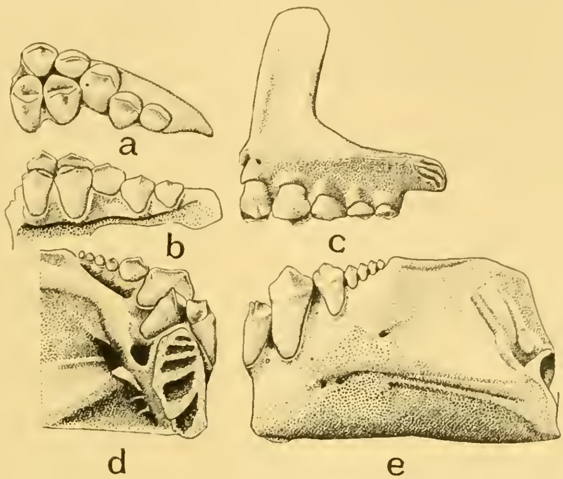


FIG. 11. Dentition of *Piaractus nigripinnis* (Cope). *a*, *b*, *c*, the premaxillary from below, within, and without, respectively. *d* and *e*, the dentary from within and without. $\frac{2}{1}$.

statement, that the two posterior mandibulars are in contact with the median pair of the anterior series, and are separated by a narrow interspace from each other, evidently refers to the teeth of the upper jaw." Doubting whether Cope meant the upper jaw when he wrote "mandibular," it is quite evident that Fowler again means to say that the anterior and posterior teeth of the upper jaw are in contact.[8]

The rays of the adipose are poorly represented in Fowler's figure, which is a fair representation of the following specimens:

5637 *a–b*. C. M. Two, 220 mm. Manaos, Nov. 16, 1909. Haseman.

[8] I have recently examined the specimens described by Fowler and find that the teeth are in contact and that the subgenus *Waiteina* is a pure synonym.

5635 *a*. C. M. 195 mm., and 5636 *a–e*, five, 147–186 mm. Santarem, Dec., 1909. Haseman.

Head 2.6–3, measured to end of long opercle and end of scales; depth 1.8, D. 16 or 17, A. 25 to 27; scales 20 to 23–77 to 80–20 or 21. Abdominal serræ 45–50; eye 1 in snout, 4–4.5 in head, 2–3 in interorbital; naked portion of cheek 1–1.33 in the width of the second suborbital; greatest width of opercle 2–2.33 in its height.

Body compressed, subrhomboidal, the head very wide; profile depressed over the eyes, predorsal line naked; abdominal serræ all simple; frontal fontanel ovate, shorter, but wider, than parietal; occipital process extending about one-fourth to the dorsal, bordered by about ten scales; skull with various ridges; mouth moderate, mandible equals snout and half the eye; maxillary slender, concealed when the mouth is closed; opercle with strong radiating ridges, bordered by a very broad membrane; second suborbital narrow.

Gill-rakers fine, similar on both arches, almost half as long as the eye, about 36 + 40.

Origin of dorsal equidistant from end of scales at base of middle caudal rays and anterior part of eye; anterior dorsal rays equal length of head without opercle; distal portion of adipose fin rayed; depth of caudal peduncle equals the length of the opercle or less; caudal broad, its margin lunate when expanded, naked portion of the lobe nearly equal to the length of the head; origin of anal about equidistant from snout with the base of the last dorsal ray, highest rays equal to length of the head less half or the whole of the opercle; ventrals lanceolate, sometimes reaching nearly to origin of anal; pectorals extending a little beyond origin of ventrals.

Scales moderate, largest just beneath origin of dorsal, minute on adipose; caudal naked.

Fins steel blue. Middle of sides in the smallest with numerous round spots the size of the pupil or smaller; these become obscure with the development of surface pigment with age. Region below the lateral line smutty in adults, especially between the line and anal.

Depth of anterior air-bladder equals the length of the posterior, which is small, conical, as long as eye and half the snout; anterior bladder equal about to head less opercle.

Vertebræ 8 + 22 (counting those with hæmal canal and not counting the coalesced vertebræ); dorsal inserted on the sixth.

X. Genus MYLOSOMA Eigenmann.

31. **Mylosoma ocellatum** Eigenmann, sp. nov.?

5629 C. M. Type. 44 mm. and 5630 C. M. Paratypes, nineteen, largest 48 mm. Villa Hays, Paraguay, April 13, 1909.

These specimens may prove to be the young of *M. albiscopus.* Head 3; depth 1.30 in the largest, 1.5 in some of the smaller; D. 16–19; A. 33–36; abdominal serræ 39–48; eye 2.5 in the head; 1.33 in interorbital; very compressed, deep; profile steep, slightly concave at the occiput. Ventral profile pendulous; predorsal area naked. Ventral spines simple thorns (in the young only?) present both in front and behind ventrals. About half of the cheek is naked. Teeth of the premaxillary close together. Gill-rakers 12 + 13.

Origin of dorsal nearly equidistant from tip of snout and base of caudal, its highest ray equals head less opercle; depth of caudal peduncle equal to the length of the eye; origin of anal about equidistant from the snout with the adipose; margin of anal convex, the highest ray little if any more than snout and eye. Ventral small, its origin equidistant from snout with the posterior part of the dorsal, its tip reaching anal; *pectorals small, about equal to ventrals,* not nearly reaching ventrals.

Scales small, lateral line developed (in young?) to below dorsal or shorter; anal with a few scales along its base only.

Caudal hyaline; dorsal hyaline or with blackish; anal blackish; a black ocellus below the middle of the dorsal; sides with alternating light and dark cross-bands, the third light cross-band being continuous with the light about the ocellus.

32. **Mylosoma aureus** (Spix).

5721 *a–b.* C. M. Two, 75–77 mm. Berlin, Rio Mamoré, Sept. 15, 1909. Haseman.

5722 *a.* C. M. One, 90 mm. Santarem, Dec. 12, 1909. Haseman.

5723 *a–c.* C. M. Three, 147–170 mm. San Antonio, Rio Madeira, November 2, 1909. Haseman.

Head 4–$4\frac{1}{3}$, depth $1\frac{3}{7}$–$1\frac{1}{2}$, D. 17 or 18; A. 32–34.

Serræ 43–49.

The following specimens are probably the young of *aureus.*

5631 and 5632 C. M. Two, 22 and 29 mm. Santarem, Dec. 9, 1909. Haseman.

5697 *a–d*. C. M. Four, 19–25 mm. Santarem, Dec. 15, 1909. Haseman.

Head 3.2; depth 1.5; D. 18–21; A. 32 to 37; abdominal serræ 39 or 40 plus, three on either side of the anus; eye 2.5 in the head, about equal to interorbital, .5 in snout. Scales minute; greatest width of opercle about 2.5 in its height.

The specimens are evidently young and the proportions, especially those about the head, will probably be very different in adults.

Compressed, subrhomboidal, the profile in front of the dorsal nearly straight, the profile of the serrated portion of the belly rounded; teeth of the outer and inner series of the premaxillary close together. Origin of the dorsal equidistant from tip of snout and base of caudal, highest dorsal ray about equal to snout and eye; adipose short; depth of caudal peduncle about equal to eye; caudal slender, moderately forked; anal large, rounded, its origin equidistant from snout with the last dorsal ray; highest anal ray about equal to length of head; ventrals small, under last half of dorsal, reaching anal; pectorals still archaic.

Scales minute, largest about the pectorals. Anal naked.

Like *ocellatum*, dorsal dark at base, hyaline above the basal fourth; adipose margined with black; caudal hyaline; anal uniformly very dark. Visceral area of sides and lower part of head silvery; sides with alternating light and dark shades which become more evident forward and disappear on the caudal peduncle. In the largest the dark band down from in front of the dorsal is well marked to the visceral area; it is darkest above, just in front of the dorsal; the light band in front of this is well marked; in front of this a dark band is wedge-shaped, its posterior margin more or less parallel with the margin of the band behind it, its anterior margin is very oblique and extends to the middle of the eye, it is darker along the anterior margin and at its upper end; in front of this is another light band which curves forward above the edge to the nares, the median line of the head is also colorless; a line forward from the eye and the area between the median light space just above the eye is again very dark. Chin and ventral edge between the spines with some dark.

33. **Mylosoma albiscopus** (Cope).

5638 *a*. C. M. One, 205 mm. San Luiz de Caceres, May 22, 1904. Haseman.

5639 *a*. C. M. One, 92 mm. Berlin, Rio Mamoré, Sept. 15, 1909. Haseman.

5640 C. M. One, 147 mm. San Joaquin, Bolivia, Sept. 4, 1909. Haseman.

?5629 C. M. 44 mm. and 5630 C. M. Nineteen, largest 48 mm. Villa Hays, Paraguay, April 13, 1909. Haseman.

DESCRIPTION OF ADULT.

Head 3.5–3.75; depth $1\frac{1}{4}$–$1\frac{2}{7}$; D. 14, 15, 16, 16; A. 30, 33, 34, 37.
Abdominal serræ, 45, 49, 50.
Scales 50–86–40, supplementary scales numerous.

XI. Genus METYNNIS Cope.

34. **Metynnis guaporensis** sp. nov. (Plate LIV.)

5729 *a–c*. C. M. 73–99 mm. Maciél, Rio Guaporé, July 26, 1909. Haseman.

The largest the type.

5730 *a*. C. M. 51 mm. San Joaquin, Bolivia, Sept. 4, 1909. Haseman.

Head 3–3.25; depth $1\frac{2}{7}$, equals body and opercle; D. 18–20; A. 41–44; serræ 29–32; eye 3.5 in head, interorbital 2.75; gill-rakers long, slender, those of the middle of the upper and longer, nearly as long as eye, 30 + 35. Scales 90.

Compressed; dorsal profile rising rapidly from the base of the occipital process to the predorsal spine; ventral profile nearly regularly arched to the anus.

Occipital process reaching four-tenths the distance from its base to the dorsal; second suborbital bordered by a naked area about equal to its own width.

Ventral spines rather strong, those behind the ventrals widened at the tip with anterior and posterior points; origin of the dorsal equidistant from snout and end of scales at base of middle of caudal; the second and third rays prolonged, 2.5 in the length, reaching about to the middle of the base of the adipose; base of adipose about equal to the postorbital portion of the head; depth of caudal peduncle equals the length of the head; caudal lobes nearly equal to length of head; distance of origin of anal from tip of snout a little less than the origin of the adipose from the same point; margin of anal nearly straight, without a lobe; origin of ventrals about equidistant from snout with the origin of the dorsal, ventrals not reaching anal; pectorals about equal to postorbital part of head and half the eye.

Caudal naked; the minute scales of the sides extending a little way on the base of the anal:

A minute spot just above the lateral line an orbital distance from its origin.

35. **Metynnis roosevelti** sp. nov. (Plate LV.)

5738 *a–d*. C. M. Four, 90–118 mm. Santarem, Dec. 5, 6, 1909. Haseman.

The formulæ in the four specimens are:

D. 15;	A. 40;	Serræ 34
16	43	33
17	41	31
16	42	33

5739 *a–c*. C. M. Three, 62–140 mm. Bastos, June 26, 1909. Haseman.

In two specimens the formula is D. 17; A. 41; serræ 38, in the third specimen it is D. 18; A. 42; serræ 42.

5740 *a–c*. C. M. Three, 115–120 mm. Manaos. The smallest is the type.

D. 17; A. 40; serræ 33; D. 15; A. 36; serræ 34; the serræ in the third specimen number 35.

Head 4; depth 1.4, not equal to the length without the head. D. 15–18; A. 36–43; serræ 31–42; scales about 85. Interorbital 2 in the length of the head; eye 3 in the head; gill-rakers 9 + 17, longest about 2 in eye.

Profiles in front of dorsal and ventrals nearly symmetrical, there being but a faint depression over the eyes.

Occipital process extending one-third to the base of the dorsal; second suborbital bordered by a naked area equal to its own width.

Origin of dorsal equidistant from snout and end of scales at base of caudal, tip of highest ray usually not reaching adipose; base of adipose about equal to postorbital part of head and half the orbit; depth of caudal peduncle equal to eye and half the snout in the larger, but little greater than eye in the smaller; origin of anal equidistant from snout with the base of one of the posterior rays of the dorsal; distance between snout and ventrals greater than distance between snout and dorsal; ventrals not reaching anal; pectorals equal to postorbital part of head and half the eye.

Scales small; caudal naked; scales of the side extending on base of anal.

Brassy; a humeral spot almost as large as the eye. Sides in the larger with more or less obscure spots variously distributed.

36. **Metynnis hypsauchen** (Müller & Troschel).

5731 *a*. C. M. 134 mm. Manaos, Nov. 16, 1909. Haseman.

5732 *a–d*. C. M. 130–177 mm. Santarem, Dec. 15, 1909. Haseman.

5733 *a–b*. C. M. 70 and 95 mm. Manaos, Nov. 29, 1909. Haseman.

5736 *a*. C. M. 45 mm. Bastos, June 26, 1909. Haseman.

37. **Metynnis maculatus** (Kner).

5734 *a*. C. M. 84 mm. San Joaquin, Sept. 4, 1909. Haseman.

5735 *a*. C. M. 49 mm. Caceres, Paraguay basin, May 24, 1909. Haseman.

5737 *a–h*. C. M. 50–80 mm. Jauru, Paraguay basin, June 2, 1909. Haseman.

XII. Genus MYLEUS Müller & Troschel.

38. **Myleus pacu** Humboldt.

5749 *a*. C. M. One female, 255 mm. Manaos, Dec. 4, 1909. Haseman.

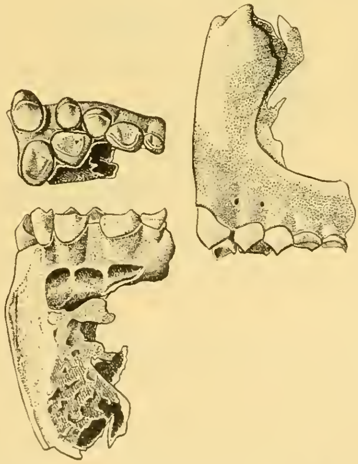


FIG. 12. Enlarged teeth of a young specimen of *Myleus pacu* Humboldt. $\frac{2}{1}$.

5750 *a*. C. M. One male, about 270 mm. Manaos, Dec. 4, 1909. Haseman.

5751 *a*. C. M. One male, 210 mm. Manaos, Nov. 17, 1909. Haseman.

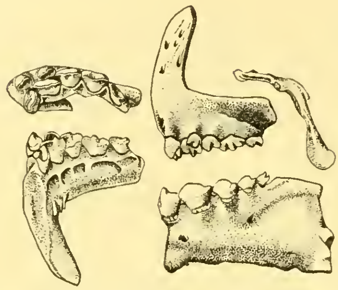


FIG. 13. Dentition of a large specimen of *Myleus pacu* Humboldt. $\frac{1}{2}$.

5752 *a*. C. M. One, 25 mm. Villa Bella, Oct. 5, 1909. Haseman.

Individual rays of the dorsal prolonged, filiform. Base of dorsal longer than base of anal.

XIII. Genus MYLOPLUS Gill.

39. **Myloplus micans** (Lütken).

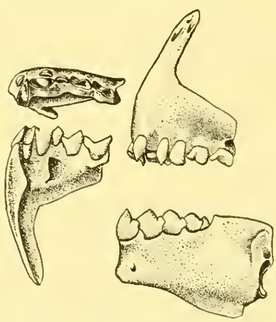


FIG. 14. Dentition of *Myloplus micans* (Lütken). $\frac{2}{1}$.

a–b. C. M. Two, 180 and 192 mm. Cidade do Barra, Dec. 6, 1907. Haseman.

5700 *a*. C. M. 38 mm. Santa Rita, Jan. 24, 1908. Haseman.

Head 4.33; depth $2\frac{1}{3}$–$2\frac{2}{5}$.

D. 26; A. 37 and 38, serræ 51 and 54; interorbital 2.2 in the head. Lips very thin, teeth partly naked, the anterior two teeth of the outer row closely pressed to the inner teeth. Intestines very large, filled with vegetable matter.

The color of the young is very similar to the color of the young of *Myleus pacu*.

40. **Myloplus rubripinnis** (Müller & Troschel).

5745 *a–g*. C. M. 54–87 mm. Rio Jauru, June 3, 1909. Haseman.
5746 *a*. C. M. 80 mm. Cachoele de Riberao, Madeira, Oct. 18, 1909. Haseman.

D. 28; A. 35; serræ 42.

5753 *a*. C. M. 70 mm. Maciél, July 23, 1909. Haseman.
6534 *a*. C. M. 75 mm. Alcobaça, Jan. 10, 1910. Haseman.

Depth a little greater than the length of the body, counting from the end of the scales at the base of the caudal; base of dorsal about equal to the length of the anal; adipose 2.5 in the eye, second suborbital about equal to first; more than half the cheek naked.

41. **Myloplus schomburgki** (Jardine). (Plates LVI and LVII.)

5747 *a*. C. M. One, 135 mm. Manaos, Nov. 28, 1909. Haseman.
5748 *a–h*. C. M. Eight, ♂ and ♀, 150–200 mm. Santarem, Dec. 15, 1909. Haseman.

Depth about 1.5; head 3.5; D. 25 or 26; A. 34–36; serræ 33–36; interorbital 2–2.25 in the head; eye 2.5–2.75 in head, equal to the postorbital portion of the head.

Dorsal and anal falcate, the anal two-lobed in the male; anal lobe and dorsal lobe very narrow, adipose fin longer than its distance from the dorsal.

42. **Myloplus rhomboidalis** (Cuvier).

5754 *a*. C. M. One, 165 mm. Manaos, Nov. 16, 1909. Haseman.
5755 *a*. C. M. One, 90 mm. Cochoele de Riberao de Rio Madeira, Oct. 18, 1909. Haseman.

These differ from specimens from Guiana in having the second suborbital longer than the first; depth less than the length without head; dorsal shorter than anal; adipose .6–1 in eye.

43. **Myloplus levis** (Eigenmann & McAtee).

5743 *a*. C. M. Corumbá, April 28, 1909. Haseman.

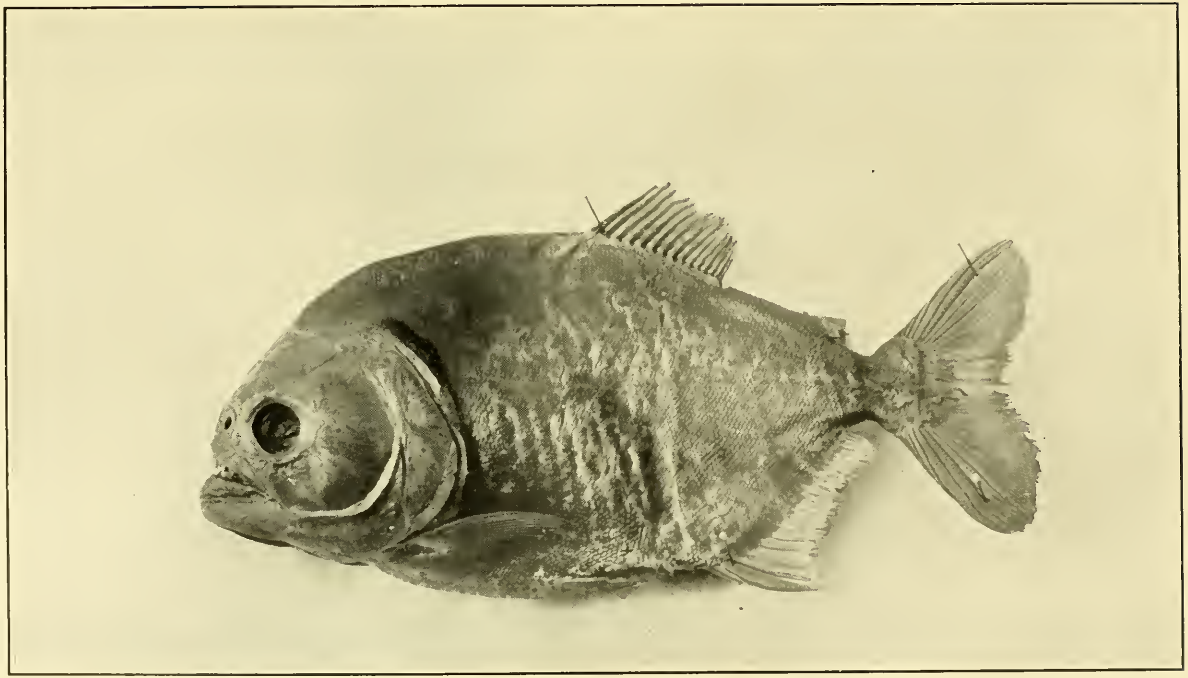
D. 31; A. 36; serræ 40. Depth less than length of body; adipose 2.5 in eye; base of dorsal greater than base of anal; anterior teeth close to posterior; first suborbital longer than second.

5742 *a*. C. M. About 150 mm. Rio Boaventura, June 16, 1909. Haseman.

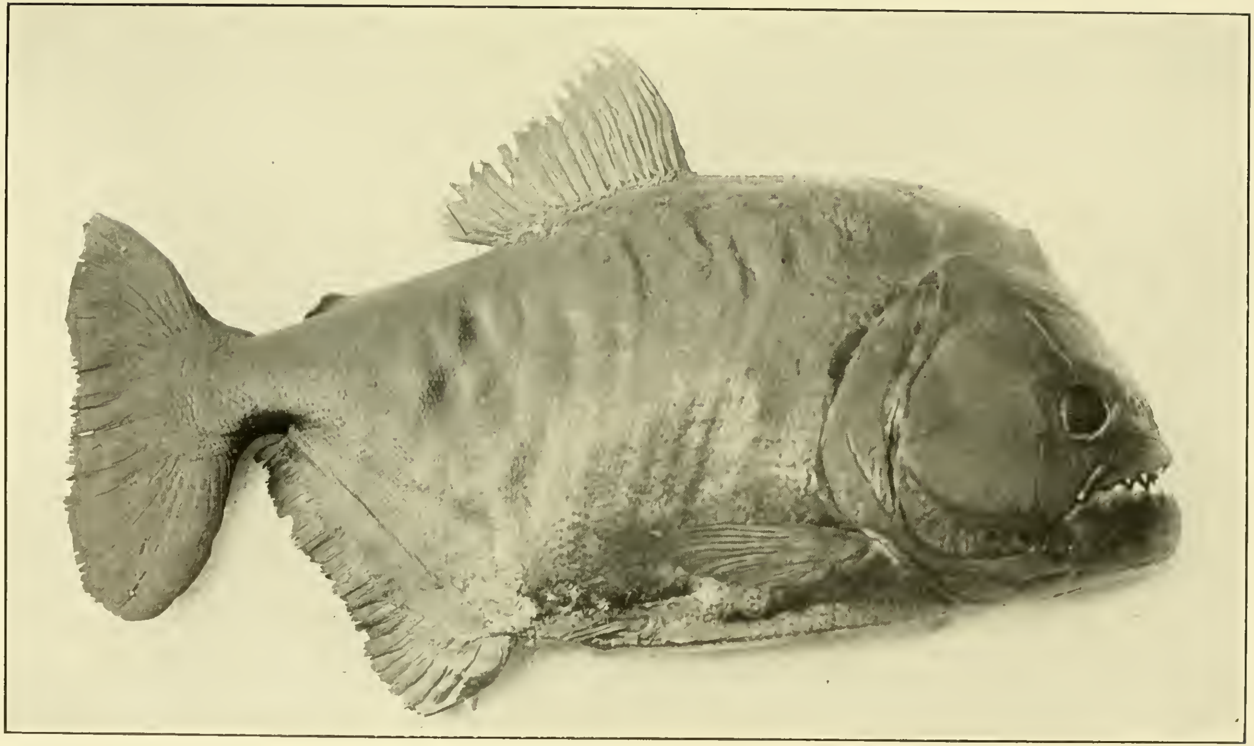
D. 29; A. 36; serræ 53.

5744 *a*. C. M. 35 mm. Caceres, May 23, 1909. Haseman.

D. 27; A. 35; serræ 41.

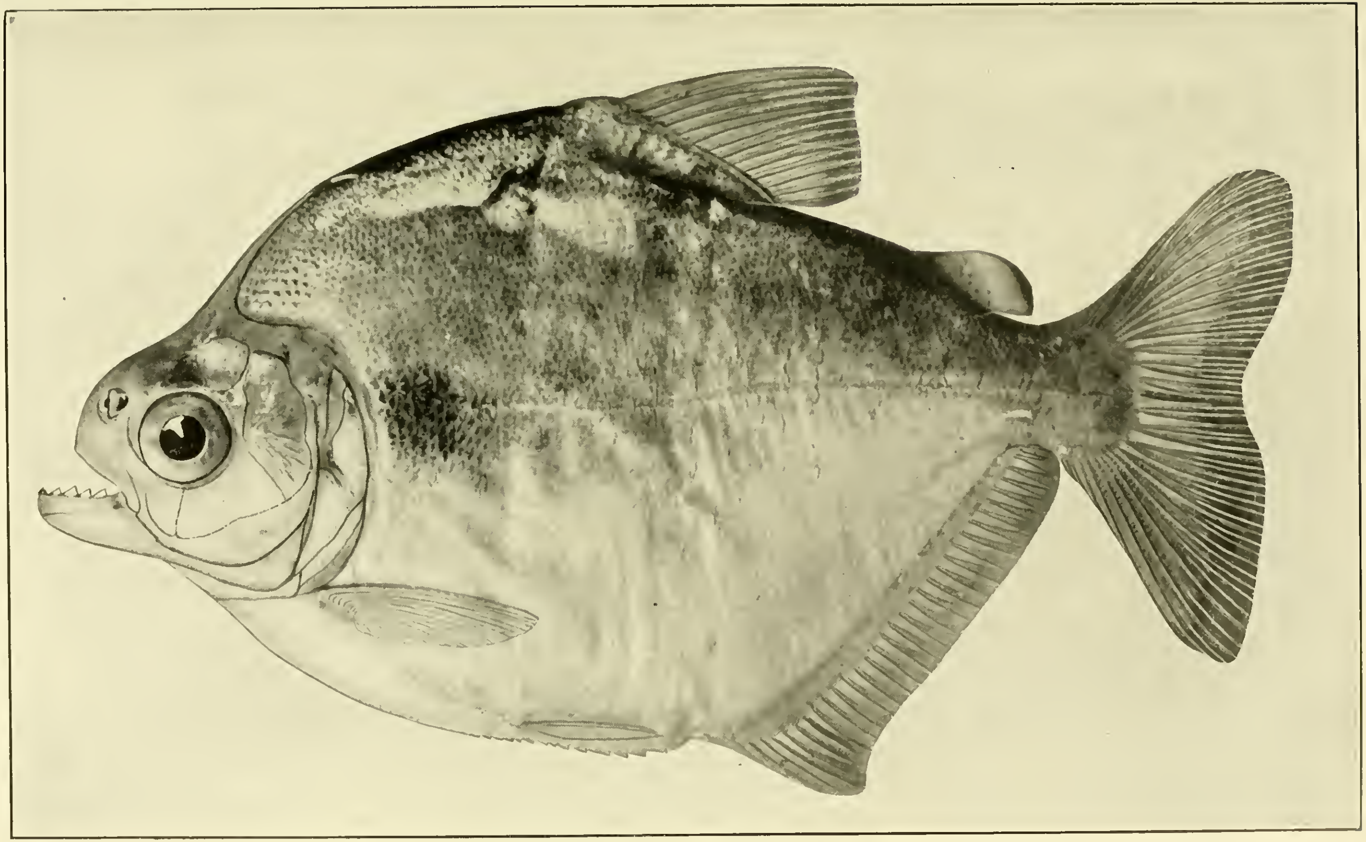


Pygocentrus piraya (Cuvier). Specimen No. 3630, Berlin Museum, labelled "*P. nigricans*" in the hand-writing of Johannes Müller. 127 mm. long. Guiana.

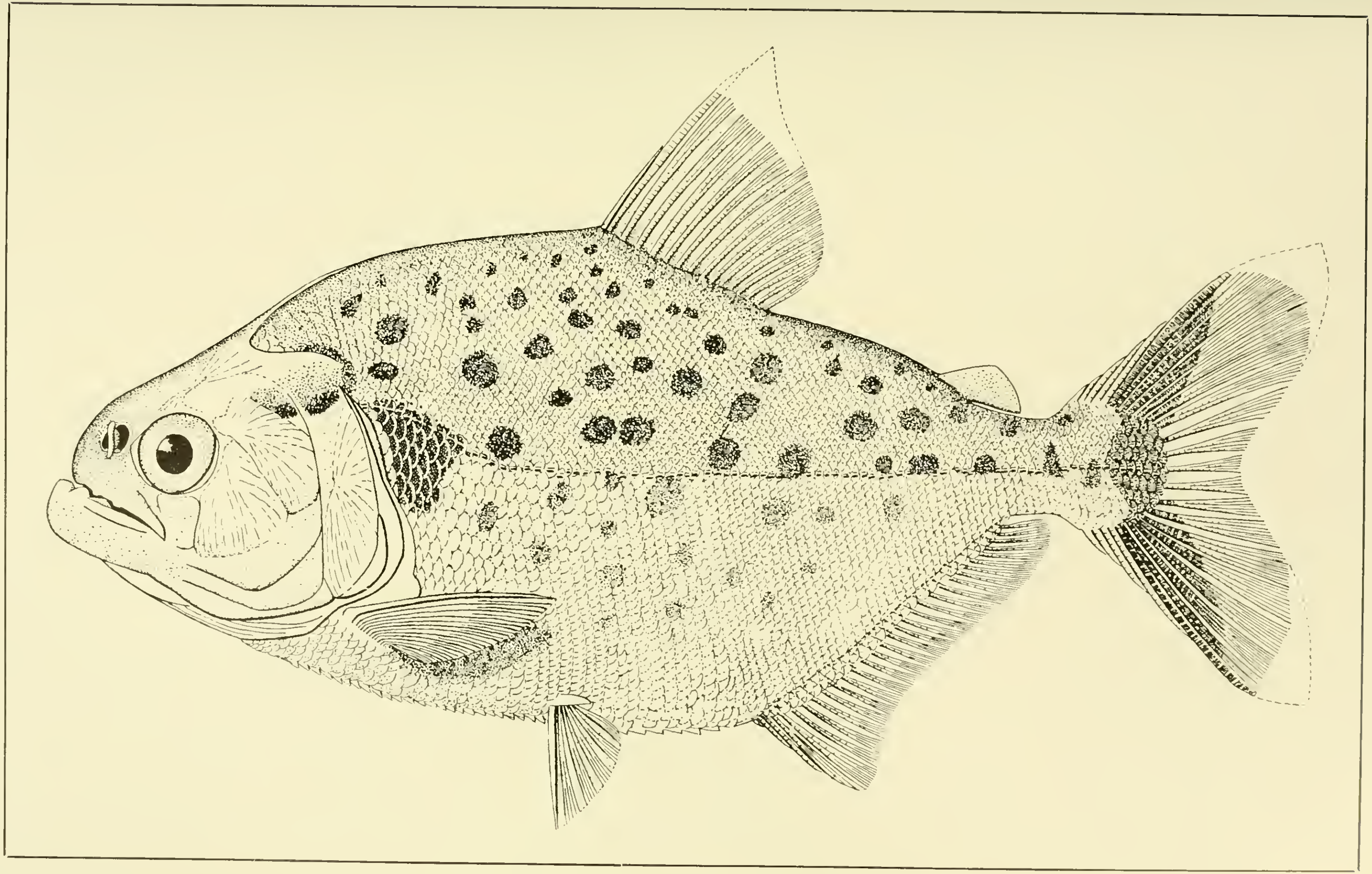


Rooseveltiella niger (Müller & Troschel). Type No. 3631, Berlin Museum. Labelled "*Pygocentrus niger* M. Tr." in the hand-writing of Johannes Müller. 365 mm. long. Guiana.

Rooseveltiella altus (Gill). No. 21432, U. S. N. M., presumably the type. 155 mm. long. Napo, on Marañon River. Collected by Orton.

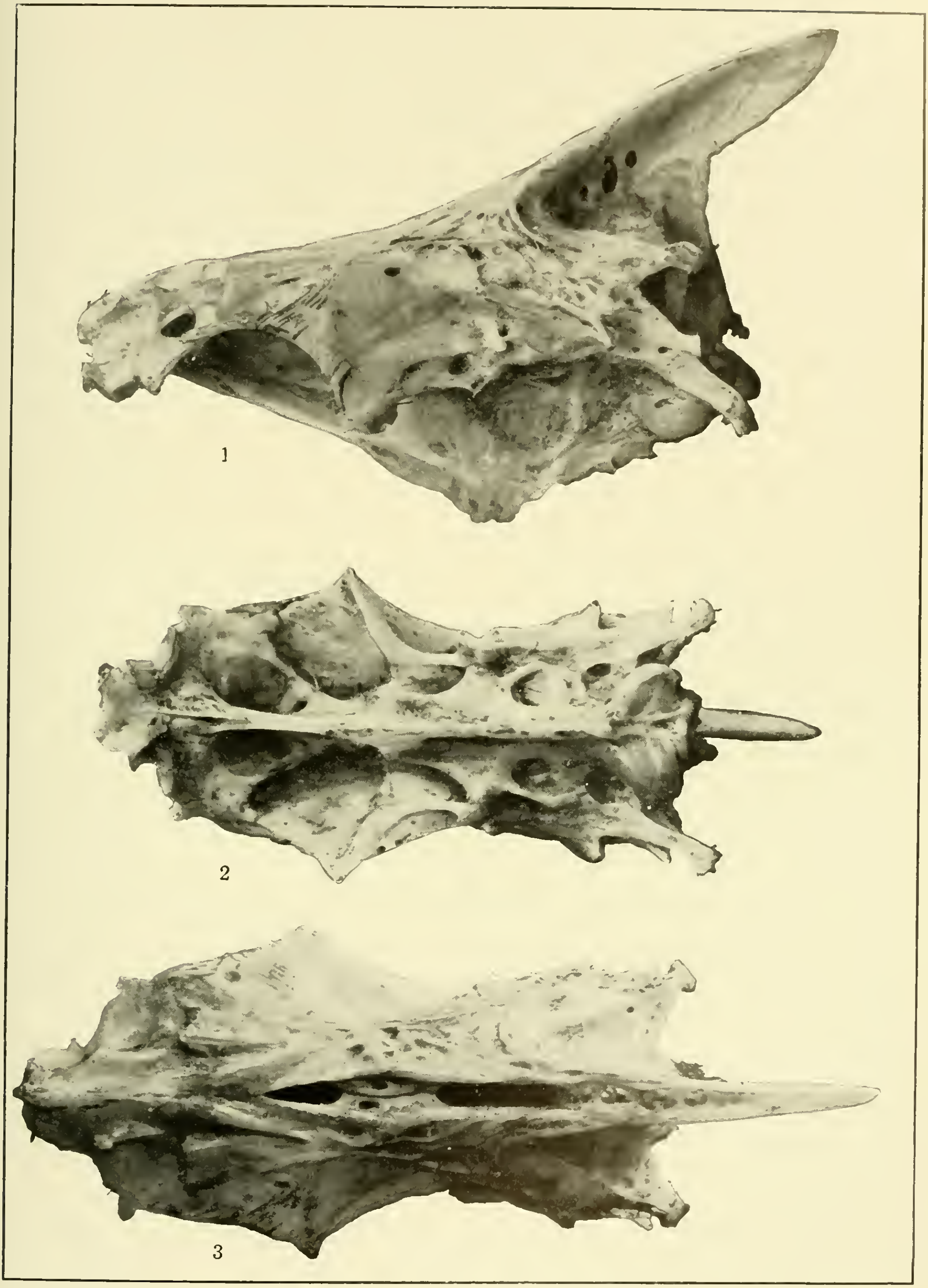


Pristobrycon calmoni (Steindachner). C. M. No. 5797. 132 mm. Santarem.

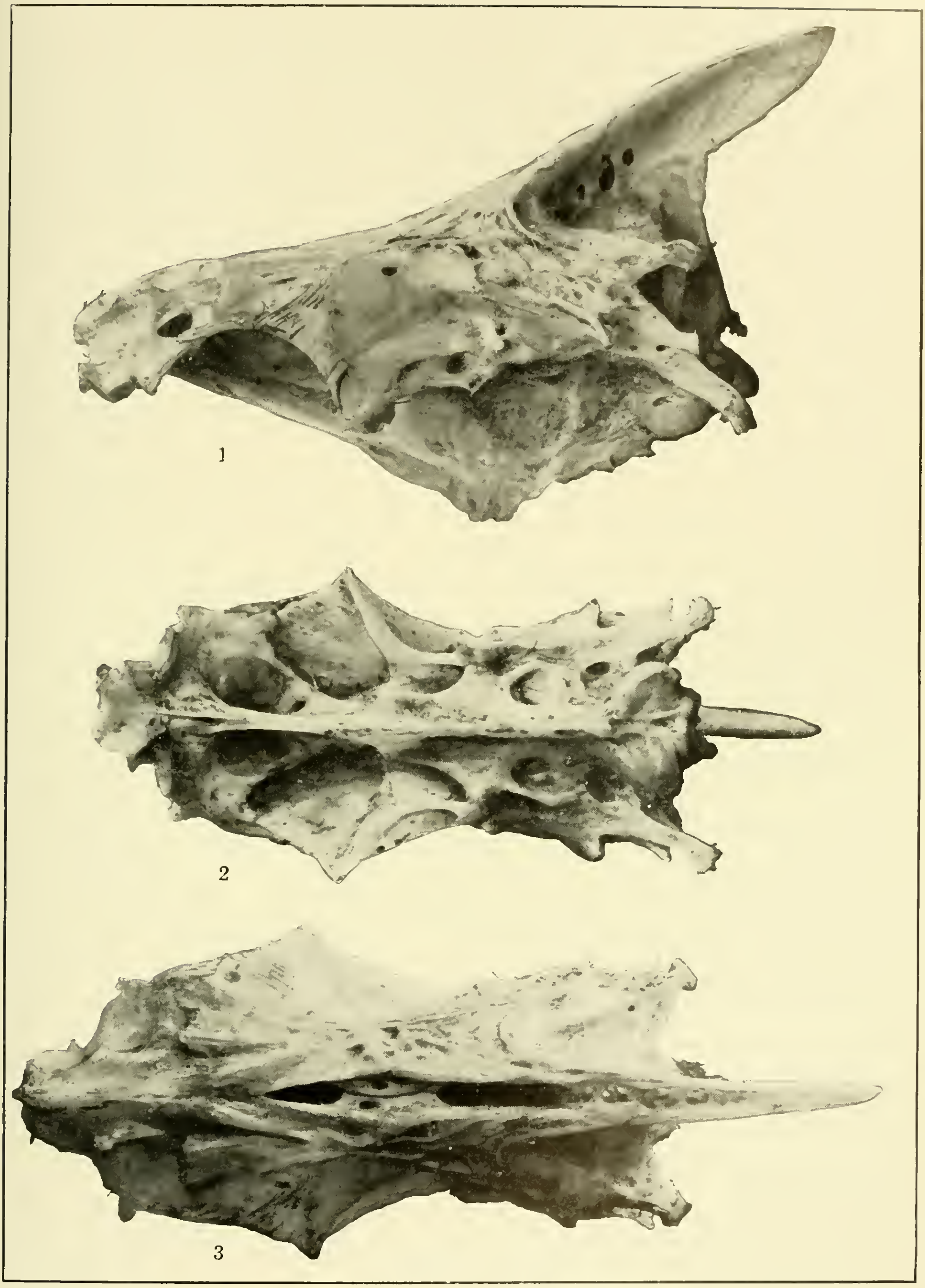


Serrasalmo hollandi Eigenmann. Type. C. M. 5793. 139 mm. Maciél, Rio Guaporé.

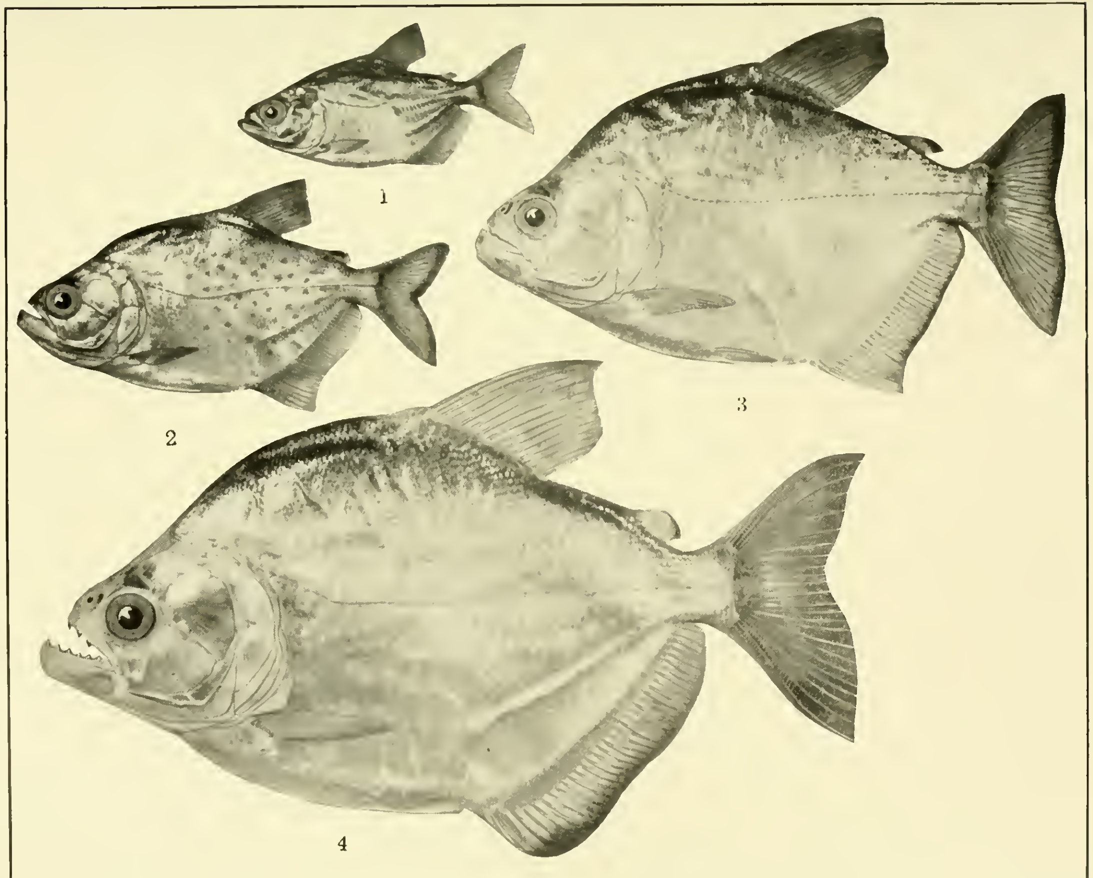
Serrasalmo spilopleura Kner. 1. C. M. No. 5779. 42 mm. Uruguana. 2. C. M. No. 5778. 84 mm. Caceguy.
3. C. M. No. 5778. 137 mm. Caceguy



Serrasalmo humeralis Cuvier and Valenciennes. Lateral (1), ventral (2) and dorsal (3) views of skull. I. U. Mus. No. 10,044.

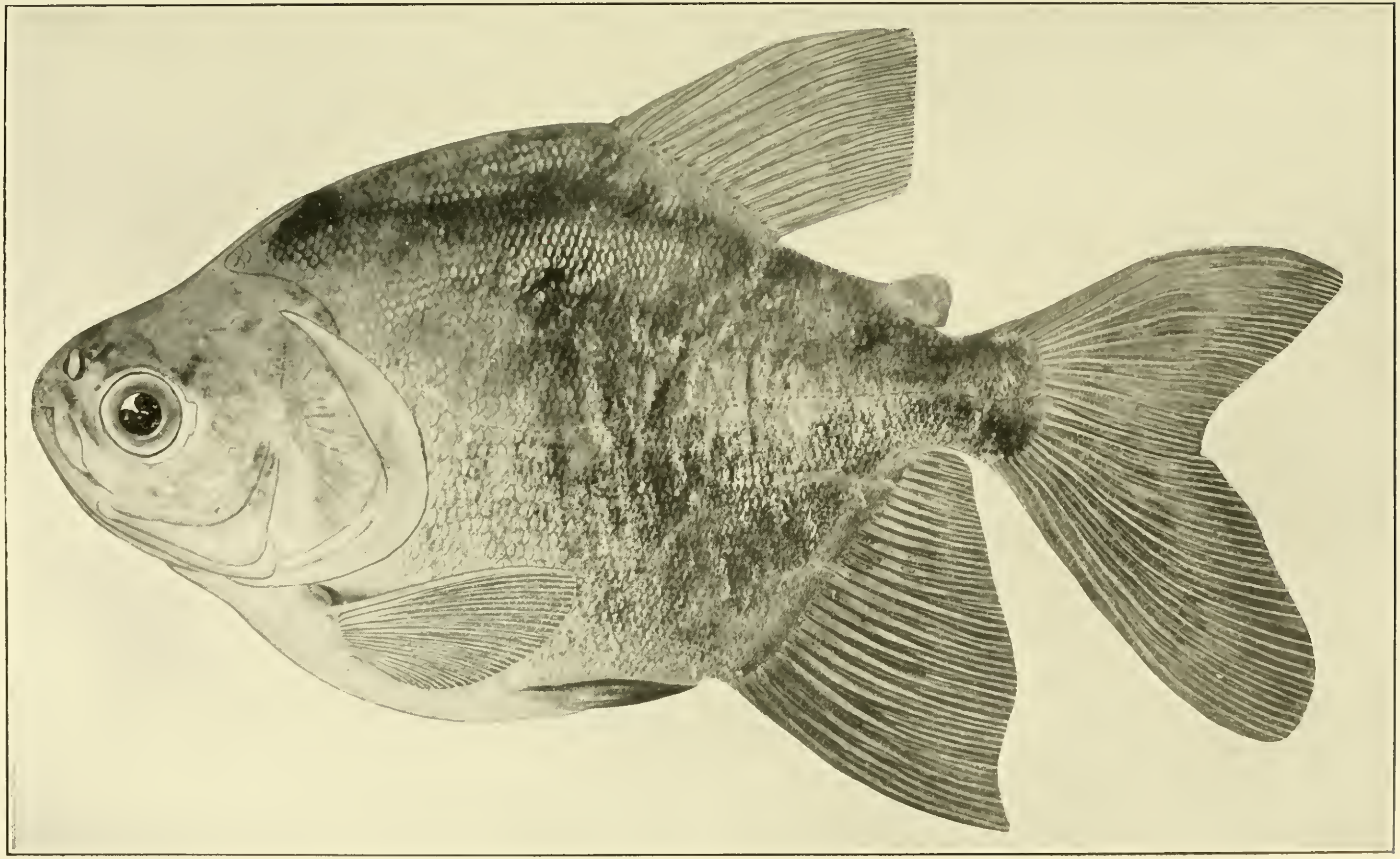


Serrasalmo humeralis Cuvier and Valenciennes. Lateral (1), ventral (2) and dorsal (3) views of skull. I. U. Mus. No. 10,044.

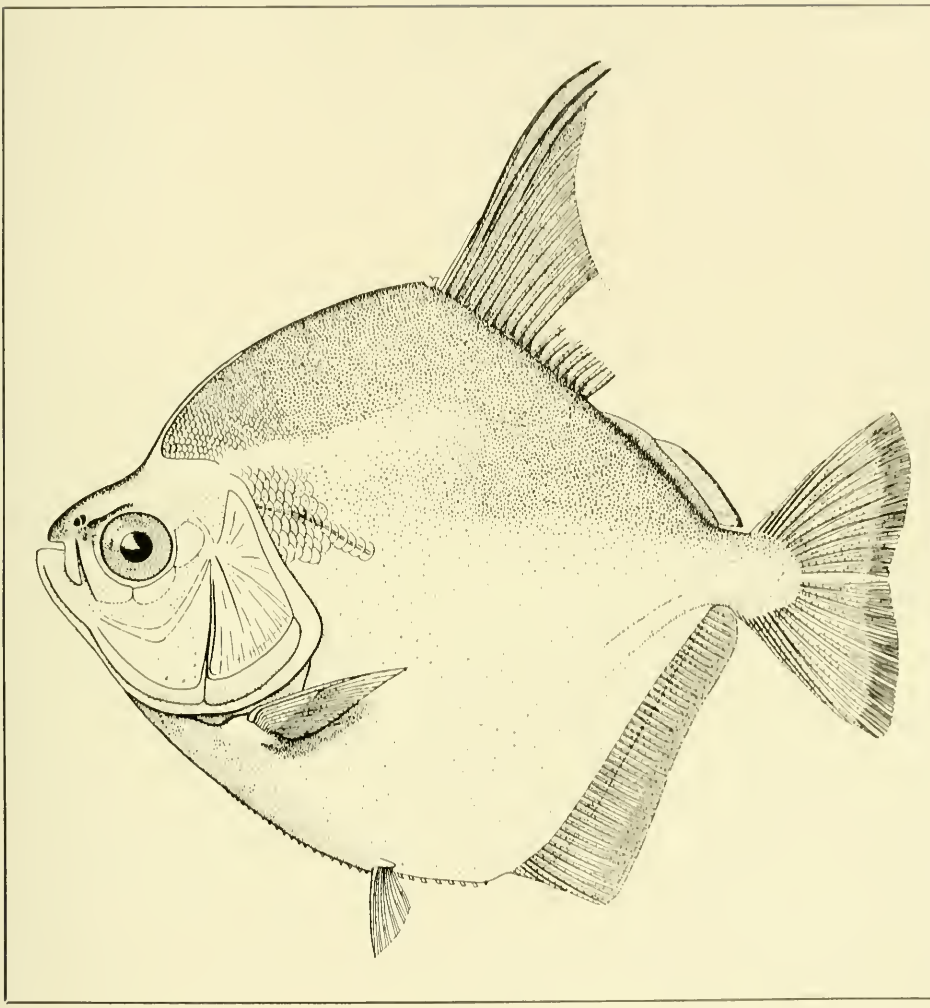


Serrasalmo brandti Reinhardt. 1. C. M. No. 5766. 59 mm. Pirafora. 2. C. M. No. 5766. 85 mm. Pirafora. 3 C. M. No. 5762. 123 mm. Joazeiro. 4. C. M. No. 5762. 170 mm. Joazeiro.

Colosoma mitrei (Berg). C. M. No. 5634. 180 mm. Santarem.



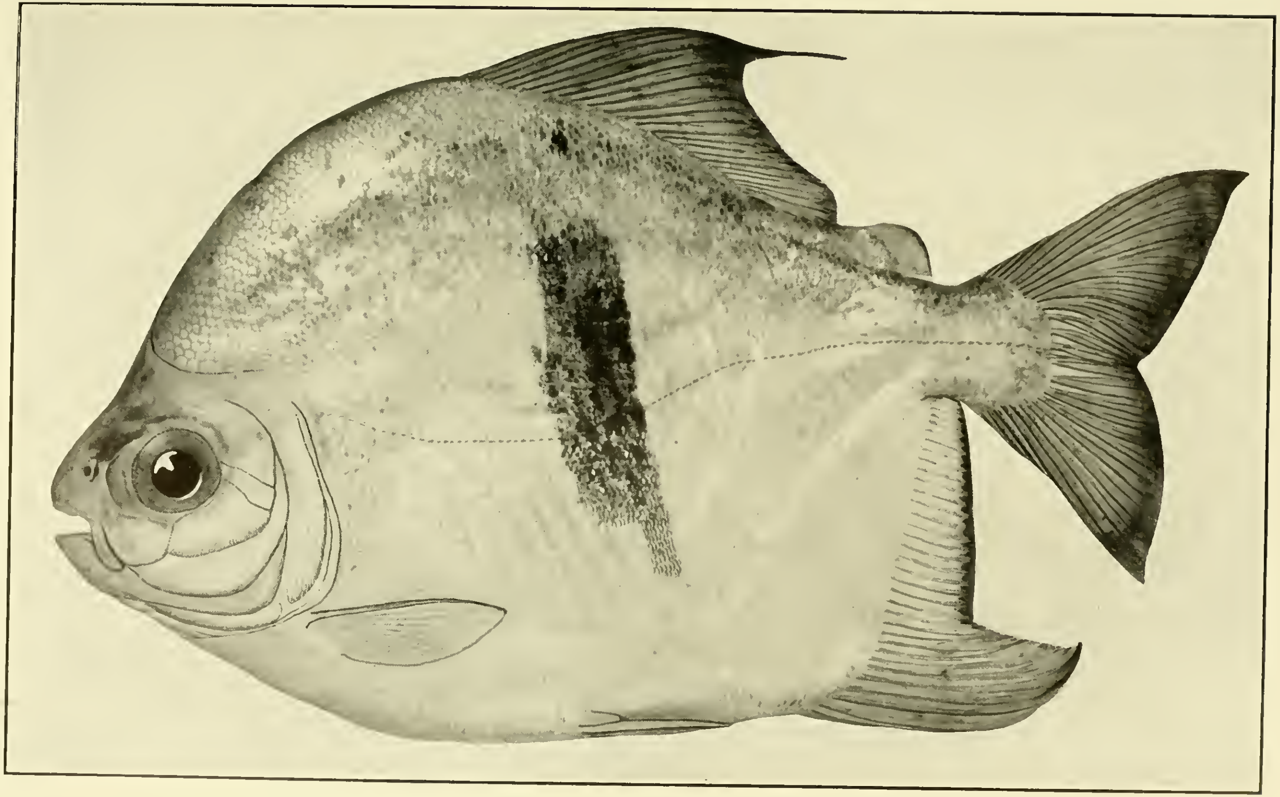
Piaractus nigripinnis (Cope). C. M. No. 5635. 192 mm. Santarem.



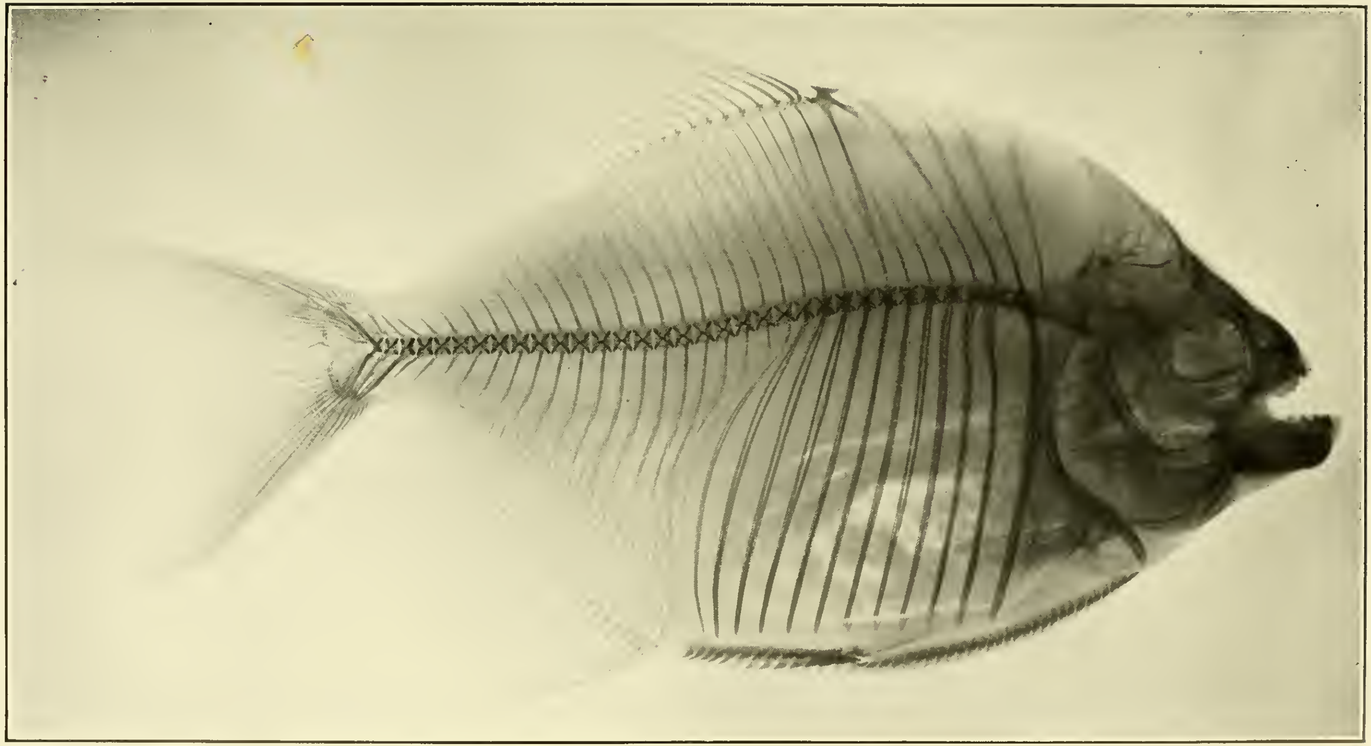
Metynnis guaporensis Eigenmann. Type. C. M. No. 5729. 99 mm. Maciél, Rio Guaporé.

Melynnis roosevelti Eigenmann. Type. C. M. No. 5740. 115 mm. Manaos.

Myloplus schomburgki (Jardine). ♂. C. M. No. 5748. 172 mm. Santarem.



Myloplus schomburgki (Jardine). ♀. C. M. No. 5748. 197 mm. Santarem.



Radiograph of *Serrasalmo rhombeus* (Linnæus). I. U. M., No. 11,650. 208 mm. From Crab Falls, British Guiana.

XVI. HEADS AND TAILS; A FEW NOTES RELATING TO THE STRUCTURE OF THE SAUROPOD DINOSAURS.[1]

By W. J. Holland.

(Plate LIX.)

For several years past, under the oversight of Mr. Earl Douglass, the Carnegie Museum has been carrying on extensive excavations in Uinta County, Utah. The result of this work has been the discovery of a very large number of skeletons, principally of sauropod dinosaurs, although there have also been uncovered more or less imperfect skeletons of several Stegosaurs, and recently the skeleton of an *Allosaurus*, or closely related theropod dinosaur, which promises to be sufficiently perfect to permit a restoration to be made, the skull, the vertebræ, and limb bones of the specimen seeming to be, according to reports received from Mr. Douglass, quite well preserved, and not much dislocated. One of the remarkable features of this deposit of bones is the fact that in the majority of cases the skeletons of the animals have been but slightly disturbed in position since having been laid down. In several instances the entire vertebral series has been found articulated, or but little displaced, so that it is possible to reach correct conclusions as to the number of vertebræ entering into the composition of the skeleton.

The deposit appears to represent a section of the bed of a small stream or river. At the bottom is a layer of cobblestones and coarse gravel more or less firmly cemented together by lime. Superincumbent upon this are sandstones, the material composing which varies from coarse sand in some places to finer sand in other places. The sandstones composing the matrix when exposed to the weather rapidly disintegrate, especially the layers which are composed of the finer materials, which after a few weeks become soft and resolve themselves into loose sand. There are several layers represented in this quarry lying more or less conformably in relation to each other, but disclosing pockets and irregularities which naturally would occur in the bed of a small stream subject to the action of drouth succeeded

[1] Read before the meeting of the Paleontological Society of America, at the meeting held in Philadelphia, December 31, 1914.

by freshets. There is evidence of the existence of a current which flowed from west to east. Mussel-shells and remains of tortoises prove the fluviatile origin of the beds.

In the lowermost of the strata which have been investigated we have succeeded in finding skeletons, more or less complete, of nearly a score of dinosaurs, large and small. One of the largest of these skeletons, representing an animal provisionally referred to *Brontosaurus*, or *Apatosaurus*, has been already taken from the matrix and the skeleton is being installed in the Carnegie Museum. This is probably one of the most perfect skeletons of a sauropod dinosaur which has ever been recovered. All the vertebræ from the axis to very near the end of the tail were found in place; the whole of the pelvis, the right hind limb, the two scapulæ, all of the ribs, and the entire right fore limb with the manus, as well as most of the left fore limb, were discovered in such a position as to leave no doubt whatever that we are dealing in the case of these remains with one individual. Numerous sternal ribs were also found. With this skeleton, lying about twelve feet from the atlas, and in the same layer, was a skull the condyle of which shows perfect adaptation to the atlas. Had nothing in the past been written in reference to the structure of the skull of *Brontosaurus* the conclusion would naturally and almost inevitably have been reached that this skull belongs to the skeleton the remainder of which has been recovered. The skull is decidedly like that of *Diplodocus*, though very much larger in size than any skull representing that genus of which the writer has knowledge. It is characterized by the same feeble dentition. The fact that in this particular layer, exposed to view in the quarry, there are also the remains of one or two comparatively small animals, which may be referred to *Diplodocus*, naturally suggests that the skull in question might possibly have belonged, in spite of its apparent relationship to the specimen of which I have spoken, to one of these other skeletons. The curious fact, however, should here be mentioned, that in this particular stratum, which thus far has only yielded one or two skeletons which are referable to the *Diplodocidæ* (in the accepted meaning of that term), we have recovered the remains of at least eleven skulls, all of which are characterized by the same general style of dentition, although the skeletons, exclusive of the two which we can refer without much doubt to *Diplodocus*, undoubtedly belonged either to animals much more closely related to *Brontosaurus*, or some of them possibly to allied genera not yet defined. There is not a single trace in the bed from which these remains have come of any animal possessing the peculiar dentition belonging to the skull which Professor Marsh originally attributed to his *Brontosaurus*. Such a skull has indeed been found by us, but it lay far to the west of the remains of the *Brontosaurus* which we are assembling, according to Mr. Douglass, and in a layer at least eight feet higher than that in which the *Brontosaurus* remains were discovered, a layer which was deposited at a later time and is now found to contain remains provisionally referred by Douglass to *Barosaurus*, or an allied sauropod, characterized by cervical vertebræ the centra of which are from three to four feet in length. This skull cannot have belonged to the *Brontosaurus* which we are engaged in mounting. Skulls do not wash up stream against the current, nor do they burrow upward eight feet through superincumbent sand. This skull of which I am speaking by no possibility can be attributed to the large skeleton which we are setting up.

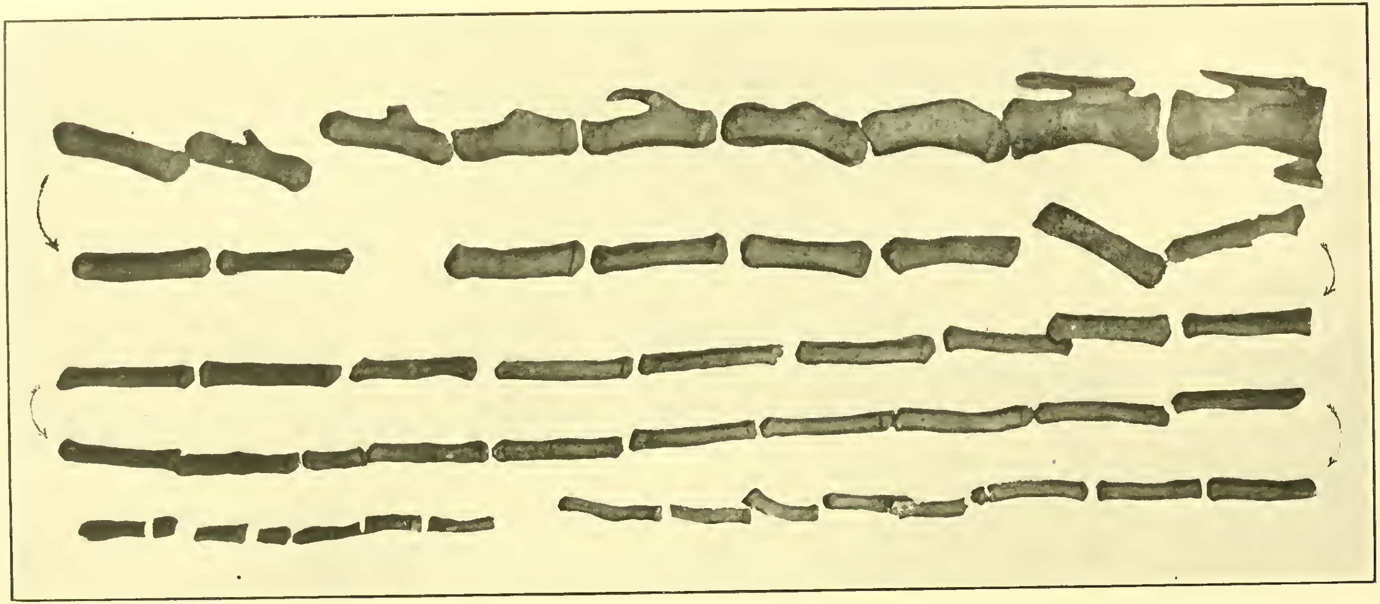
Under the circumstances and in view of these facts the writer has undertaken an investigation of the subject, with the following results:

Professor R. S. Lull, with the most obliging courtesy, has examined the records preserved at the Peabody Museum in relation to the material collected and utilized by Professor Marsh when making his restoration of *Brontosaurus*. Without going into the details of the matter I may say that Dr. Lull reports to me that the skull attributed by Marsh to *Brontosaurus* was found in Wyoming, near Como Bluffs, at a locality approximately four miles distant from the spot where the remainder of Marsh's type of *Brontosaurus* was obtained by William H. Reed. Professor Lull in his written statement thus confirms the oral statement made to me years ago by W. H. Reed, who informed me that the skull utilized by Marsh did not in the judgment of Mr. Reed belong to the same individual as the rest of the specimen, and had nothing to do with it.

There is another somewhat fragmentary skull of the same animal preserved at the United States National Museum, in reference to which Mr. C. W. Gilmore has written to me at my request. This skull was obtained at the well-known locality near Canyon City, Colorado, in what was known as "the Felch quarry." Mr. Gilmore informs me that an examination of the charts of the quarry shows that this skull was not associated with any other skeletal material referable to the genus *Brontosaurus*. It is plain from these facts that

Professor Marsh associated the skulls, which he had studied, with the remains of *Brontosaurus* as the result of a process of ratiocination, rather than as the result of ocular evidence that the skull actually belonged with the skeleton. The only circumstance which would seem to confirm the correctness of Marsh's view is the fact, to which my attention is directed by Professor Lull, that when taking up the remains of the *Brontosaurus* now on exhibition in the American Museum of Natural History he found in the deposit a tooth evidently belonging to the same genus, the skull of which Marsh has associated with the skeleton of *Brontosaurus.* Professor Lull is of the opinion that Marsh made no error, and that the presence of this tooth in the quarry, which Lull explored in Wyoming, attests the correctness of the conclusions of Marsh. The writer of these paragraphs confesses to feeling a certain measure of doubt and uncertainty as to the matter, and is disposed to the view that we do not yet positively know what really is the skull which should be attributed to the genus *Brontosaurus*, and is strongly inclined, in spite of the opinion of Dr. Lull, to think that perhaps an error has been made, and that *Brontosaurus*, which is so like *Diplodocus* in many of its skeletal features, may have had a skull like that of *Diplodocus,* characterized by feeble dentition, dentition, however, which is not inserted in the maxillæ vertically as in the case of *Diplodocus*, but which, as the skull before the writer at this moment shows, was more or less procumbent.

There is no intention in these paragraphs to dogmatize, but to express a doubt, founded upon observation, as to the correctness of Professor Marsh's surmise, which up to the present time has been unquestioningly accepted. To sum the matter up, the writer does not believe that any man is in a position to declare with positive assurance that the skull heretofore attributed to the genus *Brontosaurus* actually belonged to it. The two skulls used by Marsh were found, one four miles from the rest of his skeleton, the other about four hundred miles from it. Were it not, as I have already intimated, for Professor Marsh's action, the writer would be tempted to declare that the skull of *Brontosaurus* was not very different from that of *Diplodocus* in its main structural features in view of the fact that the skull in his possession lay only twelve feet from the cervical vertebræ and other skeletal remains before him. We know that the specimen we are mounting must have had a skull. If we refuse to affix to it the skull which lay within twelve feet of the cervical vertebræ, we must



Caudal vertebræ of Sauropod Dinosaur found in serial order in Carnegie quarry near Jensen, Utah. The cut shows the caudals from No. 34 to No. 82, arranged for convenience in photographing in five rows. The curved arrows indicate the order. (Greatly reduced.)

admit that our specimen is so far forth defective. We cannot by any possibility, for physical reasons, attribute to it the skull, which we possess, and which is like that employed by Professor Marsh, because it was found in a higher layer, further up stream, associated with the remains of so-called *Barosaurus*.

The problem is naturally perplexing, and in certain aspects amusing. My good friend, Dr. Osborn, has in a bantering mood "dared" me to mount the head, which we have found associated with our *Brontosaurus*, on the atlas, which it fits. At moments I am inclined to take his "dare," in spite of Professor Marsh's action, being not trained unquestioningly to accept the *ipse dixit* of even so learned an authority as Professor Marsh was. I feel that there is quite as much reason for putting this kind of a head on the animal as for topping off the beast with the style of headgear which Professor Marsh has associated with it. So much for heads.

And now as to tails. One of the most interesting results of the excavations made by us, has been the discovery of the fact that in at least three cases the reptiles which we have exhumed have preserved in place the so-called "whip-lash," which we know to have characterized *Diplodocus*. The large skeleton of *Brontosaurus*, which we are setting up, has a tail relatively as long as that of *Diplodocus*, and the posterior vertebræ of the tail were found in a more or less continuous series in such a position as not to admit of any doubt that they belonged to the same individual. A second skeleton of a smaller dinosaur, also related to *Brontosaurus*, but probably belonging to a genus which may not as yet have been defined, likewise has a very long tail, in which the posterior caudals were found articulated one with another, as was the case with the one provisionally referred to *Brontosaurus*. A still more remarkable specimen was found embedded in a layer of fine white sand at the western end of the quarry, all the vertebræ from the atlas to the tip of the tail being *in situ*. There are in this specimen eighty-two caudal vertebræ. A lantern slide which I am herewith communicating to the meeting (Plate LIX) shows the terminal caudals from thirty-four to eighty-two, inclusive, arranged in order. This "whip-lash," as it has been styled, recalls the long tail of the Monitors, and must have been a weapon of defence in the case of these colossal reptilia, as it is in the case of the Monitors. My friend and associate, Dr. L. E. Griffin, long connected with the Bureau of Science in the Philippines, informs me that for some time he had a *Monitor* tied up in the courtyard of his house in Manila, and that, when approached by a dog, it would deal it a sharp blow with its tail which would cause the animal to retreat with a howl of pain and never again attempt to renew acquaintance with the reptile. Such a function was no doubt that of the extremely long tail which we may believe characterized most, if not all, of the Sauropoda.

XVII. DIPTERUS REMAINS FROM THE UPPER DEVONIAN OF COLORADO.*

By C. R. Eastman.

The first announcement that strata of Devonian age occur in the San Juan region of Colorado was made by F. B. Meek[1] more than three decades ago, after an examination of some invertebrate fossils collected by F. M. Endlich of the Hayden Survey during the summer of 1874. A few fish remains were also obtained from the same beds by Endlich, who remarks upon their occurrence as follows: "Besides these, scales and fragments of bones are found, belonging to some fish of considerable size. Too little material could be collected to admit of any identification, even only generically. Small scutellæ also occur, probably belonging to the same animal."[2]

During the more recent survey of the San Juan country under the direction of Dr. Whitman Cross large collections were made from the two formations which have been found to carry Devonian fossils in southwestern Colorado, and the extensive faunas that have been brought to light from the Upper Devonian and Lower Carboniferous of this State are now satisfactorily known, thanks more especially to the studies of G. H. Girty.[3]

The limestone formation from which Devonian fossils were first obtained by Endlich is known as the Ouray limestone, this term having been proposed by A. C. Spencer[4] in 1900. It yields over thirty species of invertebrates and one species of fish, the latter described by O. P. Hay[5] under the name of *Cladodus formosus*. In the words of Dr. Whitman Cross,[6] "the position of the Ouray lime-

* Published by the permission of the Director of the U. S. Geological Survey.

[1] Bull. U. S. Geol. and Geog. Survey, 2d Ser., no. 1, 1875, p. 46.

[2] Ann. Rep. U. S. Geol. and Geog. Survey for 1874, pp. 211–214.

[3] Devonian Fossils from Colorado. The Fauna of the Ouray Limestones U. S. Geol. Survey, 20th Ann. Rep., pt. II, 1900, pp. 25–81.—The Carboniferous Formations and Faunas of Colorado. Professional Paper No. 16, U. S. Geol. Survey, 1903.

[4] "Devonian Strata in Colorado," *Amer. Jour. Sci.* [4], Vol. IX, 1900, p. 125.

[5] "Description of a New Species of Cladodus, etc.," *Amer. Geol.*, Vol. XXX, 1903, pp. 373–4. It is suggested in his paper that the age of the Ouray limestone may be late Middle or early Upper Devonian.

[6] "A New Devonian Formation in Colorado," *Amer. Jour. Sci.* [4], Vol. XVIII, 1904, p. 246.

stone as a well determined unit of the Paleozoic section of Colorado must be considered as well established." It is adjudged by the authority just quoted that the formation in question is of uppermost Devonian age, but the fauna which it contains is but distantly related to those of the New York area, or even to the more western Devonian faunas of this country. It is, on the other hand, "somewhat strikingly similar to the Devonian of Russia."

The Ouray limestone, with a thickness ranging from 100 to 250 feet in the San Juan country, rests conformably upon strata a hundred feet or so in thickness, which Dr. Cross has named the *Elbert formation*, and in the opinion of this geologist the strata so designated "seem unquestionably to form a lithologic, stratigraphic and faunal unit." Intervening between the Elbert formation and the basal granite of the region are beds of quartzite, supposed to be of Upper Cambrian age.

So much for the general Palæozoic section of the San Juan region. The stratigraphic equivalence of the Elbert formation is shown by the evidence of its fish-remains, the only fossils yet obtained from it, to be with the so-called "Parting Quartzite" of Leadville, in central Colorado, and of Aspen, on the northeastern flank of the Elk mountains; and the general aspect of these fish-remains has been pointed out by the present writer to be indicative of Upper Devonian age.[7] Nevertheless, the ichthyic fauna of the Elbert was recognized as not being closely similar to the faunas of the eastern and central United States, in this respect agreeing with the Ouray invertebrate fossils, which Dr. Girty has shown to "exhibit a closer parallel with the Devonian of the Ural Mountains."

The fish-remains thus far brought to light from the Elbert formation in Colorado, although numerically abundant, present a singular lack of systematic diversity. Arthrodires are represented by dissociated tuberculated plates belonging to a fish about twice the size of the type species of *Coccosteus*, but whose precise relations are not determinable. Besides these fragments, only four recognizable species have been thus far identified, as follows: *Bothriolepis coloradensis*, *B. nitida*,[8] *Holoptychius giganteus*, and *H. tuberculatus*. The second, third and fourth of the species just named occur typically

[7] "On Upper Devonian Fish Remains from Colorado," *Amer. Jour. Sci.*, Vol. XVIII, 1904, p. 260.

[8] This name antedates that of *B. leidyi*, which is synonymous with it.

in the Catskill of Pennsylvania, and the nearer affinities of *B. coloradensis* appear to be with certain Scottish Old Red Sandstone forms.

Only a few of the remains collected by Messrs. Spurr and Tower from the fish-bearing locality at Aspen, in central Colorado, have come under the writer's inspection. It seems to be certain, however, that Arthrodiran fragments and teeth of Holoptychius or some allied Crossopterygian occur, and the presence of Dipnoans was suspected on account of "certain smooth scales displaying their characteristic perforations." Concerning these latter it was remarked by the writer in 1904 that the remains "are noteworthy for furnishing the only indication we possess at present of the occurrence of Lung-fishes in the Colorado Devonian." No evidence had at that date been obtained which might suggest a relationship between the fauna of the Colorado Devonian and that of the west central states, and the absence of Ptyctodont tritors and Dipnoan teeth, such as constitute a so well-marked feature of the Upper Devonian of Iowa, was regarded as somewhat surprising.

Owing to the insufficient evidence on the paleontological side, it was impossible in 1904 for Dr. Cross or the present writer to reach altogether satisfactory conclusions as regards the stratigraphic equivalence of the Colorado Devonian. The former writes in his article already referred to for that year:

"While certain correlations for both the Elbert and Ouray formations seem definitely indicated by present knowledge, meagre as it is in some directions, there is a marked contrast between the lower Palæozoic section of western Colorado and that of the Front range, especially as exhibited near Canyon City."

Likewise Eastman, at the close of his article accompanying that of Dr. Cross:

"For the present, the question as to the origin of the vertebrate fauna of the Colorado Devonian must be considered as problematical, and one which will require considerable further evidence and investigation before it can be answered satisfactorily. It is evident that the remains thus far obtained . . . open up problems of distribution, and others of a geological nature, which are worthy of careful study."

Thus the problem stood eleven years ago. Thanks to the continued interest and activity of Dr. Cross, valuable new information has recently been acquired which bears upon the homotaxial relations of the Elbert formation. Briefly, the new data consist in the discovery of a small number of extremely characteristic Dipnoan remains—Dipterine and Synthetodont teeth—which have been heretofore known from but a single horizon and locality, namely the Upper Devonian State Quarry beds of Johnson County, Iowa. Illustrations are given in the accompanying text-figure of several of these teeth, all of which were obtained by Dr. Cross in July, 1909, from the Elbert formation of Florida Valley, east side, in the Ignacio Quadrangle of southwestern Colorado. The originals of these figures are preserved in the United States National Museum.

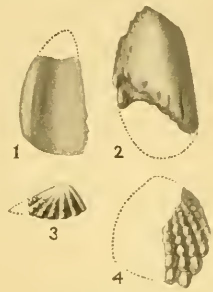
The specific identity of the *Dipterus* remains admits of not the least particle of doubt, the following forms being easily recognizable: *D. mordax*, *D. pectinatus*, and *D. digitatus*. The Synthetodont type of crushing plate (Fig. 1) is probably new, but is left unnamed for the present, or until such time as further material is available for preparing a satisfactory diagnosis. One cannot be altogether certain in the case of the unique specimen shown in the figure whether we have to do with a single complete dental plate, or with one of the halves of a composite pavement, such as we are familiar with in the type species of *Synthetodus*.

Without entering into details it may be stated that the evidence afforded by the three above-named Dipterine species, and one undescribed *Synthetodus*-like type of dental plate, is sufficient for establishing a close correlation between the Elbert formation of Colorado and the Upper Devonian of the Cedar Valley region of Iowa. In addition, the occurrence of *Dipterus* scales in the fish-bearing beds at Aspen confirms the belief in a synchronism between those beds and the Elbert formation in the San Juan country. According to this correlation a somewhat later age must be assigned to the Ouray limestone than that which Drs. Hay and Girty have been willing to concede for it.[9]

That which in 1904 appeared difficult of comprehension was how certain characteristic species from the Chemung-Catskill of the Appalachian region should have transmigrated into the Cordilleran sea by way of the Dakotan, without admixture being found in the Colorado Devonian of western Upper Devonian forms of fish life; and it was suggested at that time that the Chemung-Catskill of the Colorado Devonian fauna must have come by another route than by the Dakota sea.

[9] *Amer. Geol.*, Vol. XXX, 1903, p. 373.

The recent discovery of Dipterine remains in the San Juan country happily simplifies the problem, and appears to prove that the line of communication between the Appalachian and Cordilleran regions during late Devonian times was actually by way of the Ohioan and Dakotan seas; also that interchange took place between the faunas of the Elbert formation and the so-called State Quarry beds of Iowa toward the close of the Devonian.



FIGS. 1–4. Dipnoan dental plates from the Upper Devonian of Colorado. 1, Synthetodont type of crushing plate. 2, *Dipterus digitatus* Eastm. 3, *Dipterus mordax* juv. Eastm. 3, *Dipterus pectinatus* Eastm. (All figures natural size.)

It is of some further interest to recall in this connection that the earliest reported occurrence of Dipterine remains in this country is that of a dental plate of *Dipterus* itself in the Columbus limestone of Ohio,[10] and that the only Elasmobranch species thus far described from the Colorado Devonian (*Cladodus formosus* Hay) bears a not altogether remote resemblance to *C. concinnus* from the Huron shale of Ohio.

[10] Bull. 10, 4th Series, Geol. Survey Ohio, 1909, p. 196, pl. xvii, figs. 14–17.

XVIII. NOTES ON TROPICAL AMERICAN TETTIGONOIDEA (LOCUSTODEA).

By Lawrence Bruner.

The present paper is based on several rather extensive collections of Orthopteroid insects belonging to the Carnegie Museum, which were placed at my disposal for study. These collections were made by different persons and at various times. The majority of the material, however, comes from Brazil, hence this report may be considered a continuation of the series of three reports previously prepared by me and already published. There are still many forms of both Locustoidea and Tettigonoidea that have been put aside for further study, as well as all of the Grylloidea which will be reported upon in future numbers of the Annals.

The present paper, as was the case with the series already published, contains descriptions of a number of new genera and species. The types referred to in connection with these descriptions are practically all deposited in the collection of the Carnegie Museum.

Suborder TETTIGONOIDEA (Locustodea).

Next in numbers and importance to the locusts, or short-horned, are the long-horned grasshoppers. In some of the recent literature dealing with orthopteroid insects the authors have shown a tendency toward considering the group of more than ordinal value, some of them even going so far as to suggest a sub-class comprising several distinct orders and suborders. Two of these writers, Karny and Handlirsch, agree in calling each of the three so-called families, which taken together have been termed the "saltatorial orthoptera," as sub-orders, and the subfamilies, families. To this latter view I myself am inclined to agree, since by so considering them the confusion which has heretofore existed as to their affinities is partially remedied.

The different members of this group vary among themselves to a much greater degree than do the Locustoidea (Acridoidea), although the latter suborder contains a considerably larger number of forms. Possibly this greater variation among the forms is due to the fact that the majority of the present group are denizens of forests, jungles, etc. as well as of grassed and other open country. The various families, which are represented in South America, may be separated by the accompanying synoptical key.

SYNOPSIS OF THE S. A. TETTIGONOIDEA.

A. Tarsi more or less depressed. (Forms largely winged).
- *b*. Anterior tibiæ provided with auditory apparatus or foramina.
  - *c*. First and second tarsal joints smooth, not sulcate laterally. (Hind tibiæ with an apical spine above on each side) .... *Phaneropteridæ*.
  - *cc*. First and second tarsal joints longitudinally sulcate laterally.
    - *d*. Foramina or ear of anterior tibiæ typically wide open. Prosternum armed with a pair of spines or tubercles .... *Mecopodidæ*.
    - *dd*. Foramina or auditory apparatus either linear or shell-like in its opening.
      - *e*. Anterior tibiæ without terminal spines above.
        - *f*. Antennal scrobes or pits with the margins raised or produced. *Pseudophyllidæ*.
        - *ff*. Antennal scrobes with their margins hardly produced.
          - *g*. Fore, or both front and middle tibiæ armed with long spines decreasing in length towards the apex. *Listroscelidæ*.
          - *gg*. Fore and middle tibiæ armed with short or moderately long spines.
            - *h*. All the femora unarmed beneath, the posterior ones rarely spined on the outer, sometimes on both sides. (Size usually smaller) .... *Conocephalidæ*. [*Xiphidiidæ*.]
            - *hh*. All the femora usually spined below, rarely the posterior ones armed only on the outer side, in which case the fastigium of the vertex is either forked or extended considerably beyond the basal joint of the antennæ. (Usually larger).
              - *i*. Fastigium of the vertex generally noticeably narrower than the basal joint of the antennæ, sometimes dorsally sulcate .... *Agræcidæ*.
              - *ii*. Fastigium of the vertex usually distinctly broader than the basal antennal joint, never sulcate. *Copiphoridæ*. [*Conocephalinæ*.]
      - *ee*. Anterior tibiæ with a terminal spine above on the outer side. First joint of the posterior tarsus provided with a conspicuous free plantula beneath .... *Decticidæ*.
- *bb*. Anterior tibiæ without foramina or auditory apparatus ...... *Gryllacridæ*.

AA. Tarsi distinctly compressed (forms usually apterous).
- *b*. Tarsi provided with pulvilli, that on the metatarsus double; inserting angle of the posterior femora situated on the front side .... *Stenopelmatidæ*.

bb. Tarsi without pulvilli beneath; inserting angle of the posterior femora situated on the inner side .... *Raphidophoridæ*.

Family PHANEROPTERIDÆ.

The family known as Phaneropteridæ is a very large one and is distributed throughout the warmer countries of the globe, where its representatives are among the commoner and more conspicuous orthopterous insects to be met with at almost every turn. In tropical American regions they are especially numerous. Most of these insects are green or greenish in color, and live among the rank growth of vegetation always found in the humid sections. Many of the species are attracted to bright lights after nightfall, hence are quite readily collected. Others may be taken by beating and sweeping the foliage of trees and the herbage growing at the borders of forests, groves, and the margins of streams. Still others live upon the trunks of trees, on ledges of rocks, and the ground, mimicking their surroundings in color. Upwards of seventy-five genera are known from tropical American regions alone. These may be separated as follows:

SYNOPSIS OF SOUTH AMERICAN GENERA OF PHANEROPTERIDÆ.

A. Anterior coxæ not armed externally with a spine.
- *b*. Pronotum smooth, without a humeral sinus. Tegmina lobate.
  - *c*. Anterior femora slightly more than one-half again as long as the pronotum. Pronotum with the last transverse sulcus situated back of its middle, the hind margin truncate, or broadly emarginate. Left elytron of ♂ with a plicate vein crossing the disc... *Isophya* Brunner.
  - *cc*. Anterior femora twice as long as, or longer, than the pronotum.
    - *d*. Pronotum without lateral carinæ. Ovipositor moderately compressed, sensibly narrowed at the base, and with both margins acutely serrato-dentate towards the apex.
      - *e*. Plicate vein of the left elytron of the ♂ strongly oblique and subobliterated .... *Odonturella* Bolivar.
      - *ee*. Plicate vein of the left elytron of the ♂ well defined and crossing the disc. Genicular lobes of the hind femora acuminate. *Angara* Brunner.
    - *dd*. Pronotum with lateral carinæ present. Ovipositor compressed, the margins towards the apex very minutely crenulate. *Xenica* Brunner.
- *bb*. Pronotum provided with a distinct humeral sinus. Tegmina fully developed.
  - *c*. Tegmina narrow, shorter than the wings, when the latter are present. Wings acuminate.

d. Anterior tibiæ above closely armed on their hind margin with strong spines. All of the femora spined beneath. Pronotum subcylindrical, the lateral lobes much longer than high. The tegmina much narrowed .... *Tetana* Brunner.

dd. Anterior tibiæ above on the outer margin without spines or rarely spined. Anterior femora unarmed below, the posterior ones spined or unarmed. Pronotum with the lateral lobes either roundly or angulately joined.

e. Pronotum with its lateral lobes roundly inserted. Hind femora spined beneath .... *Pseudoburgilis* Brunner.

ee. Pronotum with its lateral lobes joined to the disc by an acute or obtuse angle. Hind femora unarmed beneath.

f. Wings rudimentary or wanting. Pronotum provided with well-defined lateral carinæ. Tegmina as long as the abdomen, acuminate, the median veins widely separated.
Euxenica, gen. nov., Bruner.

ff. Wings present and fully developed, slightly or even greatly longer than the tegmina.

g. Wings more than one-half longer than the tegmina. The latter attenuated apically. Ovipositor narrow, nearly straight, its disc roughened and with its margins acutely serrato-dentate .... *Burgilis* Stål.

gg. Wings scarcely one-third or only a trifle longer than the tegmina. Ovipositor strongly curved, compressed, either smooth or rugulose, its margins obtusely serrate.

h. Tegmina strongly dilated at their base, their anterior margin broadly rounded, apex acuminate, the tympanal field not unusually dilated. Wings a little longer than the tegmina. Ovipositor semicircularly curved, its disc somewhat roughened.
Coryphoda Brunner.

hh. Tegmina narrow, their apex rounded, and with the tympanal field normal. Wings one-fourth longer than the tegmina. Ovipositor strongly compressed, short, suddenly bent or curved upward at the base, its disc smooth.

i. Tegmina with the cross-veins in the marginal and radial fields parallel, close together; radial vein beyond the base contiguous.... *Aniarella* Bolivar.

ii. Tegmina with the cross-veins irregular; radial veins separated from the base to their outer extremity.
Hyperophora Brunner.

cc. Tegmina broader, longer than the wings. Latter obtuse or abortive.

d. Cross-veins of the tegmina much crowded or close together. (Pronotum with the disc plain or flat, the deflexed lobes angulately inserted) .... *Engonia* Brunner.

dd. Cross-veins of the tegmina wanting or very irregular.

e. Tegmina sublinear or narrow, the apex obtuse, the radial veins separated. (Pronotum with its lateral lobes roundly inserted. Anterior tibiæ spineless above) .... *Stenophyllia* Brunner.

ee. Tegmina ovate, acuminate, the radial veins touching.

f. Deflexed lobes of the pronotum attached by an acute angle, their posterior margin obliquely truncate, the humeral sinus nearly absent. Wings abortive. Anterior tibiæ nearly spineless above .... *Marenestha* Brunner.

ff. Deflexed lobes of the pronotum attached by a rounded angle, their posterior margin rounded and the humeral angle distinct. Wings although shorter than tegmina, well developed, subgenital plate of ♂ elongated, narrow. *Cosmophyllum* Blanchard.

AA. Anterior coxæ armed externally with a distinct spine.

b. Fastigium of the front laminately greatly produced. (Tegmina broad, femora and tibiæ laminately dilated) .... *Ægimia* Stål.

bb. Fastigium of the front not produced, or at most forming a short transverse plate.

c. Vertex elevated into a tooth or dentiform crest, which is remote from the fastigium. (Femora and posterior tibiæ frequently lobate or lengthily spined.)

d. Posterior femora spinulose, not lobate, nor lengthily spined.

e. Antennæ nodose. Fastigium of the vertex compressed, acuminate. Posterior femora with the genicular lobes obtuse. *Hammatofera* Brunner.

ee. Antennæ smooth, annulated with fuscous. Fastigium of the vertex depressed, sulcate. Posterior femora with the genicular lobes lengthily dentate .... *Oxyprorella* Giglio-Tos.

dd. Posterior femora either lengthily spined or lobate.

e. Hind femora and tibiæ lengthily spinose.

f. Pronotum unarmed with spines .... *Machima* Brunner.

ff. Pronotum armed above both in front and behind with a long, compressed spine .... *Markia* White.

ee. Hind femora lobate. Hind tibiæ armed with triangular teeth.

f. Vertex elevated into a spine. Antennæ with their first joint smooth .... *Dysonia* White.

ff. Vertex elevated into a crest. First joint of the antennæ armed internally with a heavy, robust, obtuse tooth. *Paraphidnia* Giglio-Tos.

cc. Vertex plain or tumescent, not spined.

d. Middle tibiæ laminately dilated apically, compressed, including a long spine .... *Centrofera* Brunner.

dd. Middle tibiæ of normal form or slightly dilated basally.

e. Ovipositor very short, always much less than the pronotum in length, the valves free or separated, rather smooth and without decided marginal teeth. Subgenital plate of ♂ either produced into narrow lobes imitating a stylus or sharpened stick, or subtruncate at apex.

f. All of the femora sulcate below and armed on the external margin with some small spines; anterior and middle tibiæ sulcate above and, with the exception of the apical spine, smooth or provided with only a few spinules.

g. Middle tibiæ noticeably compressed and dilated at base; the hind margin of the disc of the pronotum rounded. *Uberaba*, gen. nov., Bruner.

gg. Middle tibiæ of usual form, not especially compressed and dilated at base; hind margin of the disc of the pronotum truncate. [Ecuador].......... *Polychnodes* Giglio-Tos.

ff. All of the femora non-sulcate below, the anterior and middle pairs armed on the lateral margins with series of long and slightly curved spines; anterior and middle tibiæ rounded above, their lower margins also lengthily spined. [Costa Rica].............................. *Alogopteron* Rehn.

ee. Ovipositor not abnormally short, usually as long as, or longer than, the pronotum, its margins towards the apex crenulate or serrulate, very rarely smooth. Subgenital plate of ♂ with or without free styles.

f. Anterior tibiæ on their inner margin with the auditory foramina shell-like or sublinear, externally typically wide open. Ovipositor broad, its apical half convex and covered with flattened squamiform, imbricated tubercles, the edges of which are directed forwards......... *Cœlophyllum* Scudder.

ff. Anterior tibiæ with one or two exceptions having the auditory foramina on both sides either wide open, or narrow and shell-like.

* Anterior and middle tibiæ sulcate above, or plain, but acute-angled, on the outer margin either spined or smooth.

b. Fastigium of the vertex somewhat depressed, acuminate or truncate.

c. Anterior and middle tibiæ, with the exception of the external apical spine, unarmed above. Tegmina narrow, their apex rounded, the radial veins separated at the base. All the femora unarmed beneath. Wings much longer than the elytra.......... *Phaneroptera* Serville.

cc. Anterior, or at least the median, tibiæ spined above. Tegmina, wings, and femora variable.

d. Pronotum strongly saddle-shaped, the disc elevated posteriorly. Tegmina with their hind margin sinuate and the apex either obliquely truncate, or rounded. Auditory openings on both sides of the anterior tibiæ linear [Venezuela]........ *Sictuna* Walker.

dd. Pronotum with the disc either plain or saddle-shaped, but not elevated either in front or behind. Tegmina with their posterior margin straight or sinuate. Posterior femora beneath spined or lobate. The auditory foramina wide open.

e. Tegmina narrower (except in *Dolichocercus*), their posterior margins sinuate. The anterior femora above often compressed at their apex, acuminate. Posterior femora with their genicular lobes lengthily acuminate.

f. Anterior and middle femora not subcarinate above apically.

g. Genicular lobes of all the femora bearing two spines. Tegmina elongate lanceolate, their apex rounded. *Callinsara* Rehn.

gg. Genicular lobes of all the femora bearing a single spine. Tegmina rather broad, with the apex obliquely truncate. *Dolichocercus* Rehn & Hebard.

ff. Anterior and middle femora briefly subcarinated above apically.

g. Anterior ulnar vein of tegmina not united with the branch of the posterior median. Ovipositor very prominently serrato-crenulate. Sides of the disc of the pronotum only gently convergent anteriorly, the lateral carinæ obtuse............*Enthephippion*, gen. nov., Bruner.

gg. Anterior ulnar vein united with the branch of the posterior median, sometimes appearing as a continuation of the former. Ovipositor minutely serrate. Sides of the disc of the pronotum strongly convergent anteriorly, the lateral carinæ more or less acute....*Insara* Walker.

ee. Tegmina broader, their hind margin straight or rounded. Anterior femora above rounded. Posterior femora with the genicular lobes obtuse or provided with short teeth.

f. Subgenital plate of ♂ without styles.

g. Anterior and middle femora unarmed with spines beneath, the posterior ones also unarmed or furnished with but few small spinules. Ovipositor obtuse at its apex. *Scudderia* Stål.

gg. Anterior and middle femora spined beneath. Hind femora also spined. Ovipositor acuminate or obtuse. *Symmetropleura* Brunner.

ff. Subgenital plate of ♂ provided with free styles.

g. Pronotal carinæ acute, or obtuse, or none, never elevated, neither dentate nor crenulated.

h. Vertex somewhat flattened. Pronotum with the disc flat, the deflexed lobes more or less angulately inserted. Antennæ at their base not enlarged nor hirsute. Tegmina, except in the genus *Theudoria*, green.

i. Tegmina with the radial veins more or less separated (very little back of the middle), the radial branch passing out on the posterior margin of the elytra.

j. Anterior tibiæ above not provided with a spine back of the foramina. (*Ligocatinus olivaceus* has a spine at the base.) Pronotum smooth, shining. Subgenital plate of ♂ short, its posterior border emarginate. *Ligocatinus* Rehn.

jj. Anterior tibiæ above armed with a small spine back of the foramina. Pronotum smooth, but with the impressions roughened or opaque. The subgenital plate of ♂ longer, attenuate, and fissured.

k. Ovipositor with its apex acuminate.

l. Tegmina with their apex rounded, a little shorter than the wings. Posterior femora unarmed below on the outer margin (except in *Theudoria nigrolineata*, in which both margins are spined).

m. Subgenital plate of ♂ moderately attenuate. Last ventral segment of ♀ abdomen not different from the others. . *Homotoicha* Brunner.

mm. Subgenital plate of ♂ strongly attenuate and elongate, profoundly fissured. Last ventral segment of ♀ abdomen much larger than the rest, trapezoidal. Subgenital plate of ♀ very short, transverse . . . . *Theudoria* Stål.

ll. Tegmina with their apex obtuse, obliquely truncate. Posterior femora below with both margins spined. (Last ventral segment of ♀ abdomen not different from the rest. Subgenital plate of the ♀ elongate, with the apex truncate and terminating on each side with a narrow appendix) . . . . . *Parascudderia* Brunner.

kk. Ovipositor with its apex rounded. (Hind femora with both margins armed.)

l. Posterior femora simply spined below. Wings with their disc hyaline.
Ceraia Brunner.

ll. Postericr femora below lobato-dentate. Wings with their disc red.
Vellea Walker.

ii. Tegmina with their radial veins, except at the apex, contiguous, the radial branch running out at the apex, or deflexed into the posterior margin of the elytra.

j. Branch of the posterior radial vein straight, running out in the apex of the elytra. Ovipositcr suddenly curved at the base, acuminate, the margins crenulate throughout.

k. Vertex in front margined with a carina, on each side towards the middle of the eyes branching out into an obtuse tooth, the fastigium angulately deflexed. Tegmina with the radial branch not forked, joined to the ulnar vein by an oblique veinlet. *Ectemna* Brunner.

kk. Vertex in front obtuse, the fastigium roundly deflexed. Tegmina with the radial branch forked, or, in the manner of the genus preceding, joined to the ulnar vein by an oblique veinlet.

l. Size larger. Pronotum with the disc narrowed in front, the lateral lobes obtusely inserted, highest back of their middle. Anterior margin of the tegmina at their base black-bordered. Ovipositor very much roughened, with its apex colored black . . . . *Plagiopleura* Stål.

ll. Size smaller. Pronotum with the disc of equal width in front and behind, the lateral lobes acutely inserted, highest at their middle. Anterior margin of the tegmina ferruginous. Ovipositor granulose, its apex ferruginous. *Euthyrrhachis* Brunner.

jj. Branch of the posterior radial vein forked, deflexed to the posterior margin of the elytra. Ovipositor but little curved and somewhat obtuse, the margins entire or subcrenulate at its apex . . . . *Parableta* Brunner.

hh.[1] Vertex rounded, strongly declivant. Pronotum more or less saddle-shaped, the lateral lobes roundly inserted. Antennæ at base heavy, often hirsute. (Anterior tibiæ above entirely unarmed. Wings provided with a distinct apical triangular field.)

i. Antennæ very heavy at their base and always hirsute. Color blackish, steel-blue, or ferruginous. *Scaphura* Kirby.

ii. Antennæ less heavy at base and generally smooth, or only sub-hirsute. Color fuscous. *Gymnocera* Serville.

gg. Pronotal carinæ more or less elevated and dentate, or

[1] Walker's genus *Itarissa* (see Cat. Derm. Salt. Brit. Mus., II, p. 389) is placed in the vicinity of *Posidippus* by Kirby. According to the present table, however it would not fall in section *gg* because it lacks the lateral pronotal carinæ.

straight and sometimes crenulated behind. (Species of large size. The tegmina corneous. Ovipositor short, somewhat compressed, attenuate, the margins entire.)

h. Anterior branch of the radial fork itself running out at the apex of the tegmina.

i. Fastigium of the vertex horizontally produced, sulcate, a little wider than the first antennal joint. Carinæ of the pronotum crenulate only on their posterior fourth. . *Microcentrum* Scudder.

ii. Fastigium of the vertex deflexed, not sulcate, twice as wide as the first antennal joint. Carinæ of the pronotum ampliated and crenulato-dentate throughout . . . . *Steirodon* Serville.

hh. Anterior branch of the radial fork running out on the posterior margin of the tegmina.

i. Lateral carinæ of the pronotum cristato-elevated. Anterior tibiæ flattened above. (Posterior tibiæ strongly compressed and dilated. . *Peucestes* Stål.

ii. Lateral carinæ of the pronotum not elevated. Anterior tibiæ sulcate above. Eyes globose, prominent.

j. Posterior tibiæ alone compressed, and slightly dilated near the base. . . . . *Posidippus* Stål.

jj. Posterior tibiæ as well as the intermediate tibiæ compressed at base and very decidedly dilated. *Steirodonopsis* Scudder.

bb. Fastigium of the vertex obtuse, deflexed, much wider than the first joint of the antennæ.

c. All the femora and tibiæ simple or plain. Fastigium of the vertex about twice the width of the first antennal joint, sulcate. Mesosternum roundly lobate. Ovipositor suddenly curved at its base, a little longer than the pronotum, its upper margin straight. . *Sagona* Walker.

cc. The femora and likewise the anterior and middle tibiæ foliaceo-lobate. Pronotum with its disc profoundly concave. (Eyes greatly elongate. Tegmina very broadly obovate) . . . . *Agaura* Brunner.

**. Anterior and intermediate tibiæ above rounded, often entirely unarmed, very rarely sulcate, in which case, the apical spine is absent (*Viadana*), or when the apical spine is present the meso- and metasternum are lengthily lobate (*Orophus*). Fastigium of the front acuminate, or obtuse.

b. Anterior femora often, the middle pair always, rounded beneath, while the hind femora are flattened below. Subgenital plate of male not provided with styles. Ovipositor frequently much longer than the pronotum, somewhat curved, acuminate, smooth.

c. Posterior radial vein with its single branch furcate. Lateral lobes of the pronotum, rounded or obtusely inserted.

d. Disc of the pronotum somewhat flattened, without a median elevated longitudinal line. Ovipositor very smooth. . . *Anaulacomera* Stål.

dd. Disc of the pronotum rounded, furnished with a median, slightly elevated, longitudinal line.

e. Lateral lobes of the pronotum as high as long. Tegmina somewhat pellucid, the transverse veins not prominent, rather poorly expressed. Legs not especially slender. Anterior femora but little longer than the pronotum, the posterior pair not more than four times as long as the pronotum....*Grammadera* Brunner.

ee. Lateral lobes of the pronotum longer than high. Tegmina grass-green, opaque, the transverse veins elevated, parallel. Legs very slender. Anterior femora one-half longer than the pronotum, the posterior pair five times as long as the pronotum. *Abroidiœta* Brunner.

cc. Posterior radial vein emitting several non-forked parallel branches. Lateral lobes of the pronotum angulately inserted. (Fastigium of the vertex more or less laminately compressed. Anterior and middle tibiæ sulcate above, totally unarmed.)

d. Tegmina narrow, the branches of the posterior radial vein longitudinal, terminating in the apex of the elytra. Fastigium of the vertex a trifle longer than, or of equal length with, the first antennal joint. Lateral lobes of the pronotum higher than long, their posterior margin more or less angulately produced. Tegmina wider at base, tapering towards the apex. Ovipositor gently curved. *Tomeophora* Brunner.

dd. Tegmina strongly dilated, ovate or trapezoidal, the radial branches oblique and running out on the posterior margin of the elytra. *Viadana* Walker.

bb. All the femora sulcate below. The subgenital plate of male provided with styles. Ovipositor rarely longer than the pronotum, generally, but not always, suddenly curved, roughened, acuminate, or smooth with the apex truncate and crenulate, but obtuse.

c. Mesosternal lobes triangular, not produced; the metasternal lobes rounded, except in the genus *Diplophyllus*, where they are triangular. Ovipositor acuminate. Fastigium of the vertex also acuminate.

d. Fastigium of the vertex not touching the fastigium of the front. (In *Phylloptera peruviana* they touch.) Internal margins of the antennal scrobes when viewed from the front include the fastigium of the front. Front more or less tumescent. (Metasternum roundly lobate.)

e. Wings surpassing the tegmina.

f. Secondary veins of the tegmina irregularly placed.

g. Lateral lobes of the pronotum often higher than long, the anterior margin sinuate. Anterior and middle tibiæ less graceful. These hardly longer than the pronotum. Ovipositor a little shorter than the pronotum, its base and apex equal in width. Cerci of male shorter, curved inwards........................*Phylloptera* Serville.

gg. Lateral lobes of the pronotum as long as high, the anterior margin straight. Anterior and middle tibiæ slender, exceeding the length of the pronotum by one-half. Ovipositor longer than the pronotum (except in the genus *Cora*) with its apex narrowed. Cerci of male straight, long.

h. Fastigium of the vertex advanced a little in front of the eyes. Tegmina ovate, widest at middle, or back of the middle. Wings at apex acuminate, the triangular portion not separated as a distinct field. *Hyperphrona* Brunner.

hh. Fastigium of the vertex advanced greatly in front of the eyes. Tegmina with their margins nearly parallel. Wings with their apex obtuse and separated into a distinct rounded field....*Cora* Brunner.

ff. Secondary veins of the tegmina obliquely and regularly arranged..............................*Arota* Brunner.

ee. Wings not surpassing the tegmina, the apical field prominent. Fastigium of the vertex sulcate. Anterior and middle tibiæ less graceful, a trifle shorter than the pronotum. Lateral lobes of the pronotum highest at middle........*Prosagoga* Brunner.

dd. Fastigium of the vertex contiguous with the fastigium of the front. (In *Pycnopalpa bicordata* it is not contiguous, and in this case the margins of the antennal scrobes are rather distant.)

e. Anterior femora dentate below on the anterior border. Anterior tibiæ above dilated in the apical portion and provided with an external spine. Tegmina ovate, in their apical third three times as wide as the length of the pronotum.

f. Disc of the pronotum ornamented with two roughened heart-shaped areas set off by raised carinæ. Tegmina having the appearance of being corroded........*Pycnopalpa* Serville.

ff. Disc of the pronotum without the roughened areas set off by raised carinæ. The tegmina not having the corroded or rusted appearance as in the preceding genus. *Topana* Walker.

ee. Anterior femora armed beneath with little spinules or unarmed. Anterior tibiæ without a basal spine above. Tegmina lanceolate, or linear, not more than twice the width of the pronotal length.

f. Wings plainly longer than the tegmina. Ovipositor only a trifle longer than the pronotum.

g. Vertex depressed, contiguous with the front by means of a very obtuse angle. Tegmina with the apex obliquely truncate.

h. Tegmina with their posterior margin somewhat sinuate. Pronotum short, truncate behind...*Theia* Brunner.

hh. Tegmina with their hind margin straight. Pronotum behind lengthily and triangularly produced. *Hetaira* Brunner.

gg. Vertex horizontal, forming a distinct angle with the front. Tegmina lanceolate............*Diplophyllus* Saussure.

ff. Wings shorter, or but little longer, than the tegmina, the triangular field of their apex prominent. Ovipositor considerably longer than the pronotum.

g. Ovipositor almost twice as long as the pronotum, broadest in the middle, its apex acuminate..*Annalomes* Scudder.

gg. Ovipositor one-half longer than the pronotum, broadest beyond the middle..............*Apocerycta* Brunner.

cc. Meso- and metasternal lobes both (except in the genus *Ischira* where they are rounded) triangularly produced. Ovipositor obtuse, crenulate, or acuminate, and with the valves very smooth, separated.

d. Ovipositor suddenly curved upwards at its base, the lower valve with its apex truncate and profoundly crenulate. (Fastigium of the vertex deflexed, equal in width to the first joint of the antennæ, or wider, obtuse. Tegmina lanceolate or ovate, both forks of the radial branch passing out on the dorsal margin.)

Orophus Saussure.

dd. Ovipositor either suddenly or only gradually curved, the margins smooth, the lower valve acuminate at its apex, somewhat separated from the upper valve.

e. Fastigium of the vertex strongly obtuse, four times wider than the first antennal joint (in *Ischyra flaviceps* the fastigium is about twice as wide as the first joint of the antennæ).

f. Anterior tibiæ with the foramina on both sides shell-like. Posterior femora totally dentate below on the outer margin. Metasternum provided with triangular lobes.

Lobophyllus Saussure.

ff. Anterior tibiæ provided on both sides with wide-open foramina. Posterior femora spined below on the outer margin towards the apex. Metasternum provided with either triangular or rounded lobes.........................*Ischyra* Brunner.

ee. Fastigium of the vertex lengthily produced, or short, a little wider than the first antennal joint, or acuminate.

f. Lateral lobes of the pronotum with their margins fringed with hairs. Tegmina membranous or leathery.

Syntechna Brunner.

ff. Lateral lobes of the pronotum with their margins smooth. Tegmina corneous.

g. Posterior margin of the elytra nearly straight. Both forks of the branch of the posterior radial vein running out on the posterior border of the elytra. Mesosternal lobes plain, extending over the coxæ.

h. Fastigium of the vertex wider than the first joint of the antennæ. Tegmina strongly narrowed back of the middle. Anterior tibiæ provided with wide-open foramina on both sides..........*Philophyllia* Stål.

hh. Fastigium of the vertex narrower than the first antennal joint. Tegmina moderately narrowed beyond the middle. The foramina on both sides of the anterior tibiæ linear................*Phœbolampta* Brunner.

gg. Posterior margin of the elytra rounded, or elevated, roof-like. Both forks of the branch of the posterior radial vein passing out in the apex of the tegmina. Mesosternal lobes strongly compressed. Fastigium of the front bituberculate. Ovipositor obtuse, the valves entire. *Acra* Brunner.

Genus EUXENICA gen. nov.

The present genus is South American. Thus far only the one species, the description of which follows, is known. This insect, as may be seen by referring to the synopsis of genera on a preceding page belongs to the first section of the family Phaneropteridæ, *i. e.*, among those genera in which the anterior coxæ are unarmed with a spine. In the key of genera it falls between *Pseudoburgilis* Brunner and *Burgilis* Stål.

General form of insects moderately graceful. Anterior coxæ unarmed with a spine. Head large, a little wider than the anterior margin of the pronotum, the eyes small, but prominent, slightly elongate; occiput smooth, rounded; fastigium of the vertex roundly depressed, narrow, more or less sulcate, sub-contiguous with the fastigium of the front, which latter is bluntly rounded and does not quite reach the upper extremity of the antennal scrobes. Antennæ somewhat coarse, filiform. Pronotum with its sides parallel, carinated, the humeral sinus distinct, but not prominent; the lateral lobes nearly twice as long as high; the disc gently convex, its anterior margin subtruncate, the hind margin rounded. Tegmina as long as, or longer than, the abdomen, lanceolate, their apex acuminate; the anterior and posterior median veins widely separated throughout. Wings wanting. Anterior and middle legs slender, the femora of the former about one-half longer than the pronotum, the median pair a little more than twice its length; hind femora also slender, longer than the body, all three pairs without spines below. Auditory apparatus wide open. Anterior tibiæ spined above on their hind margin, the intermediate pair spined on both margins. Ovipositor robust, gently falcate, gradually tapering, acuminate, on the apical third crenulate, or serrate.

1. **Euxenica aptera** sp. nov.

General color of body testaceous to ferrugineo-testaceous; the tegmina grass-green; lateral carinæ of the pronotum and the humeral angles of the tegmina vinaceous. Apical portion of all the tibiæ and tarsi infuscated. Antennæ at least basally testaceo-ferruginous.

Length of body, ♀, 16 mm., of pronotum, 4 mm., of tegmina, 15 mm., of hind femora, 20 mm., of ovipositor, 10.5 mm.

Habitat.—Chapada, Brazil (H. H. Smith). There are three additional female specimens at hand. These are also from the same locality. The type is in the Carnegie Museum of Pittsburgh.

Genus ANIARELLA Bolivar.

Aniarella BOLIVAR, Bol. Soc. Esp. Hist. Nat., VI, p. 384 (1906).
Aniara BRUNNER (*nec* Dejean), Mon. Phaneropt., 16, 123 (1878); *Ib.*, Addit. Monog. Phaneropt., pp. 7, 58 (1891).

The representatives of *Aniarella* are recognizable by the absence of the spine from the anterior coxæ and by the presence of numerous parallel transverse veins on the tegmina. Three species have already been characterized, while a fourth is now added. They may be recognized by the few brief characters as given in the subjoined

SYNOPSIS OF THE SPECIES OF ANIARELLA.

A. Mediastin vein of the costal field of the elytra subobsolete or entirely absent.
- *b*. Deflexed lobes of the pronotum roundly or obtusely inserted.
  - *c*. Size larger [♂, 20 mm., tegmina, 36 mm.]. Mediastin vein wanting. *typica* Brunner.
  - *cc*. Size smaller [♂, 16 mm., tegmina, 26 mm.]. Mediastin vein present, but very short . . . . *minor* sp. nov.
- *bb*. Deflexed lobes of the pronotum acutely inserted, the angle marked by a narrow fuscous line . . . . *proxima* Brunner.

AA. Mediastin vein of the costal field present, extending beyond its middle. (Deflexed lobes of the pronotum acutely inserted, the angle marked by a narrow fuscous line) . . . . *punctulata* Brunner.

2. **Aniarella minor** sp. nov.

As indicated by the synoptic key the present insect is most closely related to the species *typica*, from which it differs in having the posterior border of the tegmina minutely punctulate with fuscous, which results from the veinlets being widely pallid over a fuscous background.

General color pale green, the legs, head, pronotum, and body testaceous. Costal area of the tegmina broad and rounded on their basal half, narrowed beyond. Transverse parallel veins not so prominent as figured for *punctulata* Brunner (see Monog. Phaneropt., pl. II, fig. 23).

Length of body, ♂, 16 mm., of pronotum, 3.5 mm., of tegmina, 26 mm., width of tegmina, 5.25 mm., length of hind femora, 16 mm.

Habitat.—The type and another male specimen are at hand. They were collected by J. Steinbach at Puerto Suarez, Bolivia, during November and January. The type is in the Carnegie Museum of Pittsburgh.

3. **Aniarella proxima** (Brunner)?

Aniara proxima BRUNNER, Addit. Mon. Phaneropt., p. 58 (1891); REHN, Proc. Acad. Nat. Sci. Phila., 1913, p. 360.

Specimens of a second species belonging to the genus *Aniarella* in the present collection are referred with some doubt to Brunner's *proxima*.

Genus HYPEROPHORA Brunner.

Hyperophora BRUNNER, Mon. Phaneropt., pp. 16, 125 (1878); *Ib.*, Addit., Mon. Phaneropt., pp. 7, 58 (1891); REHN, Proc. Acad. Nat. Sci. Phila., 1907, pp. 371–376, figs. 1–8.

The insects, which comprise the genus *Hyperophora*, are rather numerous and confined to the middle portions of South America. They are especially abundant in portions of southern Brazil, Paraguay, eastern Bolivia, and northern Argentina. Specimens are at hand from several localities, but in such numbers that they have been set to one side for later study. This course has been decided upon because of the apparent variation in color, size, width of tegmina, etc., found among the specimens coming from a single locality.

Genus OXYPRORELLA Giglio-Tos.

Oxyprorella GIGLIO-TOS, Boll. Mus. Zool. Anat. Comp. Torin, XIII, no. 311, p. 70 (1898).

Oxyprora BRUNNER (*nec.* Stål), Mon. Phaneropt., pp. 18, 148 (1878); *Ib.*, Addit. Mon. Phaneropt., p. 9 (1891).

This is also a tropical South American genus. It contains rather small, but more or less mottled and otherwise variegated insects with the characters indicated in the preceding table of genera. Two species have been characterized heretofore, to which a third is now added. They may be separated as follows:

SYNOPSIS OF THE SPECIES OF OXYPRORELLA.

A. Smaller, with the elytra very short (♀, 10 mm.) [Peru]. . . . . *misera* Brunner.
AA. Larger, with the elytra longer (♀, 23 mm. or more).
b. Posterior margin of the disc of the pronotum entire. Tegmina a little wider at middle than the length of the anterior femora [Bolivia]. *zebrata* sp. nov.
bb. Posterior margin of the disc of the pronotum incised at middle. Tegmina narrow, less than the length of the anterior femora in width [Ecuador]. *dives* Giglio-Tos.

4. **Oxyprorella zebrata** sp. nov.

Ferrugineo-testaceous, more or less mottled and streaked with fuscous and black. Body hirsute. Head a little wider than the anterior margin of the pronotum; eyes large, prominent, a little longer than wide, alternately streaked lengthwise with fuscous and testaceous; fastigium of the vertex depressed, sulcate, decidedly narrower than the first antennal joints; fastigium of the front prominent, white, almost reaching the upper end of the antennal scrobes. Antennæ annulated with fuscous. Pronotum short, the disc flat above with prominent lateral carinæ. Tegmina somewhat coriaceous, of moderate width, the apex obliquely truncate; anterior and posterior radials separated both near the base and apex, attingent between, the branch of the posterior one given off in advance of the middle, both of the forks running out at the apex. Anterior femora in front provided with a single large tooth-like spine near the apex; intermediate pair with two smaller spines; hind femora with several rather prominent spines; anterior and intermediate tibiæ dilated near their base, the auditory apparatus wide open. Cerci heavy at base, rather long, arcuate, the apical half slender. Sub-genital plate rounded, subtruncate at apex.

Front infuscated and marmorate with flavous or testaceous and rather closely punctate with fuscous dots from which eminate short pale hairs. Pronotum with the lateral carinæ and hind border black. Tegmina with a few irregular scattered and five regular oblique fuscous blotches,—the latter on the apical half of the costal field. Exposed portion of wings also so marked. Anterior femora and tibiæ basally striped in zebra fashion with black. Hind femora also showing dim bands of fuscous. Cerci for the most part black, the center ferruginous.

Length of body, ♂, 13 mm., of pronotum, 2.85 mm., of tegmina, 21.5 mm., width of same, 5 mm., length of wings, 26.5 mm., of hind femora, 15 mm.

Habitat.—The type, a male, and only specimen at hand, bears the label "Province del Sara, Bolivia, 350 meters, J. Steinbach, November, 1913."

The type is in the Carnegie Museum.

5. **Oxyprorella modesta** sp. nov.

Male.—About the same size as the preceding, but slenderer and darker colored and with the disc of the thorax beautiful apple-green, occiput short, the vertex also short, excavated anteriorly between the eyes, the fastigium not prominent. Head small, tapering below. Eyes large, prominent. Pronotum moderately elongate, the disc remarkably flat and smooth, bordered throughout with a smooth, slightly elevated ridge or carina. Lateral lobes slightly longer than high, the anterior margin roundly lobate below, lower edge and hind margins also broadly rounded. Tegmina with the margins nearly parallel, the apex obliquely truncate and with the venation something like that in the preceding species. Anterior and middle femora five-spined below, the hind pair seven-spined externally, two-spined internally. Last ventral segment of abdomen of male of moderate size, a little longer than wide, tapering, the apex truncate between short lateral blunt teeth. Cerci curved as in the preceding species, a little flattened from above on their apical half, and terminating in an acute tooth.

General color dull wood-brown more or less mottled with blotches of darker color on the tegmina and exposed portion of the wings. Fastigium of the front and excised portion of the vertex whitish; top of head, disc of pronotum, and immediate base of tegmina above green; border of the disc of the pronotum dull ivory. Dorsum of abdomen tinged with green.

Length of body, ♂, 13 mm., of pronotum, 3.6 mm., of tegmina, 21.5 mm., width of tegmina, 3.5 mm., length of hind femora, 15 mm.

Habitat.—Rio de Janeiro, October (H. H. Smith). The type alone is at hand. It is in the collection of the Carnegie Museum, Pittsburgh. It would fall in the table of species between *zebrata* and *dives*.

Genus DYSONIA White.

Dysonia WHITE, Richardson's Mus. Nat. Hist., II, p. 244 (1862); KIRBY, Syn. Cat. Orth., II, p. 411 (1906).

Valna WALKER, Cat. Derm. Salt. B. M., II, p. 357 (1869).

Aphidna STÅL, Recens. Orth., II, pp. 13, 28 (1874).

Aphidnia BRUNNER, Mon. Phaneropt., pp. 19, 151 (1878); *Ib.*, Addit. Mon. Phaneropt., p. 9 (1891).

The insects belonging to this genus are exceedingly interesting creatures, because they strongly imitate in their colors bark, twigs, and even stones which are coated with lichens. Several species are known, and all of them inhabit tropical American countries. They are either rare, or so well protected by their imitative colors, as to render their discovery difficult. But few individuals of the known species are found in collections.

6. **Dysonia elegans** (Brunner).

Aphidnia elegans BRUNNER, Mon. Phaneropt., pp. 153, 155 (1878).
Dysonia elegans KIRBY, Syn. Cat. Orth., II, p. 411 (1906).

Habitat.—A single female specimen of a species determined as *elegans* Brunner is at hand. It was taken by H. H. Smith, at Chapada, Brazil, during the month of January.

7. **Dysonia punctifrons** (Brunner)?

Aphidnia punctifrons BRUNNER, Mon. Phaneropt., pp. 152, 154, Pl. 3, fig. 40 *a*, *b* (1878).
Dysonia punctifrons KIRBY, Syn. Cat. Orth., II, p. 412 (1906).

Habitat.—A female of another species of this genus is referred to Brunner's *punctifrons* with some doubt. It comes from "Province del Sara, Bolivia," where it was collected at an elevation of 450 meters above sea-level by J. Steinbach.

8. **Dysonia** (?) **lamellipes** sp. nov.

There is also an additional species of katydid at hand, which appears to belong to the genus *Dysonia*. It is represented by a single ♀ nymph also taken by J. Steinbach during November in the "Province del Sara, Bolivia," at an elevation of 350 meters above sea-level. It differs from the imagos of the various described forms to such an extent that it very likely represents a new form. In color this nymph is largely brunneo-ferruginous somewhat varied with grayish testaceous. It has the disc of the pronotum smooth and flat, save that the surface is very finely transversely aciculated, with the hind lobe much ampliated, while the lateral lobes are nearly perpendicular and joined to the disc by sharp carinæ which are sinuose. The hind femora are provided internally on their apical third with a single large, flattened, horizontally directed, lobe-like plate the hind margin of which is bidentate; externally there is a similar, but smaller, lobe and two or three spines. The anterior and middle femora are each armed below on the front margin with three or four spines, the apical one of which is larger and tooth-like. Hind tibiæ simply spined. Antennæ distantly and narrowly fusco-annulate. Intermediate abdominal segments above and at the sides each provided near their hind margin with five prominent denticles.

Judging from the small size of this nymph the insect when grown must be smaller than is usually the case for the genus. Length of body 9.5 mm., of hind femora, which are slender, 11.5 mm.

I would suggest the name *Dysonia lamellipes* as a suitable name for this insect. It is in the Carnegie Museum.

Genus UBERABA gen. nov.

The present genus is erected for an insect with a very short ovipositor, coming from Chapada, Brazil. By referring to the generic synopsis it will be seen that it is most nearly related to *Polichnodes* Giglio-Tos.

Rather graceful, of medium or small stature, reminding one somewhat of the smaller species of *Anaulacomera* Stål, but differing from members of that genus in a number of essential characters.

9. **Uberaba brevicauda** sp. nov.

Head of medium size, about as broad as the front edge of the pronotum, the sides parallel; fastigium of the vertex gently depressed, acuminate, sulcate, its lateral margins strongly divergent behind and continuing as rather blunt ridges well towards the eyes a little back of their middle and opposite a prominent tooth-like spine; fastigium of the front acuminate, separated from the fastigium of the vertex by a considerable distance. Pronotum more or less adorned with small, scattered, pale, dark-centered pimples, most numerous on the disc; the latter flat behind and with the margin evenly rounded, gently convex anteriorly, the front margin truncate, the lateral lobes roundly inserted, about as long as high, the anterior margin straight, lower, and posterior margins evenly rounded. Tegmina and wings fully developed; former coriaceous, the posterior border rounded, apex also rounded, secondary veins rather coarse and irregular; radial veins separated both basally and apically, contiguous mesially, the branch of the posterior one arising from about its middle, the branch forking much in advance of its middle and both forks reaching the posterior margin before the apex. Tips of the wings extending well beyond the apex of the tegmina, coriaceous. Legs graceful, the femora all provided with a few spines beneath; anterior and middle tibiæ sulcate above, the intermediate pair sometimes spined above externally. Auditory apparatus wide open on both margins. Subgenital plate of the male abdomen rather small, tricarinate, gently tapering, the apex truncate, without free styles. Cerci bowed, moderately robust, their apex furnished with a blunt inwardly directed tooth. Ovipositor very short, blunt, almost as wide as long, the upper valve minutely crenulated apically; subgenital plate small and triangular, its apex entire.

Color either pale yellowish green or ferruginous, the tegmina more or less dimly maculate or marmorate with fuscous accordingly as the pallid venation permits of the showing through of the fuscous back-ground of these organs. Pronotum irregularly flecked with dark-colored dots, these flecks varying from vinaceous to fuscous; anterior ulnar vein prominent, greenish even in the ferruginous colored specimens; antennæ pale annulated with darker.

Length of body; ♂, 11 mm., ♀, 14 mm.; of pronotum, ♂, 3.25 mm., ♀, 3.50 mm.; of tegmina, ♂, 21 mm., ♀, 24 mm.; width of tegmina, ♂ and ♀, 4.75 mm.; length of hind femora, ♂, 13 mm., ♀, 14 mm., of ovipositor, 1.5 mm.

Habitat.—The types, ♂ and ♀, bear the label "Chapada, near Cuyabá, Matto Grosso, Brazil, August." Other specimens are also at hand which contain only the Chapada label. Some of them were taken during the months of June and July (H. H. Smith). The types are in the collection of the Carnegie Museum.

Genus CALLINSARIA Rehn.

Callinsaria REHN, Proc. Acad. Nat. Sci. Phila., 1913, pp. 361, 362.

The representatives of the present genus are confined to the tropical and subtropical regions of South America. The type of the genus, *C. clupeipennis* Rehn, came from Misiones, Argentina. What appears to be a second species is before me now. It has been given the name

10. **Callinsaria boliviana** sp. nov.

In its general appearance this insect is somewhat similar to the figure and description of *clupeipennis* Rehn, but slightly larger, and somewhat differently shaped and colored. In the present insect, the entire costal margin of the tegmina is rather widely ivory white bordered behind by a conspicuous line of purple, and the costal field has fewer and more regularly arranged oblique white lines, while above or back of the radials the pale oblique marks are very dim or even almost obliterated, and the hind or dorsal margin is narrowly infuscated. The disc of the pronotum has its margin defined by carinæ, which are simply arcuate instead of sinuate, and the lateral lobes are much higher behind than in front. The auditory opening is black with the base of the anterior tibiæ dark vinaceous.

Length of body, ♂, 19 mm., of pronotum, 4.1 mm., of tegmina, ♂, 29 mm., of hind femora, 22 mm.

Habitat.—The two males at hand come from Puerto Suarez, Bolivia, where they were collected during November at an elevation of 150 meters above sea-level. (J. Steinbach.) The type is in the Carnegie Museum.

Genus ENTHEPHIPPION gen. nov.

Related to *Insara* Walker (*Hormilia* Stål) in its structural features as shown by the synopsis of genera given on preceding pages of the present paper. It also bears some resemblance to *Gymnocera* Serville, especially in colorational features and in the structure of the ovipositor.

The representatives of the present genus are rather small to medium in size. The head is a little wider than the anterior margin of the pronotum, the front perpendicular, sides parallel, the occiput short, rounded; fastigium of the vertex somewhat depressed, sulcate, blunt at apex and not quite touching the fastigium of the front; eyes moderately prominent, a little longer than wide. Pronotum with the disc somewhat narrowed anteriorly, the lateral angles blunt, anterior margin truncate, rounded behind, lateral lobes roundly inserted, the lower and posterior margins evenly rounded. Tegmina narrow, considerably longer than the abdomen and hind femora, their apex rounded; wings reaching beyond the tegmina by at least the width of the latter. Anterior and middle, as well as posterior femora, spineless beneath; anterior and middle tibiæ sulcate above, the latter spined on the inner margin near its middle. Ovipositor moderately robust, curved, and strongly dentate both above and below, as well as on the carinæ of the lateral disc. Antennæ filiform, not robust. The type of the genus is the species

11. **Enthephippion obscuripenne** sp. nov.

General color brunneo-ferruginous, varied on the tegmina and hind tibiæ and femora with a tinge of green. Front with four fuscous spots above the base of the clypeus and the same number of inconspicuous dashes of the same color above the spots. Eyes castaneous. Antennæ ferruginous, apex of second joint piceous, beyond this the antennæ at intervals are fasciate with fuscous. Tegmina more or less fuscous along the disc, the costal and dorsal areas pallid, with a tinge of greenish. Wings infuscated. Legs of the general color, modified as follows: auditory apparatus fuscous, hind femora medially and hind tibiæ, except basally and at extreme apex, greenish; all the tarsi beneath infuscated. Abdomen above with a rather wide longitudinal band of black, this color including the supra-anal plate.

Length of body, ♀, 11 mm., of pronotum, 3.4 mm., of tegmina, 20 mm., width of tegmina, 2.75 mm., length of hind femora, 16 mm., of ovipositor, 5 mm.

Habitat.—Chapada, Brazil, in April, a single female specimen, the type. (H. H. Smith.) In the collection of the Carnegie Museum.

Genus SCUDDERIA Stål.

Scudderia STÅL, Bih. Svenska Akad., XXX (4), p. 41 (1873); *Ib.*, Recens. Orth. II, p. 14 (1874); BRUNNER, Mon. Phaneropt., pp. 25, 236 (1878); *Ib.*, Addit. Mon. Phaneropt., p. 16 (1891); SAUSSURE & PICTET, Biol. Cent.-Amer., Orth., I, p. 327 (1898).

The representatives of the genus *Scudderia* are rather widely distributed over North and Central America and also to a limited extent in the extreme northern parts of South America.

12. **Scudderia mexicana** (Saussure)?

Phaneroptera mexicana SAUSSURE, Rev. et Mag. Zool. (2), XIII, p. 129 (1861).

Scudderia mexicana SCUDDER, Proc. Amer. Acad. Arts. Sci., XXXIII, pp. 274, 276, 280, f. 5 (1898).

Scudderia farculata BRUNNER, Mon. Phaneropt., pp. 238, 239, Pl. 5, fig. 72*b* (1878); SAUSSURE & PICTET, Biol. Cent.-Amer., Orth., I, pp. 328, 329, 331, Pl. 15, fig. 21 (1897).

Habitat.—This insect is represented by material coming from the Island of Jamaica.

There are also specimens of *Scudderia furcata* in the collection. These latter bear no locality labels. They are very likely from some point in Pennsylvania, or nearby.

Genus SYMMETROPLEURA Brunner.

Symmetropleura BRUNNER, Mon. Phaneropt., pp. 25, 245 (1878); *Ib.*, Addit. Mon. Phaneropt., p. 16 (1891).

The genus *Symmetropleura* of Brunner is found in both hemispheres, but seems most characteristic of the Occident. Five species have been described heretofore. The collection now being studied by me contains specimens of what appear to be two more. The American forms can be separated as follows:

SYNOPSIS OF THE AMERICAN SPECIES OF SYMMETROPLEURA.

A. Elytra narrower (6 mm.), their posterior margin straight. [North America.] *modesta* Brunner.

AA. Elytra broader (10 mm. or more), their posterior margin rounded [South America].

- *b*. Tegmina with the anterior border of the basal part black margined. *lævicauda* Brunner.
- *bb*. Tegmina with the anterior border concolorous.
  - *c*. Posterior fork of branch of the hind radial confluent with the posterior ulnar vein.
    - *d*. Subgenital plate of the male abdomen rather short, truncate at its apex and with the hind angles lengthily produced, style-like [Ecuador] . . . . *fausta* Giglio-Tos.
    - *dd*. Subgenital plate of the male abdomen somewhat longer, the apex roundly emarginate, the angles produced into very heavy blunt, clubbed, finger-like projections [Bolivia] . . . *boliviana* sp. nov.
  - *cc*. Posterior fork of the branch of the hind radial not confluent with the posterior ulnar, although sometimes it may be joined to it by an oblique cross-vein [Bolivia] . . . . *abnormis* sp. nov.

13. **Symmetropleura boliviana** sp. nov.

Related to *S. fausta* Giglio-Tos from Ecuador. The main differences between this new form and the insect to which compared are in the male genitalia.

Size medium, color grass-green. Fastigium of the vertex strongly depressed in front, shallowly sulcate, the apex blunt and widely separated from the fastigium of the front. Pronotum with its disc strongly flattened and longitudinally sulcate at middle, the lateral carinæ acute, rather evenly convergent anteriorly, the front margin broadly and roundly emarginate, the hind margin evenly rounded; lateral lobes as described in *fausta*. Tegmina evenly rounded both in front and behind, the posterior ulnar vein straight and united with the upper fork of the branch of the radial which runs out at the apex, the junction of the posterior oblique veins and the ulnar nodulose, pale; branch of the posterior radial originating near its middle, itself forking near its basal fourth. Anterior and middle legs graceful, rather numerously spined beneath; the tibiæ sulcate and spined above. Hind femora spined below on both margins. Mesosternal lobes angulate behind, those of the metasternum rounded. Subgenital plate of male with the sides rather strongly convergent, the apex roundly emarginate between two robust finger- or club-like continuations of the lateral angles. Cerci moderately robust at base, strongly bowed and tapering, the apical portion provided with two or three small piceous spines or teeth.

Length of body, 23 mm., of pronotum, 5.5 mm., of tegmina, 38 mm., width of tegmina, 12.5 mm., length of hind femora, 26.5 mm.

Habitat.—The only specimen in color, a male and the type, comes from "Quatro Ojos, Department of Santa Cruz, Bolivia," where it was taken at an elevation of 300 meters above sea-level by J. Steinbach. It is in the Carnegie Museum.

A second specimen, also a male, is at hand. While not typical, it has nearly the same dimensions, but approaches the next species in the characters of the venation. It is apparently faded from immersion in spirits. The locality-label for this specimen is "Prov. del Sara, Bolivia, 350 m. J. Steinbach, 11–1913."

14. **Symmetropleura abnormis** sp. nov.

As indicated in the synopsis of species above, the present insect is abnormal in the venation of the tegmina. Otherwise it is quite similar to both *fausta* and *boliviana*.

General color yellowish green, becoming testaceous on the head, legs, and lower side of body. Antenna infuscated apically, though with a magnifier showing minute pallid annulations. Subanal plate of abdomen of male similar to that of the above described form, but relatively smaller and with the prolongations of its lateral angles slenderer. Ovipositor short, strongly curved, both margins towards the apex minutely crenulate or serrate.

Length of body, ♂, 19 mm., ♀, 23 mm., of pronotum, ♂ and ♀, 5 mm., of tegmina, ♂, 33.5 mm., ♀, 38 mm.; width of tegmina, ♂, 11 mm., ♀, 12 mm.; length of hind femora, ♂, 23.5 mm., ♀, 27 mm.; of ovipositor, 5.5 mm.

Habitat.—1♂, 1♀, the types, both from the "Prov. del Sara, Bolivia, 350 m., J. Steinbach, 11–1913." These insects belong to the Carnegie Museum.

Genus LIGOCATINUS Rehn.

Ligocatinus REHN, Can. Ent., XXXIII, p. 272 (1901); KIRBY, Syn. Cat. Orth., II, p. 449 (1906).

Amaura BRUNNER (*nec* Moll.) Mon. Phaneropt., pp. 25, 247 (1878); *Ib.*, Verh. Zool.-bot. Ges. Wien, XLI, pp. 17, 122 (1891); SAUSS. &. PICT., Biol. Cent.-Amer., Orth., I, p. 321 (1897).

The representatives of the genus *Ligocatinus* are few in number, but have a rather wide distribution, species occurring from Mexico to Central Argentina.

15. **Ligocatinus spinatus** (Brunner)?

Amaura spinata BRUNNER, Mon. Phaneropt., p. 248, pl. 5, fig. 74 *a*, *b* (1878); *Ib.*, Addit. Mon. Phaneropt., p. 122 (1891); SAUSS. & PICT., Biol. Cent.-Amer., Orth., I, p. 322 (1897).

Ligocatinus spinatus KIRBY, Syn. Cat. Orth., II, p. 449 (1906).

Habitat.—Specimens of both sexes of what I take to be *L. spinatus* Brunner are at hand. They come from Corumbá, Brazil, (H. H. Smith), Puerto Suarez, and Province del Sara, Bolivia (J. Steinbach).

Genus HOMOTOICHA Brunner.

Homotoicha BRUNNER, Verh. Zool.-bot. Ges. Wien, XLI, pp. 17, 124 (1891).

This genus is rather closely related to the preceding, and contains five recognized forms. They are all South American in their distribution.

16. **Homotoicha fuscopunctata** Caudell.

Homotoicha fuscopunctata CAUDELL, Proc. U. S. Nat. Mus., XXX, p. 236 (1906).

Habitat.—There are a number of specimens of both sexes at hand. They were taken at Chapada, Brazil (H. H. Smith) and Santa Cruz de la Sierra, Bolivia (J. Steinbach).

Although the series examined varies a little in size, they agree well with a type specimen which is in the writer's collection.

Genus THEUDORIA Stål.

Theudoria STÅL, Recens. Orth., II, p. 15 (1874); BRUNNER, Mon. Phaneropt., pp. 25, 249 (1878); *Ib.*, Addit. Mon. Phaneropt., pp. 17, 126 (1891).

This genus is confined to South America, and contains but few representatives.

17. **Theudoria pyrrhocnemis** Brunner?

Theudoria pyrrhocnemis BRUNNER, Mcn. Phaneropt., p. 250 (1878); *Ib.*, Addit. Mon. Phaneropt., p. 126 (1891).

Habitat.—A single male specimen of the genus *Theudoria* is referred with some doubt to Brunner's *pyrrhocnemis*. It bears the locality label "Chapada, Brazil (H. H. Smith)."

Genus PARASCUDDERIA Brunner.

Parascudderia BRUNNER, Addit. Mon. Phaneropt., pp. 18, 126 (1891).

The genus *Parascudderia* was created for a species of katydid coming from Fonteboa on the Upper Amazon, only the female of which was described. There is before me in the present collection a single male specimen, which runs to the genus in the synoptic table by a number of characters. It may be the opposite sex of Brunner's *dohrni*, but it is difficult to believe this, because it differs from Brunner's description in several respects. The following characterization of the specimen is offered.

18. **Parascudderia abnormalis** sp. nov.

General color sordid olivaceous, the secondary veins quite regular, sanguineous. Pronotum smooth, the disc somewhat convex, somewhat similar to that in *Ceraia*. Head medium or small, the occiput smooth, rounded; eyes globular, prominent; fastigium of the vertex somewhat flattened, gently depressed, blunt, and not touching the fastigium of the front. Pronotum with the lateral lobes roundly inserted, higher than long, anterior margin of the disc nearly straight, the hind margin broadly rounded. Tegmina translucent, rather scantily veined, the longitudinal veins greenish and testaceous, the cross-veins sanguineous, the minor veinlets pallid. Exposed portion of wings sordid olive, the remainder hyaline. Anterior femora below spineless, intermediate one-spined externally and hind pair many-spined on both margins. Anterior tibiæ sulcate and provided externally above, just beyond the foramina, with a minute spine; middle tibiæ also spined above. Last dorsal segment of abdomen of male rather large, on each side tumid; the supra-anal plate, or what seems to be a modification of it, divided above the bases of the cerci, into two widely separated long sickle-like appendages which are nearly twice as long as the cerci and somewhat flattened and smooth; the cerci moderately robust at base, bowed, tapering, and ending in a dusky inwardly directed tooth. Subgenital plate elongate, attenuate, curved upward and truncate at its apex, the lateral angles provided with short, blunt, free styles.

Occiput and pronotum above dark brunneo-ferruginous, almost castaneous, the latter infuscated just above the humeral sinus, the disc of the lower portion of the lateral lobes marked with a large pallid area. Face, legs, and body below, testaceous.

Length of body, ♂, 20 mm., of pronotum, 5 mm., of tegmina, 31 mm., greatest width of same, 6.5 mm., length of hind femora, 21.5 mm.

Habitat.—Chapada, Brazil, in April (H. H. Smith). The type is in the Carnegie Museum.

Genus CERAIA Brunner.

Ceraia BRUNNER, Addit. Mon. Phaneropt., pp. 18, 127 (1891).

The present genus has been separated from the old *Scudderia* to accommodate several moderately large insects with the apex of ovipositor blunt or rounded. The described forms are in their distribution tropical American. At least a dozen species have been recognized.

19. **Ceraia punctulata** Brunner?

Scudderia punctulata BRUNNER, Mon. Phaneropt,. pp. 238, 243 (1878).
Ceraia punctulata BRUNNER, Addit. Mon. Phaneropt., pp. 128, 129 (1891).

Specimens coming from Chapada, Brazil, and Santa Cruz de la Sierra, Bolivia, are referred here with some doubt owing to a few slight differences from the description. The Bolivian specimens were taken by J. Steinbach, the Brazilian by H. H. Smith.

20. **Ceraia cornutoides** Caudell.

Ceraia cornutoides Caudell, Proc. U. S. Nat. Mus., XXX, p. 237 (1906).

The present species is represented by specimens coming from Corumbá and Chapada, Brazil (H. H. Smith) and Puerto Suarez, Bolivia (either J. D. Haseman, or J. Steinbach).

21. **Ceraia atrosignata** Brunner?

Ceraia atrosignata BRUNNER, Addit. Mon. Phaneropt., pp. 128, 130 (1891).

A single female specimen of the genus *Ceraia* is referred with a little doubt to Brunner's *atrosignata*. It was taken at "Las Juntas, Dept. Sta. Cruz, Bolivia," by J. Steinbach.

Genus VELLEA Walker.

Vellea WALKER, Cat. Derm. Salt. B. M., II, p. 359 (1869); KIRBY, Syn. Cat. Orth., II, p. 451 (1906).

Only a single species of this genus has been thus far recognized from South America. The present writer had, at one time, a couple of nymphs bearing the locality label "Central America." Whether or not they belonged to another species I cannot say. These insects are now in the collection of Morgan Hebard, Philadelphia, Pennsylvania.

22. **Vellea cruenta** Burmeister.

Phaneroptera cruenta BURMEISTER, Handb. Ent., II, p. 691 (1838).
Scudderia cruenta BRUNNER, Mon. Phaneropt., pp. 238, 244 (1878).
Ceraia cruenta BRUNNER, Addit. Mon. Phaneropt., pp. 128, 131 (1891).
Vellea rosea WALKER, Cat. Derm. Salt. B. M., II, p. 360 (1869).

A specimen is at hand from Rio de Janeiro, while another comes from Bonda, Dept. Magdalena, Colombia (H. H. Smith).

Genus ECTEMNA Brunner.

Ectemna BRUNNER, Mon. Phaneropt., pp. 26, 251 (1878); *Ib.*, Addit. Mon. Phaneropt., p. 18 (1891); SAUSS. & PICT., Biol. Cent.-Amer., Orth., I, p. 323 (1897).

Another small genus of tropical American katydids, the insects comprised in which are related to *Scudderia*, *Ceraia*, etc.

23. **Ectemna carinata** Brunner?

Ectemna carinata BRUNNER, Mon. Phaneropt., p. 251, Pl. 5, fig. 76 *a–c* (1878); SAUSS. & PICT., Biol. Cent.-Amer. Orth., I, pp. 323, 324 (1897).

Habitat.—A single male katydid from Rio de Janeiro is referred here with some doubt. It was taken by H. H. Smith.

Genus PARABLETA Brunner.

Parableta BRUNNER, Mon. Phaneropt. pp. 26, 253 (1878); Addit. Mon. Phaneropt., pp. 18, 133 (1891).

This genus is confined to South America, where the known species are all tropical in their distribution. Two species have been described heretofore, while a third is now added. They may be separated as follows:

SYNOPSIS OF THE SPECIES OF PARABLETA.

A. Posterior femora seven- to nine-spined on the internal margin. Ovipositor with the margins entire, smooth, the apex somewhat obtuse.
- *b.* Size larger (♂ tegmina 38 mm., ♀, 41 mm.) [Bolivia]. . .*boliviana* sp. nov.
- *bb.* Size smaller (♂ tegmina 33 mm., ♀, 33 mm.) [Ecuador]. *integricauda* Brunner.

AA. Posterior femora four- to five-spined on the internal margin. Ovipositor obtuse, the apex crenulate on both margins [Upper Amazon, Brazil].
soror Brunner.

24. **Parableta boliviana** sp. nov.

Related to *integricauda* of Brunner, from which it differs in its larger size.

Pale green, the eyes dark ferruginous, or brown. Fastigium of the vertex depressed, the apex subacute, sulcate, touching the fastigium of the front. Pronotum with the disc very slightly convex, its front margin shallowly and roundly emarginate, the hind margin evenly rounded; lateral lobes angulately inserted, perpendicular, higher than long, in front straight, below and behind evenly rounded. Tegmina scarcely subpellucid, though not opaque; the posterior fork of the branch of the hind radial approaching quite closely to the ulnar, to which it is joined by a short transverse veinlet. There are three infuscated spots located along the ulnar vein at the points where it emits branches and where it is joined with the fork of the posterior radial branch. Anterior and middle femora four- to five-spined below, hind pair seven- to nine-spined on both margins; anterior and middle tibiæ one- to three-spined above. Last ventral abdominal segment moderately large, tapering but little, the sides carinated, fissured almost to the base, the styles elongate. Cerci similar to those in *integricauda*. Ovipositor smooth, subacuminate; the subgenital plate short, triangular, the middle carinated, the apex entire, blunt.

Length of body, ♂, 17 mm., ♀, 25 mm.; of pronotum, ♂ and ♀, 6 mm.; of tegmina, ♂, 38 mm., ♀, 41 mm.; width of same, ♂, 10 mm., ♀, 11 mm.; length of hind femora, ♂, 23 mm., ♀, 24 mm.; of ovipositor, 10 mm.

Habitat.—There are specimens at hand from "Province del Sara," and Quatro Ojos and Las Juntas, Department of Santa Cruz, Bolivia. The types, ♂ and ♀, are from the first named locality. They were taken during December. All the specimens were taken by J. Steinbach. The types are in the Carnegie Museum.

25. **Parableta soror** Brunner?

Porableta soror BRUNNER, Addit. Mon. Phaneropt., p. 134 (1891).

A single male katydid bearing the labels "Corumbá, high land," and "April" is referred doubtfully to this species. It was taken by H. H. Smith.

Genus SCAPHURA Kirby.

Scaphura KIRBY, Zoöl. Journ. I, p. 432 (1825); II, p. 9 (1825); WESTWOOD, Zoöl. Journ. IV, p. 227 (1828); SERVILLE, Encl. Méth., Ins. X, p. 345 (1825)—and many others, see Kirby, Syn. Cat. Orth. II, p. 453 (1906).

Aganacris WALKER, Cat. Derm. Salt. B. M., V, suppl. p. 41 (1871).

Representatives of the genus *Scaphura* are confined to South American countries south of the equator, where they are most abundant in middle and southern Brazil.

26. **Scaphura nigra** (Thunberg).

Gryllus niger THUNBERG, Mém. Acad. Petersb. IX, p. 415 (1824).

Scaphura nigra STÅL, Recens, Orth., II, p. 15 (1874), for synonymy see KIRBY, Syn. Cat. Orth. II, p. 454 (1906).

Habitat.—Specimens are at hand from Rio de Janeiro and Chapada, Brazil, from Puerto Suarez and the Province del Sara, Bolivia, and from Rio Bermejo, Prov. of Salta, Argentina.

At least six varieties of this interesting species have been recognized and described.

Genus GYMNOCERA Brullé.

Gymnocera BRULLÉ, Hist. Nat. Ins., IX, p. 145 (1835); BURMEISTER, Handb. Ent., II, p. 687 (1838); SERVILLE, Ins. Orth., p. 425 (1839); BLANCHARD, Hist. Nat. Ins., III, p. 24 (1840); KIRBY, Syn. Cat. Orth., II, p. 454 (1906).

Scaphura PERCHERON (*nec* Kirby) Gen. Ins. Orth., pl. 4 (1836).

The present genus is related to *Scaphura* in so far as its members are varicolored, but the basal portion of their antennæ lacks the hairs which are so prominent on the basal antennal joints in the representatives of that genus.

27. **Gymnocera elegans** Serville.

Gymnocera elegans SERVILLE, Hist. Ins. Orth., p. 427 (1839); KIRBY, Syn. Cat. Orth., II, p. 455 (1906).

Scaphura elegans BRUNNER, Mon. Phaneropt., pp. 256, 258, Pl. 5, fig. 79 *a–c* (1878).

Var. *Scaphura bicolor* BLANCHARD, D'Orbigny, Voy. Amer. Merid. VI, (2), p. 215, pl. 26, f. 7 (1844).

Habitat.—Several specimens, male and female, coming from Puerto Suarez, Bolivia, seem to belong here. They were taken by J. D. Haseman.

28. **Gymnocera fasciata** (Brunner)?

Scaphura fasciata BRUNNER, Mon. Phaneropt., pp. 257, 260 (1878).

Gymnocera fasciata KIRBY, Syn. Cat. Orth., II, p. 455 (1906).

Habitat.—A single imperfect female specimen coming from Rio de Janeiro has been referred here.

29. **Gymnocera infuscata** (Brunner).

Scaphura infuscata BRUNNER, Mon. Phaneropt., pp. 257, 262 (1878).
Gymnocera infuscata KIRBY, Syn. Cat. Orth., II, p. 455 (1906).

Habitat.—Specimens are before me coming from Corumbá, Brazil, Puerto Suarez, Bolivia, and Rio Bermejo, Province of Salta, Argentina. These latter specimens are much smaller than the typical form, and have much narrower tegmina than Brunner mentions in his description. Otherwise the description fits fairly well.

Genus MICROCENTRUM Scudder.

Microcentrum SCUDDER, Bost. Journ. Nat. Hist., VII, p. 446 (1862) (*nec* Stål); KIRBY, Syn. Cat. Orth., II, p. 455 (1906).
Stilpnochlora Stål, Œfv. Vet.-Akad. Förh. XXX (4), p. 40 (1873); *Ib.*, Recens. Orth., II, p. 19 (1874); BRUNNER, Mon. Phaneropt. pp. 32, 358 (1878); *Ib.*, Addit. Mon. Phaneropt., p. 18 (1891); SAUSSURE & PICTET, Biol. Cent. Amer., Orth., II. p. 367 (1898).

As indicated by the above synonomy there seems to have been some confusion concerning the large insects which comprise the present genus. At least seven species are recognized by recent writers.

30. **Microcentrum marginellum** (Serville).

Phylloptera marginella SERVILLE, Ins. Orth., p. 405 (1839).
Microcentrum marginellum KIRBY, Syn. Cat. Orth., II, p. 455 (1906). For a rather full synonymy of this insect see Kirby, *l. c.*

Habitat.—This insect is credited to Central and South America as well as to several of the West Indian islands. Specimens in the present collection come from Rio de Janeiro, Brazil, and the Isle of Pines, West Indies.

31. **Microcentrum incisum** (Brunner).

Stilpnochlora incisa BRUNNER, Mon. Phaneropt., pp. 359, 361 (1878); SAUSSURE & PICTET, Biol. Cent.-Amer., Orth., I, pp. 368, 369 (1898).
Microcentrum incisum KIRBY, Syn. Cat. Orth., II, p. 456 (1906).

Habitat.—Although this insect is credited to Peru a male specimen in the collection now under consideration comes from the Province del Sara, Bolivia, where it was collected by J. Steinbach.

Genus PEUCESTES Stål.

Peucestes STÅL, Recens. Orth., II, p. 20 (1874); BRUNNER, Mon. Phaneropt., pp. 32 363 (1878); *Ib.*, Addit. Mon. Phaneropt., pp. 18, 181 (1891); SAUSSURE & PICTET, Biol. Cent.-Amer., Orth., I, p. 370 (1898).

The genus *Peucestes* Stål is tropical and subtropical American in its distribution, and is made up of large showy insects. Eight species are known.

32. **Peucestes dentatus** Stål.

Peucestes dentatus STÅL, Recens. Orth., II, p. 45 (1874); BRUNNER, Mon. Phaneropt., pp. 364, 365 (1878); SAUSS. & PICT., Biol. Cent.-Amer., Orth., I, pp. 370, 371, Pl. 18, figs. 3–5 (1898).

Phaneroptera citrifolia BLANCHARD (*nec* Linnaeus), Hist. Ins., III, p. 24, Pl. 7 (1840).

Habitat.—There are two specimens of this species in the collection, a male and female. The former comes from Villa Bella, Bolivia, and the latter from El Calloa, Venezuela. Both specimens are quite typical.

33. **Peucestes unidentatus** Brunner.

Peucestes unidentatus BRUNNER, Addit. Mon. Phaneropt., pp. 182, 183 (1891).

Habitat.—A single female specimen bearing the locality label "Santa Cruz de la Sierra, Bolivia," is referred here. It was probably taken by J. Steinbach.

34. **Peucestes striolatus** Brunner.

Peucestes striolatus BRUNNER, Mon. Phaneropt., pp. 365, 366 (1878); BOLIVAR, Viaje al Pacifico, Ins., p. 58 (1884); SAUSSURE & PICTET, Biol. Cent.-Amer., Orth., I, pp. 370, 372 (1898).

Habitat.—There are in the collection two specimens of this interesting katydid from eastern Bolivia.

Genus POSIDIPPUS Stål.

Posidippus STÅL, Recens. Orth., II, p. 20 (1874); BRUNNER, Mon. Phaneropt., pp. 32, 36 (1878); *Ib.*, Addit. Mon. Phaneropt., pp. 19, 183 (1891); KIRBY, Syn. Cat. Orth., II, p. 453 (1906).

Frontinus STÅL, Recens. Orth., II, p. 20 (1874).

The insects which comprise the genus *Posidippus* Stål are all rather large and showy. They are tropical American and with a single exception are confined to South America. Including the species described herewith, there are an even dozen known to science.

35. **Posidippus flavolineatus** sp. nov.

Related to *P. stali* and *P. lineatus* and in size about midway between them. The costa, humeral angle, and posterior margin of the tegmina are flavous.

Front rounded, the fastigium of the front bituberculate, the margins of these tubercles crenulate, touching the fastigium of the vertex, which also terminates in two smaller tubercles, sulcate. Pronotum widely, shallowly, and roundly emarginate in front, without a median denticle; carinæ multidentate, somewhat arcuate. Anterior femora below on the front margin three-spined, middle four-spined, the hind pair ten- to twelve-spined externally, eight-spined internally; intermediate tibiæ above externally four-spined, behind or internally five-spined.

Length of body, ♂, 38 mm., ♀, 40 mm.; of pronotum, ♂, 9.75 mm., ♀, 10.5 mm.; width of pronotum, ♂, 8 mm., ♀, 8.85 mm.; length of tegmina, ♂, 59 mm., ♀, 67 mm.; width of tegmina, ♂, 19 mm., ♀, 21 mm.; length of hind femora, ♂, 31 mm., ♀, 35 mm.; of ovipositor, 5.5 mm.

Habitat.—There is a large series of this insect in the collection. They come from Chapada and Corumbá, Brazil, where they were taken during June, July, and August by H. H. Smith. The types belong to the Carnegie Museum.

36. **Posidippus fastigiosus** Brunner.

Posidippus fastigiosus BRUNNER, Mon. Phaneropt., pp. 368, 370 (1878); *Ib.*, Addit. Mon. Phaneropt., p. 184 (1891); KIRBY, Syn. Cat. Orth., II, p. 459 (1906).

Habitat.—A single male coming from the Province del Sara, Bolivia, belongs here. It was taken by J. Steinbach.

Genus STEIRODONOPSIS Scudder.

Steirodonopsis SCUDDER, Proc. Bost. Soc. Nat. Hist., XVII, p. 259 (1875); KIRBY, Syn. Cat. Orth. Brit. Mus., II, p. 458 (1906).

The present genus was established for an insect coming from the Peruvian Marañon. A second species is now added, based also on a single male specimen from Bolivia.

SYNOPSIS OF THE SPECIES OF STEIRODONOPSIS.

A. Size larger (male, with tegmina 46 mm. long). Occiput and pronotum with a median longitudinal pink or reddish line .... *bilobata* Scudder.

AA. Size smaller (male, with the tegmina 40 mm. long). Occiput and pronotum without a differently colored median longitudinal line..... *scudderi* sp. nov.

37. **Steirodonopsis scudderi** sp. nov.

In many respects like *S. bilobata*, but decidedly smaller.

Head short and rather broad, the occiput smooth and bulging fastigium of the vertex rather prominent, but short, depressed, sulcate, tapering anteriorly, the two sides terminating in rounded tubercles, touching the two much larger, widely rounded, and elevated tubercles of the fastigium of the front; eyes large, globular, widely separated. Pronotum flat above, or even a little concave, its lateral carinæ prominent, crenulate; anterior margin roundly emarginate, behind rounded; lateral lobes about as long as high. Tegmina coriaceous, smooth. Hind femora compressed, not robust, hind and intermediate tibiæ compressed and rather strongly dilated basally. Anterior tibiæ with the auditory opening on the front side sub-linear, behind wide open. Subgenital plate rather small and tapering, tricarinate, the middle keel sharp, the lateral ones heavy and blunt, apex truncate, the styles short, conical; cerci heavy at their base, evenly tapering, bowed upwards, the apex terminating in a piceous tooth, or hook.

General color yellowish green, the lower side and limbs paler. Tubercles of the front and upper margin of the lateral lobes of the pronotum, base of anterior and middle tibiæ and tips of their femora lavender-tinted, two basal antennal joints and eyes ferruginous; pronotal carinæ, shoulders, basal portion of costal border, and posterior radial vein of tegmina testaceous. There are also scattered over the tegmina a number of small, inconspicuous, raised papillæ, which are likewise testaceous.

Length of body, ♂, 24 mm., of pronotum, 6.5 mm., width, 5.5 mm., length of tegmina, 40 mm., width, 12 mm., length of hind femora, 18 mm.

Habitat.—The only specimen available, the type, comes from the Province del Sara, Bolivia, where it was taken by J. Steinbach during December at an elevation above sea-level of 350 meters. It is the property of the Carnegie Museum.

Genus ANAULACOMERA Stål.

Anaulacomera STÅL, Vet.-Akad. Förh. XXX, (4) pp. 41, 43 (1873); *Ib.*, Recens. Orth., II, pp. 16, 35 (1874); BRUNNER, Mon. Phaneropt., pp. 27, 277 (1878); *Ib.*, Addit. Mon. Phaneropt., pp. 20, 140 (1891); SAUSS. & PICT., Biol. Cent.-Amer., Orth. I, p. 340 (1897).

Œcella KIRBY, Journ. Linn. Soc. Lond., Zool. XX, p. 535 (1890).

The present genus without doubt is the most extensive of the family Phaneropteridæ. Most of its representatives are tropical South American and seem to be well represented in the present collections. Only a portion of the specimens at hand have been studied with the following result: *i. e.*, ten of the described forms have been determined provisionally, and three others have been set aside as possibly representing new species.

38. **Anaulacomera brevicauda** Brunner?

Anaulacomera brevicauda BRUNNER, Addit. Mon. Phaneropt., pp. 140, 144 (1891); KIRBY, Syn. Cat. Orth., II, p. 466 (1906).

Habitat.—A large series of an insect which appears to be this species is at hand. Both sexes are represented. They were taken at Chapada, Brazil. (H. H. Smith).

39. **Anaulacomera intermedia** Brunner.

Anaulacomera intermedia BRUNNER, Mon. Phaneropt., pp. 278, 283 (1878); *Ib.*, Addit. Mon. Phaneropt., p. 140 (1891); KIRBY, Syn. Cat. Orth., II, p. 466 (1906).

Habitat.—A male *Anaulacomera* coming from Rio de Janeiro, Brazil, is referred to Brunner's *intermedia.* It was also taken by H. H. Smith.

40. **Anaulacomera nodulosa** Stål.

Anaulacomera nodulosa STÅL, Vet.-Akad. Förh. XXX (4) p. 43 (1873); *Ib.*, Recens. Orth. II, p. 35 (1874); BRUNNER, Mon. Phanercpt., pp. 279, 291 (1878); *Ib.*, Addit. Mon. Phaneropt., p. 141 (1891).

Habitat.—A female specimen which agrees with Stål's *nodulosa* is among the material collected by H. H. Smith at Chapada.

41. **Anaulacomera unicolor** Brunner?

Anaulacomera unicolor BRUNNER, Addit. Mon. Phaneropt., pp. 142, 147 (1891); KIRBY, Syn. Cat. Orth., II, p. 467 (1906).

Habitat.—Among the material taken at Benevides, Brazil, is a female specimen which is doubtfully referred to Brunner's *unicolor.* It was taken by H. H. Smith.

42. **Anaulacomera chelata** Brunner.

Anaulacomera chelata BRUNNER, Mon. Phaneropt., pp. 280, 293 (1878); *Ib.*, Addit. Mon. Phaneropt., p. 143 (1891); KIRBY, Syn. Cat. Orth., II, p. 467 (1906).

Habitat.—Both sexes of the present species are before me. They were collected at Rio de Janeiro, Brazil, by H. H. Smith.

43. **Anaulacomera cornucervi** Brunner.

Anaulacomera cornucervi BRUNNER, Mon. Phaneropt., pp. 279, 290 (1878); *Ib.* Addit. Mon. Phaneropt, p. 143 (1891); KIRBY, Syn. Cat. Orth., II, p. 468 (1906)

Habitat.—A couple of specimens, male and female, from Santa Cruz de la Sierra, Bolivia, are referred here. They were taken by J. Steinbach.

44. **Anaulacomera dama** Rehn.

Anaulacomera dama REHN, Proc. Acad. Nat. Sci. Phila., 1913, p. 369, figs. 31, 32.

Habitat.—A female specimen coming from the "Province del Sara, Bolivia," is referred to Rehn's *A. dama.* It was taken by J. Steinbach during the month of October, 1913, at an elevation of 350 meters above sea-level.

45. **Anaulacomera inversa** Brunner.

Anaulacomera inversa BRUNNER, Mon. Phaneropt., pp. 278, 284 (1878); *Ib.*, Addit. Mon. Phaneropt., p 143 (1891).

Habitat.—There is a male specimen of the genus *Anaulacomera* at hand which seems to be *A. inversa* Brunner. It was taken by H. H. Smith at either Chapada, or Rio de Janeiro, Brazil.

46. **Anaulacomera biramosa** Brunner?

Anaulacomera biramosa BRUNNER, Addit. Mon. Phaneropt., pp. 143, 148 (1891); KIRBY, Syn. Cat. Orth., II, p. 468 (1906).

Habitat.—A male specimen of still another species of the genus *Anaulacomera* is referred doubtfully to *biramosa* Brunner. It comes from Rio de Janeiro, Brazil, where it was collected by H. H. Smith.

47. **Anaulacomera sulcata** Brunner?

Anaulacomera sulcata BRUNNER, Mon. Phaneropt., pp. 279, 289 (1878); *Ib.*, Addit. Mon. Phaneropt., p. 143 (1891).

Habitat.—Male and female specimens of an *Anaulacomera* from Rio de Janeiro, Brazil, seem to fit the description of *sulcata* Brunner, better than any other of the tabulated species. (H. H. Smith, collector.)

Genus GRAMMADERA Brunner.

The genus *Grammadera* is composed of medium-sized insects, all of which are confined to tropical and sub-tropical South America, where they are distributed from the Guianas and Ecuador to Buenos Aires, Argentina. Their center of abundance, however, seems to be southern Brazil. Altogether ten species have been recognized. Three of these are herewith described as new.

48. **Grammadera albida** Brunner?

Grammadera albida BRUNNER, Mon. der Phaneropt., p. 298 (1878); REHN, Proc. Acad. Nat. Sci. Phila., 1907, p. 377.

Specimens which I am inclined to regard as Brunner's species *albida*, though doubtfully, bear the labels "Chapada, Brazil," (H. H. Smith) and "Province del Sara, 350 meters, Bolivia" (J. Steinbach). The species has been recorded heretofore from Misiones, Argentina, and Sapucay, Paraguay, by Rehn, and simply "Brazil" by Brunner.

49. **Grammadera chapadensis** sp. nov.

Somewhat closely related to *albida* Brunner and *rostrata* Rehn, but a little larger than both of them. The chief characteristics seem to be in the structure of the supra-anal plate, which in this species has the vertical compressed apical portion very large, smooth, and formed like the blade of a broad hatchet, which when viewed laterally gives the impression of a short ovipositor instead of a male appendage. The male cerci are much as described for this sex of *albida*, as is also the subgenital plate. The venation is similar to that of *rostrata* as figured by Rehn (Proc. Acad. Nat. Sci. Philad., 1907, p. 378), while the ovipositor is slightly more falcate and somewhat tapering instead of noticeably broadened at the apical third.

The general color of this insect is pale grass-green with a moderately large, circular, sub-basal, dark brown maculation on the external area of the stridulating field of each elytron of the male, and a narrow, more or less strongly infuscated edge, on the dorsal margin in both sexes.

Length of body, ♂ and ♀, 20 mm.; of pronotum, ♂, 4.1 mm., ♀, 4.5 mm.; of tegmina, ♂, 31 mm.; ♀, 33 mm., width of tegmina ♂ and ♀, 7 mm.; length of hind femora, ♂, 18 mm., ♀, 19.5 mm.

Habitat.—A number of specimens are at hand from Chapada, near Cuyabá, Matto-Grosso, Brazil. Types are in the Carnegie Museum. There are no variations in the form of the apical portion of the supra-anal plate in the ten or a dozen males examined, nor in the ovipositors of the seven females at hand.

50. **Grammadera clara** Brunner?

Grammadera clara BRUNNER, Mon. der Phaneropt., p. 298 (1878).

A male specimen of the genus *Grammadera* coming from Corumbá, Brazil, is referred here with some doubt. It was taken by H. H. Smith.

51. **Grammadera janeirensis** sp. nov.

Related to both *pellucida* Giglio-Tos and *forcipata*, so far as the structure of the male genitalia are concerned, but having the elongate fastigium of the vertex of *hastata* Brunner. Like both *pellucida* and *forcipata* this insect has the sulcate pronotum.

Moderately robust, body compressed; head small, depressed, the fastigium of the vertex prominent, projecting beyond the front, its sides parallel, in the male plane, in the female broadly and shallowly sulcate. Pronotum smooth, the disc ridged in center anteriorly, becoming flat posteriorly, where it is depressed, so that when viewed laterally it appears somewhat arcuate, the middle provided with a longitudinal depressed line. Tegmina coriaceous, the veining a little irregular, the hind margins evenly rounded. Anterior and middle femora four-spined below; hind femora three-spined on exterior margin. Supra-anal plate of male triangular, rather plain, cerci as in *forcipata*. subgenital plate moderately long, tapering, tectate, and carinated below, the apical third slender, deeply fissured, the parts finger-like, Ovipositor somewhat sickle-shaped, widest beyond its middle, acuminate, its lower margin somewhat crenulate on apical half; subgenital plate tapering rather deeply, and angulately emarginate.

General color chrome-green. Front whitish, pronotum, legs, and lower side somewhat testaceous. Stridulating area of male tegmina embrowned basally and centrally.

Length of body, ♂, 16 mm., ♀, 19 mm.; of pronotum, ♂ and ♀, 5 mm.; of tegmina, ♂, 25 mm., ♀, 28 mm.; width of tegmina, ♂, 6.5 mm., ♀, 7.25 mm.; length of hind femora, ♂, 14.5 mm., ♀, 15.5 mm.; of ovipositor, ♀, 9.5 mm.

Habitat.—The types and only specimens at hand are labeled "Rio de Janeiro, Oct." and were taken by H. H. Smith. They are the property of the Carnegie Museum.

52. **Grammadera steinbachi** sp. nov.

A third apparently new form is before me. It belongs to the same section of the genus and is quite closely related to the preceding as well as to *albida* and possibly also to *rostrata*. It, like *chapadensis*, has quite a distinct structure of the vertical apical portion of the supra-anal plate. In the present form it is scarcely a hatchet-blade, but is rounded from above, has the lower side deeply and widely emarginate, followed by a long slender tooth which is directed downwards. On the upper side and just at the base of the vertical portion is located a prominent tooth with its apex directed anteriorly. Cerci and subgenital plate very similar to that of *albida*. Ovipositor as figured for *rostrata* Rehn. General color much as in *chapadensis*, but a little paler.

Length of body, ♂, 21 mm., ♀, 22 mm.; of pronotum, ♂, 3.85 mm., ♀, 4.15 mm.; of tegmina, ♂, 29 mm., ♀, 31 mm.; width of tegmina, ♂, ♀, 6.5 mm.; length of hind femora, ♂, 18.5 mm., ♀, 19.5 mm., of ovipositor, ♀, 13.5 mm.

Habitat.—The types male and female, come from Puerto Suarez, Bolivia, where they were taken by J. Steinbach during the months of November to January. They are in the Carnegie Museum.

Other individuals are also at hand from the same locality. The male genitalia are the same in all the specimens, as is likewise the ovipositor in the various females at hand.

Genus TOMEOPHORA Brunner.

Tomeophora BRUNNER, Mon. Phaneropt., pp. 28, 299 (1878).

This genus of katydids is entirely confined to South America, where the known species seem to be more or less restricted in their distribution. Judging from their peculiar tegminal venation I surmise that they are either found among bamboos, or infest grass rather than arboreal and herbaceous vegetation. Three species have previously been described, while two are now characterized. Possibly still others remain undiscovered. The subjoined table will materially assist in separating the forms:

SYNOPSIS OF THE SPECIES OF TOMEOPHORA.

A. Fastigium of the vertex laminately compressed, greatly surpassing the first antennal joint.................................*gladiatrix* Brunner.

AA. Fastigium of the vertex not greatly surpassing the first antennal joint, usually obtuse.

b. Tegmina with their median width about twice the length of the pronotum.

c. Tegmina with their posterior margin distinctly rounded. Fastigium of the vertex equal to the first antennal joint in length, sulcate. [Peru].................................*pungiunculata* Brunner.

cc. Tegmina with their hind margin straight. Fastigium one-half the length of the first antennal joint, scarcely sulcate. [Bolivia]. *brevirostris* sp. nov.

bb. Tegmina with their median width less than twice the length of the pronotum.

c. Posterior margin of the pronotal disc angulate, the hind margin of the tegmina rounded. (Veins of the tegmina prominent, parallel). *ovatipennis* sp. nov.

cc. Posterior margin of pronotal disc rounded, the hind margin of tegmina straight. Veins of the tegmina not prominent...*modesta* Brunner.

53. **Tomeophora brevirostris** sp. nov.

Male.—This insect can best be compared with *T. pungiunculata* of Brunner from Peru, to which species it is most nearly related. In the accompanying synoptical table the former species is described as having the fastigium of the vertex sulcate and equal in length to the first antennal joint. The present species has the fastigium much shorter and scarcely sulcate. The former also has the posterior edge of the tegmina plainly rounded, while in *brevirostris* they are straight. The apex of the tegmina of the latter is also much more broadly rounded than in that of the former. The coloration and type of venation is somewhat similar in both.

Length of body, 18 mm., of pronotum, 4.2 mm., of tegmina, 29.5 mm., width of tegmina, 8.5 mm., length of hind femora, 16 mm.

Habitat.—"Province del Sara, Bolivia, 350 m." J. Steinbach, collector, February, 1913. Only the type is at hand. It is deposited in the Carnegie Museum of Pittsburgh.

54. **Tomeophora pungiunculata** Brunner.

Tomeophora pungiunculata BRUNNER, Mon. Phaneropt., p. 300 (1878).
Tomeophora punguiculata BRUNNER, Addit. Mon. Phaneropt., p. 152 (1891).

A female from Chapada, Brazil, is placed here. It was taken by H. H. Smith.

55. **Tomeophora ovatipennis** sp. nov.

A medium-sized insect with rather roughened leathery tegmina, the color of which is greenish-yellow, tinged at base and along the anterior and posterior borders with ruddy lavender.

Fastigium of the vertex somewhat compressed, almost reaching the apex of the first antennal joint, not in the least sulcate above. Pronotum with its median carina quite prominent throughout, the hind margin of the disc rounded or subangulate; lateral lobes about as long as high, their lower margin oblique, the lower posterior angle rounded. Tegmina less than twice as wide at middle as the length of the pronotum, coriaceous, opaque, the longitudinal veins heavy and parallel, transverse veins few and also parallel apically, the apex rather broadly rounded. Wings acuminate, the exposed portion leathery; the stridulating vein heavy, smooth, preceded by a deep oval pit. Supra-anal plate triangular, the last ventral segment tapering and roundly and moderately deeply emarginate. Cerci strongly hirsute, elongate, bent a trifle downwards at middle and bowed, the apex a little enlarged.

General color yellowish green, the tegmina tinged at base and along the anterior and posterior margins with vinaceous or ruddy lavender.

Length of body, 17 mm., of pronotum, 4.15 mm., of tegmina, 17.5 mm., width of tegmina, 6 mm., length of hind femora, 16 mm.

Habitat.—A single male, the type, was taken by J. Steinbach during the month of October. It came from the "Prov. del Sara, Bolivia," where it occurred at an elevation above sea-level of 350 meters. Like the former, this specimen is the property of the Carnegie Museum.

Genus PHYLLOPTERA Serville.

Phylloptera SERVILLE, Ann. Sci. Nat., XXII, p. 142 (1831); *Ib.*, Hist. Orthopt., p. 402 (1839); BURMEISTER, Handb. Ent., II, p. 691 (1838); BRUNNER, Monog. Phaneropt., pp. 28, 307 (1878); *Ib.* Addit. Monog. Phaneropt., pp. 21, 156 (1891); SAUSSURE et PICTET, Biol. Cent.-Amer., I, pp. 351 (1897).

The present genus is typically tropical American. The three dozen or more species, which have been referred to it, vary greatly in size and general appearance, as may be gathered from a reference to Brunner's *Monograph of the Phaneropteridæ* and his *Additamenta* thereto. Undoubtedly many more forms exist, which remain to be made known. In fact the present collection contains a number, which do not appear to fit in Brunner's last synoptical key for the separation of the forms; but, until all of the other species described since—a dozen or more of them—are synoptically treated, it is difficult to place new forms definitely. Specimens of two species are at hand, however, which on account of their marked characteristics have been determined as probably new and deserving of description.

56. **Phylloptera quinque-maculata** sp. nov.

Related to *maculosa* of Burmeister, from which it differs in its considerably smaller size as well as in other characters here noted. Body, and especially the head, pleura, and legs, hirsute. Anterior tibiæ plainly sulcate above, armed on this side only with the external apical spine, the intermediate pair likewise armed; anterior and middle femora both spined below on their anterior margin, the hind pair armed as in *maculosa*. Pronotum with the posterior third of the disc cinereous, margined with dark purple merging into black. Elytra broadly rounded behind, the apex roundly acuminate, the disc provided with five whitish twin maculations surrounded by purple, three of these maculations following the ulnar vein and the other two located on the forks of the branch of the posterior radial. The branch of the radial is given off at about its middle and forks on its basal third.

General color pale green, the legs, and especially the tibiæ, closely flecked with ferruginous and fuscous dots about the roots of the pale hairs mentioned above. Under side testaceous. Ovipositor short and very robust, strongly bent upward, the apex acuminate.

Length of body, ♂, 19 mm., ♀, 20 mm.; of pronotum, ♂, 5 mm., ♀, 5.5 mm.; of tegmina, ♂, 31 mm., ♀, 35 mm.; width of tegmina, ♂, 10 mm., ♀, 12 mm.; length of hind femora, ♂, 16 mm., ♀, 17 mm.; of ovipositor, 5 mm.

Habitat.—The male and female types, as well as quite a series of other specimens were taken at Chapada, near Cuyabá, Matto Grosso, Brazil, during the months of June to August. (H. H. Smith collector.) The types are in the Carnegie Museum.

57. **Phylloptera ovalifolia** Burmeister.

Phylloptera ovalifolia BURMEISTER, Handb. Ent., II, p. 693 (1838); BRUNNER, Monog. Phaneropt., pp. 309, 311, pl. 6, fig. 89, *a–c* (1878); BOLIVAR, Viaje al Pacif., Ins., p. 56 (1884); SAUSSURE et PICTET, Biol. Cent.-Amer., I, p. 352 (1897).
Phylloptera punctum-album SERVILLE, Ins. Orth., p. 407, no. 5 (1839).
Phylloptera viridicata SERVILLE, *l. c.* no. 6 (1839).

Habitat.—A number of this rather generally distributed and somewhat variable species are at hand. They come from Rio de Janeiro (H. H. Smith).

58. **Phylloptera roseo-inflata** Brunner?

Phylloptera roseo-inflata BRUNNER, Addit. Monog. Phaneropt., pp. 157, 16 (1891).

Habitat.—Several specimens of what I doubtfully refer to Brunner's *P. roseo-inflata* are found among the material collected by H. H. Smith at Chapada, near Cuyabá, Matto Grosso, Brazil. Both sexes are represented.

59. **Phylloptera famula** Brunner.

Phylloptera famula BRUNNER, Monog. Phaneropt., pp. 309, 313 (1878); *Ib.*, Addit. Moncg. Phaneropt., p. 158 (1891).

Habitat.—Several specimens of both sexes of a small species of the genus coming from Corumbá, Brazil, are referred here with doubt. They were collected by H. H. Smith. Other specimens are also at hand coming from Bolivian localities. These latter were taken by J. Steinbach.

60. **Phylloptera linea-purpurea** sp. nov.

Related to *P. picta* Brunner, but much smaller and of different color. Rather below the medium in size, somewhat robust, and with sub-corneous shining tegmina.

Front smooth and rounded, nearly perpendicular, the sides a little compressed, roughened; vertex acuminate, sulcate. Pronotum with the disc flat, roundly emarginate in front, rounded behind, in the middle provided with a depressed longitudinal line; lateral carinæ flavous, blunt, but continuous to the front border; lateral lobes perpendicular, higher than long. Elytra sub-corneous, rather closely punctulate, shining, the veins of the costal area very obscure, widest before the middle. Anterior femora below two-spined in front, intermediate three-spined and the posterior many-spined externally and three-spined internally. Mesosternal lobes acuminate, the meta-sternal lobes rounded behind.

General color of pronotum, tegmina, and body above greenish testaceous. Lateral carinæ of pronotum flavous in continuation of the humeral angle and dorsal margin of the tegmina, on the disc of pronotum bordered internally with a vinaceous line, which continues anteriorly along the sides of the occiput to the hind margin of the eyes. Tegmina punctulate, marmorate and maculate with ferruginous, purple, and brown. Of the larger maculations there are six, three located along the ulnar vein, one on the upper fork of the radial branch, and two on the lower fork.

Length of body, ♂, 21 mm., of pronotum, 4.75 mm., of tegmina, 28 mm., width of tegmina, 8.5 mm., length of hind femora, 15 mm.

Habitat.—The single specimen now before me comes from the "Province del Sara, Bolivia," where it was taken at an elevation of 450 meters above sea-level. (J. Steinbach, collector.) The type belongs to the insect collections of the Carnegie Museum.

61. **Phylloptera spinulosa** Brunner?

Phylloptera spinulosa BRUNNER, Monog. Phaneropt., pp. 309, 314 (1878); *Ib.*. Addit. Monog. Phaneropt., p. 159 (1891).

Habitat.—There are specimens at hand from both Chapada and Corumbá, Brazil, which appear in some regards to be this species according to the synoptical table given in Brunner's Additamenta. They were taken by H. H. Smith, but the reference is only made by me provisionally.

Genus HYPERPHRONA Brunner.

Hyperphrona BRUNNER, Monog. Phaneropt., p. 315 (1878); *Ib.*, Addit. Monog. Phaneropt., p. 165 (1891).

This is one of the commoner genera of American katydids, but its representatives seem to be confined to the tropical portions of South America. A dozen or more species are already known. Another is now added. The various representatives can be separated by the table of Brunner's as printed in the later of the two publications referred to above.

62. **Hyperphrona abdominalis** sp. nov.

A rather large insect related to Brunner's *striolata*, from which it differs very notably in having the abdomen of both the male and female very strongly tinted with bright carmine above, and along the hind margins of all the segments, even well down their sides, in the longer hind femora and tegmina of the male; and in having the antennæ ferruginous and annulated with fuscous throughout, instead of being entirely fuscous. The terminal segments of the abdomen of the male, together with the cerci are similar to those described for this sex of *striolata*. General color yellowish green, the head, pronotum, legs, and under side paler, almost dull white; antennæ with the two basal joints whitish and twice longitudinally streaked, and the apex half-way margined with deep black; several of the following joints, all of which are ferruginous, also longitudinally streaked with black below. Eyes pale castaneous. Anterior and median tibiæ more or less tinged with ferruginous, the hind pair also to a limited degree likewise tinted apically. Tegmina with three dark blotches along the ulnar vein where its principal branches are given off, the dorsal margin and also the cells along some of the veins more or less infuscated. Abdomen as described above, the last segment of the male dorsally having the lateral acuminate lobes colored to their tips. Ovipositor with the apex and corrugations or tooth-like roughenings piceous.

Length of body, ♂, 27 mm., ♀, 29 mm.; of pronotum, ♂ and ♀, 6 mm.; of tegmina ♂, 42 mm., ♀, 45 mm.; greatest width of same ♂ and ♀, 18 mm.; length of hind femora, ♂, 24 mm., ♀, 25 mm.; of ovipositor, 10 mm.

Habitat.—The female type comes from Las Juntas, Department of Santa Cruz, Bolivia, at an elevation of 250 meters above sea-level.

Another pair are labeled "Province del Sara, Bolivia," from an elevation of 350 meters. The former were collected in December, while the latter were taken in November. All of these specimens were collected by J. Steinbach. The types, ♂ and ♀, are among the collections of the Carnegie Museum.

The female specimen taken in the Province del Sara has the tegmina 2 mm. narrower and 4 mm. shorter than those of the type.

63. **Hyperphrona cærulescens** Brunner?

Hyperphrona cærulescens BRUNNER, Addit. Monog. Phaneropt., p. 166 (1891).

Habitat.—A single female specimen belonging to the genus *Hyperphrona*, bearing the locality label "Corumbá, Brazil (high land)," is referred with doubt to *H. cærulescens* Brunner. It was taken during April by H. H. Smith.

Genus TOPANA Walker.

Topana WALKER, Cat. Derm. Salt. B. M., II, p. 364 (1869); KIRBY, Syn. Cat. Orth., II, p. 478 (1906).

Plagioptera STÅL, Œfv. Vet.-Akad. Förh. XXX (4), p. 41 (1873); *Ib.*, Recens. Orth., II, p. 16 (1874); BRUNNER, Mon. Phaneropt., pp. 29, 321 (1878); *Ib.*, Addit. Mon. Phaneropt., p. 22 (1891).

The present genus contains small, slender-limbed insects, which undoubtedly live somewhat obscure lives, either upon the ground among scattered small vegetation, or upon the trunks of trees among vines and other entangling plants. All of the species are more or less vari-colored, marked by blotches or splashes of ferruginous, giving to them the appearance of dead or dying leaves. The genus is based on the species placed by Brunner in his section 1.1. of the table for separating them (see Mon. Phaneropt. p. 322). All of these insects seem to be confined to South America. Five species have been described, three of them by Walker, and one each by Stål and Brunner. A sixth appears to be represented in the material at hand.

64. **Topana media** Walker?

Topana media WALKER, Cat. Derm. Salt. B. M., II, p. 365 (1869); KIRBY, Syn. Cat. Orth, II, p. 478 (1906).

Habitat.—A male specimen of *Topana* has been referred with some doubt to Walker's *T. media*. It comes from the "Province del Sara, Bolivia," where it was taken during February at an elevation of 350 meters above the sea-level (J. Steinbach).

65. **Topana postica** Walker.

Topana postica WALKER, Cat. Derm. Salt. B. M., II, p. 365 (1869); KIRBY, Syn. Cat. Orth., II, p. 478 (1906).

Habitat.—A single female, bearing the locality label "Puerto Suarez, Bolivia," is at hand.

66. **Topana rubiginosa** sp. nov.

About the size of *cincticornis* Stål, but somewhat more robust. Hind margin of elytra for about two-thirds of their length straight. Fastigium of the vertex open behind, but scarcely tuberculate. Pronotum with the disc flat and entirely margined with a raised carina, which on the sides is bisinuate, so as to leave a rather prominent outwardly directed tooth. Legs much as in *cincticornis*, but with only two large compressed spines, instead of four to five smaller slender ones on the front and intermediate femora.

Head rust-red, the fastigium of front and of vertex ivory-white, basal antennal joints testaceous, beyond at rather distant intervals widely banded with fuscous, as in *cincticornis*. Pronotum on the lateral lobes, pleura, and abdomen ferruginous; the disc dirty yellow, very narrowly bordered in front and at sides with purple, becoming black on hind margin inside of the bounding carina, the latter old-ivory-white. Tegmina yellowish green, with the stridulating field and dorsal margin, the base of costal field, and a large patch on middle of hind border, solid ferruginous; the remainder of costal and ulnar borders irregularly blotched with patches of the same color. Basal third of hind femora and apex of all the femora and bases of the tibiæ dark ferruginous.

Length of body, ♂, 11 mm., of pronotum, 3 mm., of tegmina, 21 mm., width of tegmina, 7.15 mm., length of hind femora, 12.25 mm.

Habitat.—Chapada, Brazil, in April (H. H. Smith). The insect is accompanied by a red label bearing the number 2157. The type is unique. It is deposited in the Carnegie Museum.

67. **Topana cincticornis** Stål.

Plagioptera cincticornis STÅL, Œfv. Vet.-Akad. Förh. XXX (4), p. 43 (1873); BRUNNER, Mon. Phaneropt., 322, 323 (1878).

Topana cincticornis KIRBY, Syn. Cat. Orth., II, p. 478 (1906).

Habitat.—There are a number of specimens of both sexes of this insect at hand, which also come from Chapada, Brazil (H. H. Smith).

Some of these vary considerably, both in color and size, from the typical form as described by Stål. At present, however, they are left without further study.

Genus PYCNOPALPA Serville.

Pycnopalpa SERVILLE, Ins. Orth., p. 408 (1839).
Soria WALKER, Cat. Derm. Salt. B. M., II, p. 363 (1869).

This is a closely related tropical American genus represented by two species.

68. **Pycnopalpa bicordata** Serville.

For synonymy see KIRBY, Syn. Cat. Orth., II, p. 477 (1906).

Habitat.—There are specimens of both sexes of this insect at hand. They come from Rio de Janeiro, where they were taken by H. H. Smith.

Genus DIPLOPHYLLUS Saussure.

Diplophyllus SAUSSURE, Rev. et Mag. Zoöl. (2), p. 202 (1859).
Turpilia STÅL, Recens. Orth., II, p. 16 (1874); BRUNNER, Monog. Phaneropt., pp. 29, 324 (1878); *Ib.*, Addit. Monog. Phaneropt., pp. 22, 176 (1891); SAUSSURE et PICTET, Biol. Cent.-Amer., Orthop., I, p. 353 (1898); KIRBY, Syn. Cat. Orthopt., II, p. 478 (1906).

The representatives of the present genus are for the most part found in the tropical portions of the Americas. Already at least fifteen species have been recognized. What appears to be an additional species is now at hand.

69. **Diplophyllus insularis** sp. nov.

Related to *opacus* Brunner and *punctatus* Stål, from both of which it differs in several respects.

Eyes globose, quite prominent; fastigium of the vertex subacuminate, profoundly sulcate. Pronotum subopaque, rather closely and coarsely punctulate, the disc flat, gently narrowed anteriorly, the sides distinctly carinated, but the carinæ becoming less marked from behind forward, the front margin straight, behind subangulately rounded; lateral lobes much higher than long, the anterior margin roundly emarginate. Tegmina subopaque, the hind margin nearly straight, moderately broad. Anterior and middle femora spined beneath on the front margin, the hind pair spined on both margins. Metasternal lobes rather lengthily produced behind, their outer margin straight, the inner margin rounded; mesosternal lobes triangular, acuminate. Hind femora rather short. Ovipositor short, strongly bent upwards, the apex subacuminate, the apical half crenulate on both margins.

General color grass-green, eyes castaneous; face testaceous; apex of ovipositor more or less piceous.

Length of body, ♀, 23.5 mm., of pronotum, 5.65 mm., of tegmina, 35 mm., width of tegmina, 10 mm., length of hind femora, 18 mm., of ovipositor, 5.5 mm.

Habitat.—The type and only specimen examined is contained in a collection made at Nueva Gerona, Isle of Pines, West Indies. It was taken during the month of June, and is in the Carnegie Museum, belonging to Acc. No. 4656.

Genus OROPHUS Saussure.

Orophus SAUSSURE, Rev. et Mag. Zool. (2), XI, p. 204 (1859); WALKER, Cat. Derm. Salt. Brit. Mus., II, p. 381 (1869); KIRBY, Syn. Cat. Orth., II, p. 480 (1906).

Microcentrum SCUDDER (in part), Boston Journ. Nat. Hist., VII, p. 446 (1862); STÅL, Recens. Orth., II, p. 18 (1874); BRUNNER, Monog. Phaneropt., pp. 29, 333 (1878); *Ib.*, Addit. Monog. Phaneropt., pp. 22, 179 (1891).

The genus *Orophus* contains more than two dozen recognized species, all of which belong to the tropical regions of America. At least two or three of the species, however, also occur in the temperate regions of North America nearly or quite to the northern border of the United States.

70. **Orophus angustatus** (Brunner).

Microcentrum angustatum BRUNNER, Mon. Phaneropt., pp. 334, 335 (1878); *Ib.* Addit. Mon. Phaneropt., p. 179 (1891); SAUSSURE & PICTET, Biol. Cent.-Amer., Orth., I, pp. 357, 358 (1898).

Orophus angustatus KIRBY, Syn. Cat. Orth., II, p. 480 (1906).

Habitat.—There are specimens of this species at hand, which were taken at Bogotá, Colombia, and Bahia, Brazil (H. H. Smith), and others coming from the Province del Sara, Bolivia (J. Steinbach). The latter were collected during the months of February, November, and December at a locality with an elevation of 350 meters above sea-level.

71. **Orophus lanceolatus** (Burmeister).

Phylloptera lanceolata BURMEISTER, Handb. Ent. II, p. 692 (1838).

Microcentrum lanceolatum BRUNNER, Mon. Phaneropt., pp. 334, 335, Pl. 7, fig. 97, *a*, *b* (1878); *Ib.*, Addit. Mon. Phaneropt., p. 179 (1891).

Orophus lanceolatus KIRBY, Syn. Cat. Orth., II, p. 480 (1906).

For further synonymy see KIRBY, *l. c.*

Habitat.—Rio dos Velhos, Minas Geraes, Brazil, and Rio de Janeiro, Brazil. A pair, ♂ and ♀, were taken at the last named locality by Dr. W. J. Holland.

72. **Orophus marginatus** (Brunner).

Microcentrum marginatum Brunner, Mon. Phaneropt., pp. 334, 336 (1878); *Ib.*, Addit. Mon. Phaneropt., p. 179 (1891); Saussure & Pictet, Biol. Cent.-Amer. Orth., I, pp. 357, 358 (1898).

Orophus marginatus Kirby, Syn. Cat. Orth., II, p. 481 (1906).

Habitat.—A single male specimen is at hand bearing simply the label "June." Possibly it comes from some Brazilian locality and may have been taken by either H. H. Smith or J. D. Haseman.

73. **Orophus colosseus** (Brunner)?

Microcentrum colosseum Brunner, Mon. Phaneropt., pp. 335, 341 (1878); *Ib.*, Addit. Mon. Phaneropt., p. 180 (1891); Saussure & Pictet, Biol. Cent.-Amer., Orth. I, pp. 358, 361, Pl. 17, figs. 9, 10 (1898).

Orophus colosseus Kirby, Syn. Cat. Orth., II, p. 481 (1906).

Habitat.—A male specimen coming from Rio de Janeiro has been temporarily placed here. It was possibly taken by H. H. Smith.

74. **Orophus erosus** (Brunner).

Microcentrum erosum Brunner, Addit. Mon. Phaneropt., pp. 180, 181 (1891); Saussure & Pictet, Biol. Cent.-Amer., I, p. 358 (1898).

Orophus erosus Kirby, Syn. Cat. Orth., II, p. 481 (1906).

Habitat.—A single female specimen of this species is at hand. It comes from "Province del Sara," Bolivia, and was taken by J. Steinbach during November, or December.

75. **Orophus nigrolineatus** sp. nov.

Size rather small. Related to *securiferus* and *pallidus* Brunner, but quite distinct from both of these. Characterized by a conspicuous narrow black line following along the anterior radial vein of the tegmina and a longitudinal row of six or seven small smooth yellow papillæ along the middle of the costal area.

General form of insect robust, the head as broad as the anterior margin of the pronotum, its sides parallel, front smooth. Fastigium roundly depressed, about twice as wide as the first antennal joint, a very little sulcate. Pronotum short, rather closely punctulate above, less closely so on the deflexed lobes, with the sides almost parallel; the disc flat, rounded behind, sinuate in front; lateral lobes perpendicular, higher than long, obtusely joined to the disc. Tegmina of moderate width, both forks of the branch of the posterior radial reaching the posterior border in advance of the apex, the anterior fork distantly united with the ulnar by a cross-vein. Ulnar and discal areas also provided with a few scattered, raised, smooth, pale papillæ, as described in connection with the costal area. Anterior and middle femora spineless below, hind femora spined on both margins. Cerci of male bowed, the apex not clavate but provided with a blunt hook; subgenital plate tricarinate, the apex truncate, stylets of moderate length and a little bent downwards.

General color grass-green, a little paler on the head, sides of body, and below. Lateral margins of pronotum and stridulating area, together with the middle portion of the posterior radial vein of tegmina, testaceous.

Length of body, ♂, 22 mm., of pronotum, 5 mm., of tegmina, 36 mm., width of tegmina, 10.5 mm., length of hind femora, 19 mm.

Habitat.—Province del Sara, Bolivia, at an elevation of 350 meters. Collected by J. Steinbach during December 1912. The type, a male, is the only specimen at hand. It is in the Carnegie Museum.

Genus LOBOPHYLLUS Saussure.

Lobophyllus SAUSSURE, Rev. et Mag. Zoöl. (2) XI, p. 205 (1859); BRUNNER, Mon. Phaneropt., pp. 30, 343 (1878); *Ib.*, Addit. Mon. Phaneropt., p. 22 (1891).

This monotypic genus of katydids is confined to Brazil. It is represented in the present collection.

76. **Lobophyllus legumen** (Saussure).

Phylloptera legumen SAUSSURE, Rev. et Mag. Zoöl. (2) XI, p. 205 (1859).

Lobophyllum legumen BRUNNER, Mon. Phaneropt., p. 343, pl. 7, fig. 98 *a, b* (1878); SAUSSURE & PICTET, Biol. Cent.-Amer., Orth., I, p. 364, Pl. 18, figs. 12–15 (1898).

Habitat.—A single female specimen taken by H. H. Smith at Chapada, Brazil, is referred here.

Genus SYNTECHNA Brunner.

Syntechna BRUNNER, Mon. Phaneropt., pp. 30, 347 (1878); *Ib.*, Addit. Mon. Phaneropt., p. 23 (1891); SAUSSURE & PICTET, Biol. Cent.-Amer., Orth., I, p. 366 (1898).

77. **Syntechna divisa** (Walker).

Microcentrum divisum WALKER, Cat. Derm. Salt. B. M., II, p. 373 (1869).

Syntechna divisa KIRBY, Syn. Cat. Orth., II, p. 485 (1906).

Habitat.—There are two female specimens of this insect at hand from the island of Jamaica, West Indies. They form a part of the Holland collection, Accession No. 2306, in the Carnegie Museum.

Genus PHILOPHYLLIA Stål.

Philophyllia STÅL, Recens. Orth., 2, p. 18 (1874); BRUNNER, Monog. Phaneropt., p. 349 (1878).

The representatives of this small genus are confined, so far as known, to southern Mexico and Central and South America. Three species have been described. Only one of these is at hand.

78. **Philophyllia venosa** Brunner.

Philophyllia venosa BRUNNER, Monog. Phaneropt., p. 351 (1878).

The material collected by H. H. Smith at Rio de Janeiro contains a pair of this species. The male agrees with Brunner's description in every respect so far as given. The hind femora are 22 mm. in length. The female has the following dimensions: Length of body, 23 mm., of pronotum, 5.15 mm., of tegmina, 38 mm., width, 10 mm., length of hind femora, 24 mm., of ovipositor 5 mm. At first I was inclined to place the female in the genus *Orophus* on account of the structure of the ovipositor, which does not agree with the description of that organ for the genus (see generic synopsis section *dd* under **). Instead of being acuminate, the lower valve is rounded and crenulate at the apex as in *Orophus*. The prominent veins, pointed tegmina, and the row of raised tubercles on their costal margin, however, are identical with those of the male. The female specimen is not in color and probably has faded from immersion in spirits.

Family MECOPODIDÆ.

Only three genera of the present family of the Tettigonoidea have been recorded from South American territory. None appear to be among the material now being reported upon. Their representatives are all entirely apterous, and can be separated as follows:

SYNOPSIS OF S. A. GENERA OF MECOPODIDÆ.

A. Legs very long and slender, the hind femora more than twice the length of the body, at base but little enlarged......... *Rhammatopoda* Redtenbacher.

AA. Legs less elongate, the hind femora less than twice the length of the body, at the base rather robust.

- *b*. Meso- and metasternum two-spined on each side of middle. *Tabaria* Walker.
- *bb*. Meso- and metasternum one-spined on each side of middle. *Encentra* Redtenbacher.

Family PSEUDOPHYLLIDÆ.

This family is very extensive, if we consider it as represented in both the Orient and Occident, together with the various islands of the seas. Naturally the group is tropical, although quite a number of the species of certain genera are found also in the warmer parts of the temperate regions. Most of the species are inconspicuously colored, *i. e.*, they are generally various shades of browns and grays, mottled and marbled with black, in such a manner as to be protected. They generally live among dead and fallen leaves lying on the floor of the forest, or among thorny herbs, shrubs, bushes, and on tree-trunks in the crevices of and under loose bark, where they lurk during the day-time and move about after nightfall. The representatives of a few of the genera, however, are green and entirely arboreal, and live among the foliage, which they imitate in general appearance. Our true "katy-dids" are examples of these green forms.

The various genera are separated by such characters as form of pronotum, of meso- and metasternum, spine characters, form of ovipositor, antennal structure and length, on the presence or absence of tegmina and wings, etc. The species, on the other hand, are recognized more by color and comparative size of the various parts of the body and attachments instead of the characters employed for generic separation. Unless these insects are especially searched for, they are liable to be overlooked. Hence the comparatively small series of the different species, which generally are found in collections. The various genera of the Pseudophyllidæ belonging to tropical America, North and South, may be differentiated as follows:

SYNOPSIS OF THE TROPICAL AMERICAN GENERA OF PSEUDOPHYLLIDÆ.

A. Foveola of the metasternum distant or joined by a transverse sulcus.
- *b*. Metasternum widely transverse, the foveolæ farther apart than from the lateral border, always joined by a straight sulcus.
  - *c*. All the femora unarmed below. Anterior tibiæ provided with wide open foramina. (Legs slender. Tegmina strongly abbreviated, or, when they are perfectly developed, acuminate. Wings missing.)
    - *d*. Pronotum flat. Femora smooth. Intermediate tibiæ unarmed above . . . . *Aphractus* Redtenbacher.
    - *dd*. Pronotum saddle-shaped. All the femora below ciliate. Intermediate tibiæ spined above . . . . *Polycleptis* Karsch.
  - *cc*. All the femora spined below. Anterior tibiæ with the foramina shell-like.
    - *d*. Anterior femora above acute-angled or rounded, never compressed. Intermediate tibiæ somewhat compressed, often spined above on both margins.

e. Anterior tibiæ flattened above, acute-angled.

f. Pronotum with the posterior margin elevated into callosities, obtusely triangulately emarginate.

g. Disc of the pronotum unequal, but not tuberculate, Tegmina broader, the median vein crooked, elongate, the left speculum of the male obscure. Ovipositor straight . . . . *Xerophyllopteryx* Rehn.

gg. Disc of the pronotum tuberculate or spinose on the sides.

h. Pronotum provided on each side of disc with a long spine; the hind margin tuberculated at middle and with the front margin dentate.
Championica Sauss. & Pict.

hh. Disc of the pronotum provided on each side with an acuminate tubercle; the hind margin not tuberculated at middle, nor with the front margin dentate.
Tetragonomera Stål.

ff. Pronotum with the posterior margin rounded, narrowly bordered. (Disc unequal, not tuberculate, the deflexed lobes perpendicular. Median vein straight. Ovipositor curved) . . . . *Schochia* Brunner.

ee. Anterior tibiæ rounded above, very rarely flattened, in which case both margins are spined. (Anterior margin of the pronotum sometimes furnished with a small tubercle or spine).

f. Pronotum with its anterior margin in the middle provided with a more or less obvious obtuse tubercle; the metazona not dilated, the hind margin not spinose. Anterior femora one-half longer than the pronotum.

g. Anterior femora below spined at least on the front margin. Anterior tibiæ unarmed above. Tegmina and wings fully developed. Size larger . . *Tetanopus* Redtenbacher.

gg. Anterior femora below spined on both margins. The anterior tibiæ armed above on both margins with strong spines. Tegmina very much abbreviated, not passing the first abdominal segment . . *Sagephorus* Redtenbacher.

ff. Pronotum armed in front with a median spine, the metazona often dilated (except in the genus *Adeclus* and in *Dicanthodis granosa*). Anterior femora not one-half longer than the pronotum.

g. Femora unarmed above with spines.

h. Genicular lobes of the femora spined.

i. Metazona of the pronotum greatly dilated, produced into spines on both sides, posterior margin many-spined. Ovipositor robust, straight.
Orpacophora Kirby.

ii. Metazona of the pronotum narrower, behind truncate, the hind border smooth. Ovipositor narrow, curved . . . . *Adeclus*[2] Brunner.

hh. Genicular lobes of the femora obtuse.

Hæmodiasma Brunner.

gg. Femora spined above. (Pronotum saddle-shaped, the metazona on both sides furnished with a spine. Ovipositor narrow, a little curved . . . . *Dicanthodis* Walker.

dd. Anterior femora more or less compressed. Middle tibiæ compressed, sometimes spined on the posterior margin or entirely unarmed.

e. Middle tibiæ above one- to three-spined basally, very rarely without spines. (In *Dasyscelus*).

f. Tegmina much abbreviated . . . . *Dasyscelus* Redtenbacher.

ff. Tegmina fully developed.

g. Upper carina of the anterior and posterior femora terminating at the apex in an acute apical lobe. Middle tibiæ above armed with three flattened spines. (Front femora a little longer than the pronotum. Posterior tibiæ armed above on the inner margin with heavier spines) . . . . *Anonistus* Walker.

gg. Upper carina of the anterior and posterior femora apically running out or missing. Middle tibiæ armed above with two acute spines or with one spine

h. Wings with the transverse veins narrowly pale-bordered. Posterior tibiæ hardly compressed from the sides, armed above on the inner margin with nine large dilated teeth . . . . *Pleminia* Stål.

hh. Wings unicolorous smoky or tessellate. Posterior tibiæ somewhat compressed, armed above with ten to twelve spines not much larger nor dilated.

i. Disc of the pronotum not provided with large tubercles, or sometimes with two obtuse ones on each side.

j. Anterior femora below three- to four-spined. Middle tibiæ above two- to four-spined. Wings not tessellate (except in *Lichenochrus tessellatus* and *muticus*). Metazona of the pronotum neither angulated nor tuberculated at its sides . . . . *Lichenochrus* Karsch.

jj. Anterior femora below smooth or nearly smooth. Middle tibiæ above typically sometimes armed basally with one spine. Wings always tessellate. Metazona of the pronotum laterally subangulate and on both sides provided with large obtuse tubercles. (Genicular lobes of the hind femora spined) . . *Acanthodis* Serville.

[2] According to Kirby (Syn. Cat. Orth., II, p. 314) the genus *Apercisis* Walker should be placed between *Adeclus* and *Hæmodiasma*.

ii. Disc of the pronotum provided with acuminate tubercles, which are arranged in two longitudinal series . . . . *Pristes* Redtenbacher.

ee. Middle tibiæ above unarmed or through variation one-spined (in some species of the genus *Platyphyllum* two-spined). Anterior femora somewhat compressed and a very little curved at their base. (Pronotum on the hind margin not, or but weakly, bordered. Some species provided with green tegmina).

f. Pronotum closely granoso-rugulcse, very flat, the transverse sulci inconspicuous, the deflexed lcbes low or narrow, the anterior angle obtuse, strongly rounded. Legs greatly depressed, long and densely pilose. Anterior femora curved at their base; above laminate. . . *Stenoschema* Redtenbacher.

ff. Pronotum smooth or cbtusely granulose, the sulci distinct, the deflexed lobes with the anterior angle right, acute. Legs less compressed. Anterior femora compressed and gently curved, above acutely carinated or somewhat compressed, above rounded.

g. Wings smoky or tessellate. Tegmina fuscous.
Leurophyllum Kirby.

gg. Wings hyaline. Tegmina often bright green or flavous.

h. Tegmina more than quadruple the length of the pronotum. Posterior tibiæ above on both margins many-spined . . . . *Platyphyllum* Serville.

hh. Tegmina not more than three times the length of the pronotum. Posterior tibiæ above on the outer margin smooth or few-spined. Species confined to Jamaica . . . . *Jamaicana* Brunner.

bb. Metasternum narrowed posteriorly, the foveolæ between themselves less distant than from the lateral margin, joined together by an arcuate sulcus. Anterior femora frequently armed with small inwardly curved genicular spines, or with none. (Wings smoky, never with the transverse veins margined with paler color.)

c. Genicular lobes of the hind femora armed on both sides with a spine, or at least the lobes triangulately produced. (In *Brachyauchenus atrosignatus* the external lobe is rounded.)

d. Pronotum smooth, or obtusely rugose, or granulose. Metasternal foveolæ less remote one from the other than from the lateral margin. Metazona of the pronotum a little shorter than the pro- and mesozona united.

e. Anterior femora below four-spined, the spines concolorous. (Antennæ unicolored fuscous, or pale annulate. Genicular lobes, except the external one on the intermediate femora, armed with an incurved spine . . . . *Meroncidius* Serville.

ee. Anterior femora below three-spined, all of the spines black. (Genicular lobes of the anterior femora obtuse, sometimes the inner lobes are provided with a very small spine).
Tricentrus Brunner.

dd. Pronotum acutely granulose or spinose.

e. Femora above not spinose. Middle tibiæ smooth above. Tegmina equaling or passing the abdomen. Pronotum equally densely granose. (Posterior femora heavier, the base strongly dilated) . . . . *Brachyauchenus* Brunner.

ee. Femora above lengthily spinose. Middle tibiæ above spined. Tegmina not attaining the apex of the abdomen. Pronotum furnished with dense acuminate granules.
Chœroparnops Dohrn.

cc. Genicular lobes of the posterior femora obtuse, or sometimes the internal lobes spined.

d. Anterior femora below armed with three to four spines.

e. Tegmina and wings fully developed.

f. Posterior tibiæ spined above on both margins.

g. Middle tibiæ sulcate above.

h. Intermediate tibiæ above two-spined on the posterior margin.

i. Anterior tibiæ below the auditory grooves, chiefly in the male, more or less incrassate. Posterior femora on both sides provided with obtuse genicular lobes . . . . . *Gongrocnemis* Redtenbacher.

ii. Anterior tibiæ not incrassate. Posterior femora on the inner side provided with spined genicular lobes . . . . *Anchiptolis* Brunner.

hh. Intermediate tibiæ above three- or four-spined on the posterior margin. (Coxæ marked with black. Spines of the femora entirely, or with the apex black. Anal segment of male produced on both sides into a tooth. Supra-anal lamina of male rounded or quadrate, or callosed and involuted. Ovipositor slender, straight) . . . *Idiarthron* Brunner.

gg. Middle tibiæ above rounded, smooth. (Pronotum wide, densely granulose) . . . . *Drepanoxiphus* Brunner.

ff. Posterior tibiæ above entirely spineless on the outer margin.
Enthacanthodes Redtenbacher.

ee. Tegmina lobiform. Wings wanting.

f. Posterior tibiæ unarmed above on the outer margin. Ovipositor short, straight, beyond the middle obliquely truncate. [Colombia and Mexico] . . . . *Liparoscelis* Stål.

ff. Posterior tibiæ provided above with several spines on the outer margin. Ovipositor more or less arcuate, evenly tapering. [Galapagos Islands] . . . . *Nesœcia* Scudder.

dd. Anterior femora below without spines. (Pronotum somewhat granoso-rugulose, the transverse sulci distinct. Tegmina not reaching the middle of the abdomen, provided with fuscous areoles) . . . . *Trichotettix* Stål.

AA. Foveolæ of the metasternum joined in a single orbicular furrow or in a longitudinal sulcus.

b. Pectus or sternum moderately compressed, meso- and metasternum not lobate, except in the genus *Polyancistrus*. Antennæ slender, their bases not contiguous. Tegmina narrow, lying flat when at rest.

c. Body and tegmina testaceous or olivaceo-testaceous; the latter often long and narrow with their margins parallel, their texture leathery, the veins prominent, the anterior ulnar vein running out near the apex of the elytra. Middle coxæ not tuberculate at the base.

d. Pronotum not produced posteriorly, without lateral carinæ. Basal antennal joints obtuse at the apex, except in some species of the genus *Bliastes*. (Anterior femora with their external genicular lobes rounded.)

e. Anterior tibiæ not one-half longer than the pronotum (except in the species *Nannotettix longipes*), above rounded or flattened, not sulcate, the conchs or auditory apparatus closed.

f. Mandibles abnormal, very large, at the base provided with a long tooth. Fastigium of the vertex compressed, sulcate, at the base not tuberculate.

g. Mandibles very large, not toothed.
Gnathocleta Hagenbach.

gg. Mandibles provided at the base with a long tooth. (Fastigium of the front produced into an acute process.)
Dicranostomus Dohrn.

ff. Mandibles normal. Fastigium of the vertex tuberculate on the sides.

g. Pronotum granulose.

h. Anterior femora with their genicular lobes spined internally.

i. Tegmina and wings perfectly formed, sometimes shorter than the abdomen.

j. Middle tibiæ smooth above, without spines. Hind tibiæ above short-spined.

k. Anterior tibiæ normal........*Bliastes* Stål.

kk. Anterior tibiæ with the conchs widely open and below the conchs lobate on the outer margin...........*Parabliastes* Brunner.[3]

jj. Middle tibiæ above two-spined. Posterior tibiæ armed above with strong erect spines.
Æmasia Brunner.

ii. Tegmina and wings greatly abbreviated.

j. Tegmina in the female fenestrate. All of the femora spined above...*Panoploscelis* Scudder.

jj. Tegmina of the females normal. Femora above spineless...................*Stenotettix* Stål.

[3] The genera *Nastonotus* Bolivar (Ann. Soc. Ent. France (6) x, p. 143 (1890)) and *Clisis* Walker (Cat. Derm. Salt. B. M., V, Suppl., p. 47 (1871) belong in this vicinity.

hh. Anterior femora with their internal genicular lobes obtuse.

i. Tegmina and wings completely developed.

j. Anterior tibiæ four-angled.

k. Auditory opening of anterior tibiæ narrow.

l. Intermediate and hind femora with the genicular lobes spined. . *Cocconotus* Stål.

ll. Genicular lobes of all the femora produced into a spine. . . . . . . *Cratonotus* Bolivar.

kk. Auditory opening of tibiæ rather wide. *Thamnobates* Sauss. & Pict.

jj. Anterior tibiæ tumescent below the foramina, rounded . . . . *Condylocnemis* Redtenbacher.

ii. Tegmina and wings abbreviated.

j. Clypeus smooth. Posterior tibiæ spined above on both margins. . *Nannotettix* Redtenbacher.

jj. Clypeus bituberculate or bispined. Posterior tibiæ above smooth on the outer margin, or one-spined . . . . *Disceratus* Scudder.

gg. Pronotum smooth, shining. (All the femora with the genicular lobes spined) . . . . *Homalaspis* Brunner.

ee. Anterior tibiæ more than one-half longer than the pronotum, compressed, above sulcate, the auditory foramina widely opened. (Legs long, slender.)

f. Middle tibiæ rounded below, neither sulcate, nor spined. Anterior tibiæ above provided with an apical spine on both sides. (Posterior tibiæ armed above with an apical spine on both sides) . . . . *Ischomela* Stål.

ff. Middle tibiæ sulcate below, often spined. Anterior tibiæ without apical spines above.

g. Pronotum smooth, neither granulose, nor rugose.

h. Middle tibiæ above sometimes armed on the hind margin of the base with some spinules. Pronotum elongate, the transverse sulci equally and profoundly impressed. Color greenish testaceous. *Jimenezia* Bolivar.

hh. Middle tibiæ above spined on both sides. Pronotum short, the hind-most sulcus deeply impressed. Color fusco-testaceous . . . . *Macrochiton* Redt.

gg. Pronotum granulose or rugose.

h. Anterior margin of the pronotum tuberculate. Metazona armed on each side with a spine. (*Habitus* of the genus *Brisilis*) . . . . *Acanthodiphrus* Walker.

hh. Anterior margin of the pronotum not tuberculate, semicylindrical, or with the sides of the metazona angulate, not spined.

i. Metazona of the pronotum not angulated at the sides. Wings unicolored, lightly smoked.

j. Genicular lobes all, or only the external lobes rounded. (Preradial field of the elytra with the transverse veins regularly arranged.)
Leptotettix Stål.

jj. Genicular lobes all spined
Semileptotettix Brunner.

ii. Metazona of the pronotum at the sides angulated or marked with a shining paler line.

j. Wings with the transverse venules broadly margined with fuscous. Genital armature of the male abdomen normal........*Teleutias* Stål.

jj. Wings colored, the disc infuscated and varied with irregular pale maculations. Genital armature of the male abdomen abnormal, complicated......................*Diyllus* Stål.

dd. Pronotum posteriorly produced into an acuminate process or a long spine, the lateral carinæ denticulate or smooth.

e. Pronotum flattened above. Lateral carinæ present, prominent, crenulate or dentate.

f. Tegmina lobate, wings missing. Hind margin of the pronotum somewhat elevated and in the middle strongly spined. [Cuba.]
Polyancistroides Rehn.

ff. Tegmina and wings fully developed. Hind margin of the pronotum not elevated, produced, acute-angled. [Hayti.]
Polyancistrus Serville.

ee. Pronotum saddle-shaped. Lateral carinæ wanting; the hind lobe flattened and provided on each side with three oblique spines and a single upright one on the middle of the hind border. [Ecuador]................................*Pemba* Walker.

cc. Body and tegmina green. These coriaceous, the veins poorly expressed, wider and with the margins rounded, the anterior ulnar vein running out long before reaching the apex of the elytra. Middle coxæ more or less distinctly tuberculated on the lower margin.

d. Posterior femora somewhat incrassate, armed below on the apical half with some spinules. Fastigium of the vertex reaching in front of the margins of the antennal scrobes.

e. Anteradial field of the elytra irregularly veined, or the veins few and regularly placed, the mediastin vein somewhat distinct, produced obliquely from the base. Anterior femora compressed, curved at the base.

f. Meso- and metasternal lobes more or less acutely produced.
Scopiorus Stål.

ff. Meso- and metasternal lobes not produced, at most minutely dentate......................*Caloxiphus* Sauss. & Pict.

ee. Anteradial field of the elytra closely and regularly reticulate, with oblique transverse veins, the median vein at its base closely approaching the radial vein, on its basal third suddenly deflexed. Anterior femora rounded or compressed, straight.

f. Hind lobe of the pronotum not carinated at the sides. The genicular lobes obtuse. Male cerci forked.

g. Tegmina of male irregularly veined in the postradial field. Anterior and middle femora four-spined.

Pterophylla Kirby.

gg. Tegmina of male regularly veined in the postradial field. Anterior and middle femora eight-spined.

Chlorocœlus Kirby.

ff. Hind lobe of the pronotum carinated at sides. Genicular lobes acuminate; male cerci simple........*Thliboscelus* Serville.

dd. Posterior femora greatly incrassate, below entirely, or nearly, armed with heavier spines. Fastigium of the vertex not produced beyond the anterior margin of the antennal scrobes.

e. Pronotum destitute of a longitudinal median carina.

f. Middle tibiæ above spined on their posterior margin. Tegmina opaque, the posterior margin straight..*Diophanes* Stål.

ff. Middle tibiæ above smooth or very minutely spinulose. Tegmina corneous, shining, the posterior margin rounded.

Xestoptera Redtenbacher.

ee. Pronotum provided with a median longitudinal carina.

Lophaspis Redtenbacher.

bb. Pectus or sternum greatly compressed. Meso- and metasternum produced into acuminate lobes. Antennæ heavier, their bases touching. Tegmina when at rest directed upwards.

c. Posterior radial vein straight or (in the genus *Chlorophyllia*) somewhat decurved, running out before the apex of the tegmina. Genicular lobes obtuse or acuminate, not spined. Posterior femora below with few spines. Middle tibiæ greatly compressed. Labial palpi ampliated at the apex, obliquely truncate.

d. Wings colored.

e. Wings ocellate at their apex.

f. Tegmina with their front margin nearly straight, the apical third rounded and somewhat sinuate. (Anterior border of the wings straight, not produced into an apical lobe.)

Pterochroza Serville.

ff. Tegmina with their anterior margin sinuate behind the middle.

g. Elytra acuminate. Wings a little shorter than the tegmina, their anterior margin broadly sinuate, and at the apex produced into a lobe..............*Tanusia* Stål.

gg. Elytra obliquely truncate at their apex. Wings much shorter than the tegmina, their anterior margin straight, the apex rounded........*Porphyromma* Redtenbacher.

ee. Wings variegately colored, but the apex not ornamented with eye-spots....................*Rhodopteryx* Saussure & Pictet.

dd. Wings unicolored, white, or hyaline, not ocellate. (Pronotum above flat or concave, the deflexed lobes attached with an acute angle.

e. Anterior femora armed entirely, or in part, with flattened teeth. Posterior tibiæ more or less lobate.

f. Anterior tibiæ not flattened above, strongly compressed; the auditory openings linear. Spines of the anterior femora only in part foliaceous. Tegmina with the anterior field narrower than the posterior field . . . *Calidophylla* Sauss. & Pict.

ff. Anterior tibiæ flattened above, not compressed.

g. Inner opening of the auditory foramina of anterior tibiæ very prominent or produced. Pronotum lengthily produced behind, emarginate. Spines of anterior femora all foliaceous. Tegmina with the anterior margin rounded or sinuate . . . . *Mimetica* Pictet.

gg. Inner operculum of the foramina of the anterior tibiæ not produced. Pronotum truncate behind.

h. Wings with their apex rounded. Anterior femora compressed, toothed, the apex very rarely lobate.

i. Posterior margin of the pronotum not one-half wider than the anterior margin. Elytra widest in their apical third. Mediastin vein running out in the basal third of the tegmina, two or three branched . . . . *Typophyllum* Serville.

ii. Posterior margin of the pronotum almost twice as wide as the front margin. Tegmina widest in the middle. Mediastin vein running out towards the middle of the elytra, seven- or eight-branched.
Roxelana Kirby.

hh. Wings with their apex produced into a lobe. Anterior femora lobate at the apex. . . . *Catasparata* Brunner.

ee. Anterior femora round, armed with very minute spinules or unarmed. Posterior tibiæ entirely unarmed, or armed with very small spines . . . . *Chlorophylla* Pictet.

cc. Posterior radial vein curved downwards at the apex, running out before the apex of the elytra. Genicular lobes spined. Posterior femora closely armed with large spines. Middle tibiæ but little compressed. Elytra green, acuminate, the anterior margin rounded. Wings entirely hyaline . . . . *Cycloptera* Serville.

Genus ANONISTUS Walker.

Anonistus WALKER, Cat. Derm. Salt. B. M., V, Suppl., p. 46 (1871); KIRBY, Syn. Cat. Orth., II, p. 315 (1906).

Phyllostachys STÅL, Recens. Orth., 2, p. 61 (1874); BRUNNER, Monog. Pseudophyll., pp. 15, 120 (1895).

There is a single male before me which is referable to this genus according to the synoptical key, but does not fit the descriptions of either of the described species. It is therefore here described as new.

79. **Anonistus elongata** sp. nov.

In color and other general characters most closely related to *A. scops* of Burmeister, but larger, and belonging in the section of the genus in which the genicular lobes of the hind femora are obtuse, instead of acuminate.

Pronotum verrucose, in front above provided with a rather prominent compressed blunt spine. Tegmina with the ground-color pale greenish gray, rather narrow, tapering, the principal longitudinal veins green, the transverse and some of the longitudinal veins narrowly black-margined. All the legs closely fringed below with pale, long hairs, above less closely with shorter hairs, gray, marmorate with fuscous. Front cinereous; eyes shiny, ferruginous, mottled with fuscous. Antennæ annulated with fuscous. Anterior femora internally on apical half transversely dimly and closely fasciate with fuscous; the intermediate pair along with their tibiæ largely irregularly black marmorate.

Length of body, ♂, 28 mm., of pronotum, 8 mm., of tegmina 33 mm., of hind femora, 18 mm.

Habitat.—Rio de Janeiro, Brazil (H. H. Smith). The type belongs to the Carnegie Museum.

The three species of this genus may be separated as follows:

SYNOPSIS OF THE SOUTH AMERICAN SPECIES OF ANONISTUS.

A. Superior carina of the hind femora terminating in an acute-angled lobe. Genicular lobes rounded at apex.
- *b*. General color testaceous. The front bluish black. Pronotum granulose. *scariosa* Burmeister.
- *bb*. General color pale greenish-gray. Front cinereous. Pronotum verrucose or strongly rugulose . . . . *elongata* sp. nov.

AA. Superior carina of the hind femora not lobate; genicular lobes acuminate. Color pale greenish gray, marmorate with fuscous . . . . . . *scops* Burmeister.

Genus LICHENOCHRUS Karsch.

Lichenochrus KARSCH, Ent. Nachr., XVI, pp. 268, 275 (1890); BRUNNER, Mon. Pseudophyll., pp. 16, 125 (1895); SAUSS. & PICT., Biol. Cent.-Amer., Orth., I, p. 409 (1898).

This is a rather extensive genus of the Pseudophyllidæ. Most of the species are at home in tropical American countries.

80. **Lichenochrus vulturinus** (De Geer)?

Locusta vulturinus DE GEER, Mem. Ins., III, p. 451, Pl. 39, fig. 2 (1773).
Brisilis vulturina STÅL, Recens. Orth., II, p. 80 (1874).

Lichenochrus vulturinus BRUNNER, Mon. Pseudophyll., 125, 127 (1895).
Conocephalus trifidus THUNBERG, Mem. Acad. Petersb., V, p. 277 (1815).

Habitat.—A single female specimen, which according to the synoptic table is referable to the genus *Lichenochrus*, is classified as *vulturinus* with some doubt. It bears the label, "Presented as from S. America."

Genus ACANTHODIS Serville.

Acanthodis SERVILLE, Ann. Sci. Nat., XXII, p. 150 (1831); *Ib.* Ins. Orth., p. 450 (1839); BURMEISTER, Handb. Ent., II, p. 699 (1838); BLANCHARD, Hist. Nat. Ins., III, p. 21 (1840) *nec* Stål.

Brisilis Stål, Œfv. Vet.-Akad. Förh., XXX, (4) p. 46 (1873); *Ib.*, Recens. Orth., II, pp. 62, 78 (1874); BRUNNER, Mon. Pseudophyll., pp. 16, 132 (1895).

This is also a strictly South American genus of the Pseudophyllidæ. All of the described species of the genus are large protectively colored insects, which live about the trunks of trees, to the bark of which they show a remarkable similarity in appearance. There are two species among the material now in hand. One of these seems to be new. The following table will assist in recognizing the species including the new one:

SYNOPSIS OF THE SPECIES OF ACANTHODIS.

A. Metazona of pronotum bituberculate on both sides. Wings tessellate, without transverse veins in the pallid maculations. Hind femora ornamented on the inner face with a black vitta.
- *b.* Ovipositor not longer than the hind femora.
  - *c.* Pronotum with the hind margin subangulated, lateral tubercles of the metazona very distinct . . . . *aquilina* Linnæus.
  - *cc.* Pronotum with the posterior margin rounded, lateral tubercles of the metazona somewhat obsolete . . . . *curvidens* Stål.
- *bb.* Ovipositor much longer than the hind femora.
  - *c.* Smaller. (Tegmina of female 70 mm.) . . . . *longicauda* Stål.
  - *cc.* Larger. (Tegmina of female 82 mm.) . . . . *gigantea* sp. nov.

AA. Metazona of pronotum unituberculate. Wings unicolorous, infuscated, the transverse veins equally arranged. Posterior femora unicolored on the inner face, pale.
- *b.* Front together with the sternum black. Mesosternum with its anterior angles obtuse . . . . *tenebrosa* Brunner.
- *bb.* Front and sternum pallid. Mesosternum with its anterior angles produced into a spine . . . . *unicolor* Brunner.

81. **Acanthodis gigantea** sp. nov.

Size maximum. General structure and color as described for *longicauda*.

Length of body, ♀, 57 mm., of pronotum, 13 mm., of tegmina, 82 mm., width of tegmina, 16 mm., length of hind femora, 40 mm., of ovipositor 52 mm., width of ovipositor, 6 mm.

Habitat.—The type, a beautiful female specimen, was taken at Quatro Ojos, in the Department of Santa Cruz, Bolivia, during the month of November at an elevation of 300 meters above sea-level. (J. Steinbach.) It is the property of the Carnegie Museum.

82. **Acanthodis tenebrosa** (Brunner).

Brisilis tenebrosa BRUNNER, Mon. Pseudophyll., pp. 132, 134 (1895).
Acanthodis tenebrosa Kirby Syn. Cat. Orth., II, p. 319 (1906).

A single female of this species is contained in the collection made at Puerto Suarez, Bolivia. It was also taken by J. Steinbach during the period November to January inclusive. It is quite typical.

Genus PRISTES Brunner.

Pristes BRUNNER, Mon. Pseudophyll., pp. 16, 135 (1895); SAUSSURE & PICTET, Biol. Cent.-Amer., Orth., I, p. 411 (1898).

This small genus of the Pseudophyllidæ seems to be confined to northern South America and Central America. It is represented by two female specimens which appear to belong to a new species intermediate between the two described forms. The species of *Pristes*, including the present, may be recognized as follows:

SYNOPSIS OF THE SPECIES OF PRISTES.

A. Pronotum between the tubercles granular.
 b. Sternum black. Size larger . . . . *tuberosus* Stål.
 bb. Sternum brown. Size smaller . . . . *colombiæ* sp. nov.
AA. Pronotum between the tubercles almost smooth. Sternum concolorous.
minor Brunner.

83. **Pristes colombiæ** sp. nov.

As indicated by the above table, this insect is intermediate between *tuberosus* Stål and *minor* Brunner. It is rather dark fusco-testaceous, varied with green on the tegmina along the costal field near the base and the median veins, and marked with dark fusco-cinereous on the legs. On the tegmina near the base of the disc is located a patch of ochraceous blotches, while the outer side of the hind femora are also rather largely testaceous on their middle one-third. Front, including the clypeus, brunneo-piceous, bordered with testaceous; cheeks and occiput longitudinally alternately pale and dark banded.

Length of body, ♀, 49 mm., of pronotum, 11 mm., of tegmina, 56 mm., width of tegmina about 13 mm.; length of hind femora, 33 mm., of ovipositor, 30 mm.

Habitat.—Bonda and Don Diego, Department of Magdalena, Colombia, in May and June, at an elevation of 100 feet to 250 meters above sea-level. (H. H. Smith.) The type is in the Carnegie Museum.

Genus LEUROPHYLLUM Kirby.

Platyphyllum SERVILLE, Ins. Orth., p. 443 (1839)—in part.
Leurophyllum KIRBY, Syn. Cat. Orth., II, p. 320 (1906).
For other synonymy see KIRBY, *l. c.*

While the representatives of the present genus are rather numerous and widely distributed over the neotropical regions, there are but fourteen forms recognized so far. Twelve of these are described in Brunner's Monograph of the family Pseudophyllidæ. There are before me specimens of two species, neither of which seem to agree with any of those treated by Brunner. His key for the disposal of the species recognized by himself is given herewith with such modifications as are necessary to include the two apparently new forms. I do not happen to have the description of *regimbarti* Griffini at hand, while Walker's species is recognizable only by examination of the type.

SYNOPSIS OF THE SPECIES OF LEUROPHYLLUM.

A. Anterior femora compressed at their base, a little curved, above acutely carinated or sulcate. Wings of one color.
- *b*. Femora all lengthily pilose beneath. Ovipositor narrow. (Front black).
  - *c*. Wings smoky, unicolored.
    - *d*. Pronotum unequal, but not granulose. Cerci of the male simply spined.
      - *e*. Anterior femora below with the anterior margin smooth or two-spined, the posterior margin subundulate. *transiens* Brunner.
      - *ee*. Anterior femora below three-spined, the posterior margin straight. . . . .*unicolor* Brunner.
    - *dd*. Pronotum granulose (closely verrucose). Cerci of male bidentate at the apex. . . . .*granulosum* Brunner.
  - *cc*. Wings infumed, the transverse veins pale bordered.
    - *d*. Tegmina with their veins and veinlets fuscous. Posterior femora below almost spineless (at the apex two-spined). *pleminioides* Brunner.
    - *dd*. Tegmina with their veins and veinlets concolorous, provided with castaneous areoles. Posterior femora below six-spined. *guttatum* Brunner.
- *bb*. Femora all remotely pilose or smooth below. Ovipositor heavy.
  - *c*. Front black or gray. Anterior femora two-spined below.
    - *d*. Ovipositor at middle one-fifth as wide as long. Subgenital plate of female profoundly incised. [Amazonica]. *brevixiphum* Brunner.

dd. Ovipositor at middle not over one-sixth as wide as long. Subgenital plate of female very little emarginate. [Bolivia].
angustixiphum Brunner.

cc. Front concolorous or pale bluish-gray. Anterior femora below three- to four-spined.

d. Anterior femora three-spined below.

e. Color greenish testaceous. Clypeus more than twice as wide as long, largely black.

f. Posterior femora black on their inner side or face.
consanguineum Serville.

ff. Posterior femora with little black on the inner face.
bolivianum sp. nov.

ee. Color pale yellow. Clypeus equally as long as wide.
luridum Brunner.

dd. Anterior femora four-spined below. Intermediate tibiæ two-spined above. Last segment of abdomen black in both sexes.
nigricaudum sp. nov.

AA. Anterior femora not compressed, above almost rounded. Wings smoky, and variegated with paler.

b. Tegmina testaceous.

c. Wings fuscous, the transverse veins bordered with white. Anterior femora below three-spined. [Mexico] .... *toltecum* Saussure.

cc. Wings somewhat smoked, the transverse veins broadly margined with fuscous. Anterior femora one-spined below.
unispinulosum Brunner.

bb. Tegmina greenish. (Wings tessellate with fuscous and pallid). [Brazil. Peru, etc.] .... *maculipenne* Serville,

84. **Leurophyllum bolivianum** sp. nov.

About the size of *luridum* Brunner, but differing from that insect, as indicated in the synoptical key of species. General color greenish testaceous, quite profusely and rather prominently variegated with paler and fuscous maculations. The pronotum rugulose, the transverse sulci deeply impressed, the disc on the hind lobe flattened, longitudinally streaked with fuscous. Front lurid (♀) or bluish gray (♂), the clypeus formed much as described for the much larger *consanguineum.* Anterior femora three-spined below, the intermediate four-spined, posterior seven- to eight-spined; all the legs rather prominently variegated with black or fuscous. Dorsal margin of closed tegmina prominently marked alternately with pallid and fuscous maculations. Ovipositor moderately robust, the base at sides and above and all of the apical half black. Cerci of male with the apex terminating with a single prominent inwardly directed tooth.

Length of body, ♂, 32 mm., ♀, 37 mm.; of pronotum, ♂, 7.25 mm., ♀, 8 mm.; of tegmina, ♂, 33 mm., ♀, 41 mm.; width of tegmina, ♂, 7.5 mm., ♀, 8 mm.; length of hind femora, ♂, 19.5 mm., ♀, 23 mm.; of ovipositor, 17 mm.

Habitat.—Santa Cruz de la Sierra, Bolivia, at an elevation of 450 meters above sea-level. (J. Steinbach collector.) The types, ♂ and ♀, are the only specimens examined. They belong to the Carnegie Museum.

85. **Leurophyllum maculipes** sp. nov.

There are four other specimens at hand which rather strongly resemble this species both in color and size, but differ in spine-characters. The anterior femora are four-spined below, as are also the intermediate pair. The middle tibiæ above are one- to two-spined. The color variations from those of *bolivianum* are the lacking of most of the greenish tint in the general color and the addition to the number and regularity of the fuscous maculations, there being considerable regularity in the transverse fuscous markings of the tegmina. The ovipositor is somewhat slenderer and a little more arcuate, while it is not black on the sides and above at the base. I suggest the name, *Leurophyllum maculipes* for this second insect. It measurements are practically those of the preceding form. In the table of species *maculipes* would fall in the section with *nigricaudum*.

Habitat.—Four specimens, 1♂, 3♀♀, are at hand. They come from the Province del Sara, Bolivia, where they were collected during November at 350 meters above sea-level (J. Steinbach). The typical specimens are also in the insect collection of the Carnegie Museum.

86. **Leurophyllum nigricaudum** sp. nov.

Of about the same stature as the two preceding but lacking much of the maculations exhibited in them. The chief distinguishing color characteristic of *nigricaudum* is the uniform black anal segment of both sexes. General color of tegmina and body a dark cinereo-testaceous. Front gray. Dorsal margins of the tegmina more or less clearly alternately brown and pale maculate. Pronotum and legs fusco-varied, the flecks on the latter chiefly external and more or less gathered into patches; internally the hind femora are pallid. Ovipositor heavy, nearly straight above, the apical half deep piceous.

Length of body, ♂, 37 mm., ♀, 38 mm.; of pronotum, ♂, 8.15 mm., ♀, 8.7 mm.; of tegmina, ♂, 37 mm., ♀, 40 mm.; width of tegmina,

♂, 8.5 mm., ♀, 9 mm.; length of hind femora, ♂ and ♀, 21–22 mm.; of ovipositor, 19.5 mm.

Habitat.—These insects come from Puerto Suarez, Bolivia, at an elevation of 150 meters above sea-level. They were collected by J. Steinbach during the months of November to January inclusive. The types are deposited in the Carnegie Museum.

Genus PLATYPHYLLUM Serville.

Platyphyllum SERVILLE, Ann. Sci. Nat., XXII, p. 145 (1831); *Ib.*, Ins. Orth., p. 443 (1839); STÅL, Recens. Orth., II, p. 62 (1874).
? *Platyphyllus* BURMEISTER, Handb. Ent., II, p. 699 (1838).
Lissophyllum BRUNNER, Mon. Pseudophyll., pp. 16, 143 (1895).

If I have rightly determined it, only a single representative of this genus is before me and it seems to be new.

87. **Platyphyllum nigriventris** sp. nov.

Nearly maximum in size, the pronotum obtusely rugulose; the transverse sulci moderately deep, the lower margin of the sides of pronotum rather heavily bordered and somewhat rugulose. Body strongly depressed.

General color brunneo-cinereous with a more or less distinct greenish tinge on the pronotum, tegmina, pleura, and apex of femora, most apparent in the male; this color rather relieved by numerous irregular markings of fuscous on the cheeks, occiput, pronotum, legs, and tegmina. Front glossy black bordered widely with white, the fastigium of the front white; antennæ pale, streaked and annulated with fuscous. Sternum and underside of abdomen rather broadly black. Tegmina lanceolate, the apex subacuminate. Wings infumate, not tesselated. Anterior femora below minutely two-spined on anterior edge; middle pair with four large spines externally, the hind pair eight-spined. All the legs lengthily hirsute. Genicular lobes of anterior and posterior femora spined on both sides, inner lobes of middle femora spined, outer lobes broadly rounded. Middle coxæ quite prominently tubercled below at the apex. Last ventral segment of abdomen of male or subgenital plate narrowed, deeply emarginate, and armed with long and heavy styles. Subgenital plate of female, rather small, tapering, the apex roundly emarginate. Ovipositor rather robust, almost straight above and with the upper margin crenulate.

Length of body, ♂, 33 mm., ♀, 31 mm.; of pronotum, ♂ and ♀, 8.25 mm.; of tegmina, ♂, 37 mm., ♀, 41 mm.; width of tegmina, ♂, about 7.5 mm., ♀, about 10 mm.; length of hind femora, ♂, 22 mm., ♀, 25.5 mm.; of ovipositor, 19.5 mm.

Habitat.—1♂, 1♀. Province del Sara, Bolivia, at an elevation of 350 meters above sea-level. The female was collected during October and the male in either April or May (J. Steinbach). The types are in the Carnegie Museum.

Genus JAMAICANA Brunner.

Jamaicana BRUNNER, Mon. Pseudophyll., pp. 16, 146 (1895).

The present genus is characteristic of the Island of Jamaica, West Indies, where it is represented by at least three species. Two of these have been described heretofore; while the third is now characterized.

SYNOPSIS OF THE SPECIES OF JAMAICANA.[4]

A. Pronotum unicolored. Wings unicolored. Wings yellowish, the veins ferruginous, with the transverse veins narrowly black-bordered. Posterior tibiæ spined on the external border .... *unicolor* Brunner.

AA. Pronotum vittate with fuscous. Posterior tibiæ not spined on the outer margin.

- *b*. Smaller (♀, 40 mm.); the pronotum rugulose, provided with a black vitta along each of the lateral carinae. Wings strongly infumate, almost fuscous .... *subguttata* Walker.
- *bb*. Larger (♀, 46 mm.); the pronotum subglabrous, not only provided with lateral vittæ along the carinæ but also with the disc largely piceous. Wings flavous, narrowly infuscated along the transverse veins. *superba* sp. nov.

88. **Jamaicana unicolor** Brunner.

Jamaicana unicolor BRUNNER, Mon. Pseudophyll., p. 147 (1895); KIRBY, Syn. Cat. Orth., II, p. 322 (1906).

There are several specimens, male and female, of this species at hand. They come from the Island of Jamaica, and form part of the Carnegie Museum, Accession No. 2306.

89. **Jamaicana subguttata** Walker.

Meroncidius subguttatus WALKER, Cat. Dermap, Salt. B. M., III, p. 445 (1870).
Jamaicana vittata BRUNNER, Mon. Pseudophyll., p. 147 (1895); KIRBY, Syn. Cat. Orth., II, p. 322 (1906).

The Jamaica material at hand also contains several specimens which belong to *subguttata* of Walker. The females average much darker

[4] An additional species is included in the genus by Kirby (Syn. Cat. Orth., II, p. 322), but I have not included it here since it is not native to Jamaica.

than the males in their coloration. They are also much larger as seems to be the rule in the various representatives of the genus. These latter specimens also belong to Accession No. 2306.

90. **Jamaicana superba** sp. nov.

Size large, form robust. Spine characters as given in synoptic table. Head and pronotum sub-glabrous, the rugæ of the pronotum, although fairly numerous, small and inconspicuous, the transverse sulci inconspicuous, not deeply impressed. General color including the tegmina flavo-testaceous. Occiput and disc of pronotum largely brunneo-piceous. There are four rather large spots or patches on the pleura and the sides of the basal abdominal segment are also black. Apical half of the ovipositor more or less piceous.

Length of body, ♀, 46 mm., of pronotum, 11.5 mm., of tegmina, 46 mm., width of tegmina, 11 mm., length of hind femora, 30 mm., of ovipositor, 20 mm.

Habitat.—The type and only specimen examined comes from the Island of Jamaica, West Indies, where it was collected by F. Klages. It is deposited in the Carnegie Museum of Pittsburgh and forms part of the collection of Dr. W. J. Holland, Accession L. No. 131.

Genus MERONCIDIUS Serville.

Meroncidius SERVILLE, Rev. Meth., Ann. Sci. Nat., XXII, p. 53 (1831); *Ib.*, Hist. Orth., 448 (1839); BRUNNER, Mon. Pseudophyll., pp. 17, 148 (1895); KIRBY, Syn. Cat. Orth., II, p. 322 (1906).

Meroncidium STÅL, Œfv. Vet.-Akad. Förh., XXX, (4), p. 46 (1873).

All the representatives (eleven) of the genus *Meroncidius* excepting *M. fuscus* recorded in Kirby's Synonymic Catalogue of the Orthoptera are credited to strictly South American territory. In the material now being studied I find several specimens of a species which apparently should be located in this genus. It seems to be distinct from the described forms.

91. **Meroncidius insularis** sp. nov.

Related to *M. ochraceus* Burmeister, but differing from it in several respects, as noted in the following brief description.

Size large, the antennæ excessively long, in the male fully three times, in the female more than twice, the length of the body including the ovipositor. Pronotum somewhat rugulose, but nowise tuberculate, the hind transverse sulcus profound, the disc back of this sulcus somewhat flattened, anterior margin broadly rounded, the middle provided with a minute tubercle in the male, but smooth in the female. Tegmina moderately broad and rather long, testaceo-cinereous, feebly marmorate with fuscous, the speculum of the male margined with castaneous. Legs moderately robust; the anterior femora flattened below, the front margin three-spined, intermediate pair four-spined externally, hind pair seven-spined; intermediate tibiæ two-spined above near the base. Ovipositor heavy, straight, about one-seventh as broad as long, only gently obliquely truncate, the disc smooth.

General color ochraco-cinereous, irregularly variegated with fuscous. Front gray or greenish-gray. Pronotum with the disc bordered laterally with piceous vittæ, which extend from the front to hind margins. Anterior femora beneath varying from testaceous through oil-green to dull gray. Ovipositor strongly infuscated beyond the middle. Wings pallid, the transverse veins a little embrowned. Antennæ pale at base, becoming dusky beyond, not annulate.

Length of body, ♂ and ♀, 46 mm.; of pronotum, ♂, 9.5 mm., ♀, 10 mm.; of tegmina, ♂, 45 mm., ♀, 50 mm.; width of tegmina, ♂, 10 mm., ♀, 11 mm.; length of hind femora, ♂, 30 mm., ♀, 31 mm.; of ovipositor, 28 mm.

Habitat.—Jamaica, West Indies. Several specimens from the collection of Dr. W. J. Holland, (coll. F. Klages) Acc. L. No. 131; and others labeled "Jamaica W. I., Accession No. 2306." The types, ♂ and ♀, are in the Carnegie Museum.

Genus ANCHIPTOLIS Brunner.

Anchiptolis BRUNNER, Monog. Pseudophyll., pp. 18, 170 (1895); SAUSSURE & PICTET, Biol. Cent.-Amer., Orth., I, p. 421 (1898).

This is another of the tropical American genera of the Pseudophyllidæ which seems to be represented in the present collection. According to Kirby's Synonymic Catalogue there have been nine species described. Our specimen does not appear to fit any of these descriptions, and accordingly is presented herewith as new.

92. **Anchiptolis chapadensis** sp. nov.

Approaching *A. pleminioides* Brunner, but differing from it in size and color. General color cinereo-testaceous, variegated with brown and fuscous. Front pale gray, margined at sides by a pale testaceous line reaching from the lower inner margin of eyes to the outer base of the clypeus. Antennæ unicolorous, ferruginous. Pronotum bluntly rugulose, marmorate with grayish fuscous. Tegmina with the veins and cross-veins narrowly bordered with fuscous, giving to these wings a netted appearance; posterior margin rather widely alternately pale and brown maculate. Wings uniformly pale fuscous, or strongly enfumed. Ninth and tenth abdominal segments above glossy black. Legs all profusely varied with fuscous bands and lines. Anterior and middle femora below four-spined, posterior pair six- or seven-spined. Front tibiæ flattened above, a little swollen below the foramina and without apical spines; intermediate tibiæ a little compressed and dilated basally, two-spined above.

Length of body, ♀, 35 mm., of pronotum, 8 mm., of tegmina, 38 mm., width of tegmina, 9 mm., length of hind femora, 23 mm., of ovipositor, 19 mm.

Habitat.—The only specimen at hand, a female and the type, comes from Chapada, Brazil, where it was taken during the month of August by H. H. Smith. It is to be found in the insect collections of the Carnegie Museum.

Genus LIPAROSCELIS Stål.

Liparoscelis STÅL, Obs. Orth. Œfv. Vet.-Akad. Förh., XXX, (4) p. 47 (1873); BRUNNER, Mon. Pseudophyll., pp. 18, 174 (1895).

A female specimen coming from Bom Fim, Bahia, Brazil, has been determined as belonging to this genus. It does not, however, agree with the described species.

93. **Liparoscelis brasiliensis** sp. nov.

Moderately robust, general color fusco-olivaceous, profusely variegated with black on the head, pronotum, tegmina, and legs. Falling in the same section with *nigrispinis* Stål, but differing from it in a number of respects.

Front somewhat depressed, but convex, comparatively smooth, with few punctures and transverse aciculations. Pronotum somewhat flattened above, rather densely and coarsely granulose. Tegmina abbreviated, the ulnar margins overlapping, the apex rounded, reaching the hind border of the second abdominal segment. Anterior and median femora moderately robust, the former below on the anterior border three- to four-spined, the latter three-spined; hind femora four- to five-spined; the anterior tibiæ smooth above, six-spined on both margins below; the intermediate seven-spined on both margins; hind tibiæ above on the external margin three- to four-spined. Subgenital plate of female short, broadly rounded at the center, narrowly, but roundly, emarginate. Ovipositor nearly straight, the base heavy, the apex lengthily acuminate.

Front with two oblong depressed black spots; occiput between two narrow testaceous lines solidly black, the sides of the face back of the eyes also provided with an oblique black dash. Pronotum with several depressed glabrous areas which are likewise black. Tegmina with the costal and oblique transverse veins piceous, the disk above more or less infuscated. Femora, especially the anterior and median, profusely transversely maculate with black; the front tibiæ internally, the median externally longitudinally streaked with the same color. Apical half and lateral carinæ basally piceous. Spines of legs pale, black-tipped.

Length of body, ♀, 40 mm., of pronotum, 9.25 mm., of tegmina, 12 mm., of hind femora, 19.5 mm., of ovipositor, 18 mm., width of latter near the base 3.75 mm.

Habitat.—The only specimen at hand, the type, bears the following label: "Bom Fim, Bahia (at Facenda Amaratii), Oct. 20, 1908. J. D. Haseman collector." The type is deposited in the Carnegie Museum.

Genus COCCONOTUS Stål.

Cocconotus STÅL, Œfv. Vet.-Akad. Förh., XXX, (4), p. 46 (1873); *Ib.*, Recens. Orth., II, pp. 65, 89 (1874); BOLIVAR, Viaje al Pacif., Ins., p. 70 (1884); BRUNNER, Mon. Pseudophyll., pp. 19, 198 (1895); GIGLIO-TOS, Boll. Mus. Torino, XIII, no. 311, p. 95 (1898); SAUSSURE & PICTET, Biol. Cent.-Amer. Orth., I, p. 425 (1898).

Representatives of this genus are abundantly distributed in tropical American countries from southern Mexico to Peru. Being arboreal and to a certain extent also diurnal, most of the species are rather pale or light-colored, many of them being more or less green-tinted. According to Kirby's Synonymic Catalogue of the Orthoptera there had been thirty-three separate species recognized up to the beginning of 1906. The material now at hand contains a specimen of what seems to be an additional species. There are also two others represented.

94. **Cocconotus retiarius** Stål?

Cocconotus retiarius STÅL, Recens. Orth., II, p. 90 (1874); BRUNNER, Monog. Pseudophyll., pp. 199, 202 (1895).

A female specimen coming from Bogota, Colombia, is doubtfully referred here. It was taken by H. H. Smith.

95. **Cocconotus vittagenæ** sp. nov.

Related to *C. degeeri* Stål and *aratifrons* Brunner, but distinct from both of these in color. Antennæ excessively long, ferruginous. Front similar to that of the species to which compared, *i. e.* glossy black, partially separated into three broad vittæ on upper two-thirds by two narrow wedge-like pale streaks coincident with the inner margins of the antennal scrobes, the median dark vitta continuing mesially nearly half way across the clypeus; the two lateral of the five black vittæ are located on the cheeks and separated from the black front by a prominent band of testaceous; outer portion of lip and mandibles also black. Pronotum at sides testaceous, above brunneo-ferruginous, fore and hind margins, except of the disc behind, narrowly black-bordered. Elytra testaceo-ferruginous, except on the costal field, where the veinlets are largely green. Legs pale ferruginous, the spines entirely black. Ovipositor rather robust, on the outer or apical half together with the upper and lower margins broadly castaneous.

Length of body, ♀, 30 mm., of pronotum, 8 mm., of tegmina, 42 mm., width of tegmina, about 7.5 mm., length of hind femora, 23 mm., of ovipositor, 17 mm.

Habitat.—Don Diego, Department of Magdalena, Colombia, at an elevation of 100 feet above sea-level, in May (H. H. Smith.) Type in the Carnegie Museum.

96. **Cocconotus angustatus** Brunner?

Cocconotus angustatus BRUNNER, Mon. Pseudophyll., pp. 201, 210 (1895).

A single female taken by J. Steinbach in the "Province del Sara," Bolivia, is referred here with some doubt. It was taken at a point 450 meters above sea-level.

Genus NANNOTETTIX.

Nannotettix BRUNNER, Mon. Pseudophyll., pp. 19, 212 (1895).

Only a single specimen of the genus *Nannotettix* is at hand and it seems to be new.

97. **Nannotettix steinbachi** sp. nov.

Most closely related to *guentheri* Brunner, but differing from it in the somewhat larger size, the absence of the black lines from the sides of the pronotum, etc.

General color brunneo-testaceous, with darker markings on the sides of the abdomen, and a pale yellowish line on the sides of the occiput and along the pronotal carinæ. Antennæ unicolorous, ferruginous. Face of female dirty greenish gray, of male grayish brown, sides of front yellow-bordered in female, orange-bordered in male. Pronotum rugulose both above and at the sides, the transverse sulci deeply impressed. Tegmina brown with testaceous nervures, reaching the hind border of the first abdominal segment in both sexes, their apex broadly rounded. Abdomen at sides and dorsally wood-brown varied with piceous, most strongly so in the male, where the sides are almost entirely of this color, while in the female the posterior margins of the segments alone are thus marked. Immediately above this dusky maculation there is a well-marked longitudinal testaceous line giving to the insect a vittate appearance. Beneath testaceous, the femora ferruginous, a little paler at their base, darker apically. Anterior and middle femora below three- to four-spined, hind femora about seven-spined. Last ventral segment of the abdomen of the male somewhat attenuated, the apex roundly emarginate, the styles large, about five times as long as broad, the apex blunt. Cerci pallid in both sexes, in the male very robust, bullate, with the apex greatly constricted, bent inwardly, and provided with an anteriorly directed spine. Ovipositor normal, the apical half rubro-piceous. Subgenital plate of female triangular, the apex triangulately emarginate.

Length of body, ♂, 24 mm., ♀, 34 mm.; of pronotum, ♂, 5 mm., ♀, 6.35 mm.; of tegmina, ♂ and ♀, 5 mm.; of hind femora, ♂, 16.5 mm., ♀, 20 mm.; of ovipositor, 14 mm.

Habitat.—Santa Cruz de la Sierra, Bolivia, 450 meters above sea-level, J. Steinbach, collector. The types, male and female, are in the Carnegie Museum.

Genus DIOPHANES Stål.

Diophanes STÅL, Bihang Svensk. Akad., III, (14), p. 38 (1874); BRUNNER, Monog. Pseudophyll., pp. 21, 241 (1895); SAUSSURE & PICTET, Biol. Cent.-Amer., I, p. 446 (1898).

Platyphyllum BRULLÉ, (*partim*), Hist. Nat. Ins. IX, p. 138 (1835).

The species of this genus, all of which are green, are tropical American in their distribution. Six have been recognized according to Kirby's Synonymic Catalogue. Another is now added. They may be separated by the accompanying synoptic table.

SYNOPSIS OF THE SPECIES OF DIOPHANES.[5]

A. Genicular lobes of the anterior femora obtuse; those on the middle femora internally armed with a spine. Middle tibiæ spined above.

b. Humeral vein on the distal half diverging from the discoidal vein; branch of hind radial arising before the middle. Wings roseate; styles of the subgenital plate of the abdomen of male long.

c. Wings beautiful rose-colored. Ovipositor slender. [Mexico, Central, and South America]....................... *perspicillatus* Fabricius.

cc. Wings hyaline roseate. Ovipositor very broad. [Panama.] *rosescens* Saussure & Pictet.

bb. Humeral vein contiguous with the discoidal vein for a long distance, at the apex suddenly deflexed.

c. Spines of the hind femora pale, their apex fuscous.

d. Somewhat large. Metazona of the pronotum of male flattened. Tegmina with the branch of the median starting beyond the middle; tympanal field black-bordered. Wings whitish. [Bolivia]................................ *atrosignatus* Brunner.

dd. Smaller. Metazona of pronotum of male ascending. Tegmina with the branch of the median arising before the middle; tympanal field pale-bordered. Styles very short [Mexico]. *abbreviatus* Brunner.

cc. Spines of the hind femora black at their base and paler towards the apex, or wholly black.

d. Hind femora with the spines pale towards the apex. Wings smoky. [Peru, Upper Amazons]..... *nigro-spinosus* Brunner.

dd. Hind femora with the spines entirely black. Wings pale yellowish white. [Bolivia].................. *atrospinosus* sp. nov.

AA. Genicular lobes of all the femora each minutely spined, or those of the front pair sometimes triangular. Intermediate tibiæ unarmed above. Wings infuscated. [Martinique, West Indies]............... *scabricolle* Serville.

98. **Diophanes atrosignatus** Brunner.

Diophanes atrosignatus BRUNNER, Monog. Pseudophyll., p. 242 (1895); SAUSSURE & PICTET, Biol. Cent.-Amer. Orth., I, p. 446 (1898).

There are two specimens, male and female, of *Diophanes* before me, which I am inclined to refer to Brunner's *atrosignatus*, although they do not agree with the description in every respect.

[5] Modified from Saussure & Pictet (Biologia Centrali-Americana, Orth. I, p. 446 (1898).

Habitat.—The male bears the label "Rio Japacani, Department of Santa Cruz, Bolivia," while the female was taken at Las Juntas, in the same department. (J. Steinbach.)

99. **Diophanes atrospinosus** sp. nov.

As indicated by the synoptic key, as well as by the specific name, the present species is at once characterized by its black femoral spines. Size medium, color above bright green. Head, legs, and underside flavo-testaceous. Antennæ long, ferruginous. Tarsi infuscated. Pronotum rather closely and sharply granulose, wider than long, somewhat saddle-shaped, the metanotum a little produced and elevated, flattened, and with the hind margin roundly truncated. Tegmina considerably longer than the abdomen, the margins nearly parallel, the extreme posterior margin infuscated. Branch of the posterior radial arising near the middle, somewhat mixed with cross-veins, so as to render its recognition more or less difficult, the posterior radial terminating near the beginning of the apical third of the elytra. Femoral genicular spines rather prominent. Anterior femora three-spined, intermediate five-spined and posterior eight- to nine-spined below; those on the anterior and middle pairs black-tipped, on hind straight, slender, and rather long, entirely black. Middle tibiæ two-spined above. Male cerci long and somewhat sinuose, gently tapering, provided with an inwardly directed spine at tip; the sub-genital plate narrow, elongate, deeply and roundly fissured.

Length of body, ♂, 35 mm., of pronotum, 7.25 mm., of tegmina, 46 mm., width of tegmina about 11 mm., length of hind femora, 20.5 mm.

Habitat.—Santa Cruz de la Sierra, Bolivia, at an altitude of 450 meters above sea-level. J. Steinbach, collector. The type alone is at hand. It belongs to the Carnegie Museum.

Genus TYPOPHYLLUM Serville.

Typophyllum SERVILLE, Ins. Orth., p. 439 (1839); PICTET, Mem. Soc. Genève, XXX, (6), p. 24 (1888); BRUNNER, Mon. Pseudophyll., pp. 22, 257 (1895).
Tovaria BOLIVAR, Ann. Soc. Ent. Fr. (6), X, p. 141 (1890).

The representatives of the present genus are all South American and occur only in the tropical forests. More than a dozen species have been recognized and described. They are remarkably leaf-like in appearance.

100. **Typophyllum helleri** Brunner.

Typophyllum helleri BRUNNER, Mon. Pseudophyll., pp. 258, 259 (1895).

A single partially mutilated female specimen of this species is at hand. It comes from Pará, Brazil, where it was probably taken by H. H. Smith. It was collected in the month of April.

Genus CHLOROPHYLLA Pictet.

Chlorophylla PICTET, Mem. Soc. Genève, XXX, (6), p. 42 (1888); BRUNNER, Mon. Pseudophyll., pp. 22, 265 (1895); SAUSSURE & PICTET, Biol. Cent.-Amer. Orth., I, p. 455 (1898).

101. **Chlorophylla falcifolia** Walker.

Cycloptera falcifolia WALKER, Cat. Derm. Salt. B. M., III, p. 463 (1870).
Cycloptera arcuata SAUSSURE & PICTET, Biol. Cent.-Amer. Orth., I, pp. 455, 456, pl. 22, fig. 19 (1898).

The male of this species is represented by a single specimen taken at Quatro Ojos, Department of Santa Cruz, Bolivia (J. Steinbach).

102. **Chlorophylla latifolia** Pictet.

Chlorophylla latifolia PICTET, Mem. Soc. Genève, XXX, (6), p. 43, pl. I, figs. 14, 14a (1888).

Three females of this genus coming from Puerto Suarez, Bolivia, are referred here. They were taken by J. D. Haseman

Family LISTROSCELIDÆ.

Like the Agræciidæ the representatives of the present family are also tropical in their distribution. The American genera number only seven with twenty-six recognized species. The life-history of these insects is almost unknown, but it is surmised that they are chiefly insectivorous. The genera may readily be separated by the following synoptical key which is a modification of that of Karny as published in *Genera Insectorum*, Fascicle No. 131.

SYNOPSIS OF TROPICAL AMERICAN GENERA OF LISTROSCELIDÆ.

A. Auditory foramina of anterior tibiæ on both sides, or at least on the outer, with margin wide open.
- *b*. Tegmina fully developed, but shorter than the wings....... *Phlugis* Stål.
- *bb*. Tegmina greatly abbreviated........................ *Phlugiola* Karny.

AA. Auditory foramina of anterior tibiæ on both sides shell-like or linear.
- *b*. Face with the front rugulose, wrinkled................ *Cerberodon* Perty.
- *bb*. Face more or less smooth, not wrinkled.
  - *c*. Tegmina and wings fully formed.

d. Large, tegmina basally without a spot. . . *Monocerophora* Walker.

dd. Not so large. Tegmina basally in front provided with a pale spot. . . . . *Listrocelis* Serville.

cc. Tegmina and wings abbreviated, lobate, or scale-like.

d. Legs robust. General color, including the femora, brunneo-ferruginous.

e. Left mandible of the male greatly lengthened, angulately bent at middle [Cuyabá, Matto-Grosso, Brazil]. *Carliella* Karny.

ee. Left mandible of the male normal, not unusually lengthened [Chapada, Brazil]. . . . . *Macrometopon* gen. nov.

dd. Legs very long and slender. General color variable, the femora green or greenish [Colombia]. . . . . *Arachnoscelis* Karny.

Genus PHLUGIS Stål.

Phlugis STÅL, Eug. Resa, Orth., p. 324 (1860).

Pilugis WALKER, Cat. Dermapt, Salt. B. M., V, Suppl., p. 15 (1871).

Thysdrus STÅL, Recens. Orth., II, p. 102 (1874), and most authors since.

The insects which comprise the genus *Phlugis* with a single exception are found in tropical America. They are small and inconspicuous, being pale testaceous, or greenish, and usually their tegmina are more or less hyaline. Judging from the spined anterior tibiæ and femora they may be predaceous in their food habit, using this pair of legs for seizing and holding their prey while devouring it. The diagnostic characters are such as size, venation, comparative length of tegmina and wings, the spines on the anterior and middle femora and tibiæ, and the form and arrangement of the various terminal appendages of the male abdomen. Of all of these characters possibly size, spine structure, and the abdominal appendages are most to be relied upon for separating the species. Undoubtedly close and careful collecting over all of tropical South and Central America will bring to light several additional forms. The accompanying synoptic key shows all of the previously described forms together with others now characterized as new.

SYNOPSIS OF THE SPECIES OF PHLUGIS.

A. Tegmina passing beyond the apex of the abdomen.

b. Ovipositor shorter than the female cerci; male not known [Guatemala, French Guiana]. . . . . *infirmus* Saussure & Pictet.

bb. Ovipositor longer than the female cerci.

c. Costal area of the tegmina regularly reticulate, the transverse veins parallel.

d. Anterior area of tegmina provided with seven to fifteen transverse veins.

e. Costal area with seven to nine transverse veins.

f. Cerci of male curved, shorter than the subgenital plate. *tener* Stål.

ff. Cerci of male straight, longer than the subgenital plate. *proxima* sp. nov.

ee. Costal area with twelve to fifteen transverse veins.

f. Costal area with about twelve transverse veins [Mexico, Central America]. . . . . *mexicanus* Saussure & Pictet.

ff. Costal area with about fifteen transverse veins.

g. Posterior margin of the elytra infuscated. Anterior tibiæ five-spined on both of their margins [upper Amazon]. *marginata* Redtenbacher.

gg. Posterior margin of the elytra concolorous.

h. Pronotum behind roundly produced.

i. Cerci of male much shorter than the subgenital plate, not cruciate nor forficate.

j. Valves of the subgenital plate of the male with their superior margin provided with a distinct angle.

k. Size smaller (male tegmina 11 mm.), superior angle of valves of subgenital plate obtuse. *virnes* Thunberg.

kk. Size larger (male tegmina 13.5 mm.). Superior angle distinct. *abnormis* Redtenbacher.

jj. Valves of the subgenital plate above destitute of an angle (male tegmina 9.5 mm.). . *similis* sp. nov.

ii. Cerci of male very long, recurved, forficate, or cruciate. . . . . *caudata* Redtenbacher.

hh. Pronotum truncate behind. The tegmina short. *macilenta* Redtenbacher.

dd. Anterior area of tegmina with about twenty-five cross-veins.

e. Anterior tibiæ five-spined.

f. Front tibiæ unusually elongate and curved. . *nemoptera* Bolivar.

ff. Front tibiæ less elongate and less curved. . . . . . *teres* DeGeer.

ee. Anterior tibiæ four-spined. *mantispa* Bolivar.

cc. Costal field of the tegmina irregularly veined, the cross-veins more or less tortuous.

d. Size smaller (tegmina of female 15 mm.). . . . . . *irregularis* sp. nov.

dd. Size larger (tegmina of female 18 mm.). . . . . . *coriacea* Redtenbacher.

AA. Tegmina not reaching the apex of the abdomen.

b. Middle tibiæ three-spined below [Brazil]. . . . . *cephalotes* Bolivar.

bb. Middle tibiæ unarmed below [Borneo]. . . . . *dubia* Karny.

103. **Phlugis tener** (Stål).

Thysdrus tener STÅL, Recens. Orth., II, p. 117 (1874); REDTENBACHER, Monog. d. Conocephalid., p. 225 (1891).
Phlugis tenera KARNY, Revis. Conoceph., p. 101 (1907).
? *Locusta spinipes* FABRICIUS, Ent. Syst. II, p. 37 (1794).

There are several specimens at hand which I am inclined to place here. They come from Villeta, Paraguay, and Chapada, Brazil. They were taken during the months of April, May, July, and November (H. H. Smith).

104. **Phlugis proxima** sp. nov.

A small inconspicuous insect, which closely resembles *P. tener* of Stål, but which differs from it in several respects, as indicated by the synoptical key printed herewith.

Size small, greenish to pale testaceous, tegmina and wings translucent or pellucid. Antennæ without fuscous annulations. Pronotum elongated and rounded behind. Tegmina not quite reaching the tips of the hind femora, their costal field provided with few transverse veins, about seven to nine. Anterior femora below three-spined in front, four-spined behind; anterior tibiæ five-spined on both margins, the spines slender and acuminate; middle tibiæ two-spined below. Male cerci straight, a trifle longer than the subgenital plate. Latter short, its sides vertical, heavy, contracted at middle, the apical portion viewed laterally spatulate and with the apex obliquely truncated from above, deeply and narrowly fissured at middle.

Length of body, ♂, 12 mm., of pronotum, 3 mm., of tegmina 10 mm., of wings, 16 mm., of hind femora, 9 mm.

Habitat.—A single male, the type, comes from Chapada, Brazil, where it was taken by H. H. Smith during the month of May. It is in the Carnegie Museum.

105. **Phlugis virens** (Thunberg).

Conocephalus virens THUNBERG, Mem. Acad. Petersb., V, p. 274 (1815).
Thysdrus virens STÅL, Recens. Orth., II, p. 117 (1874); REDTENBACHER, Mon. Conocephal., p. 224 (1891).
Phlugis virens KIRBY, Syn. Cat. Orth. Brit. Mus., II, p. 285 (1906); KARNY, Revis. Conocephal., p. 101 (1907).
Phlugis chrysopa BOLIVAR, Orth. Cuba, p. 37 (1888).

There are specimens of this species before me from Rio de Janeiro, Pará, and Chapada, Brazil, and Puerto Suarez and the Province del Sara, Bolivia. They were taken from September to January by H. H. Smith and J. Steinbach.

106. **Phlugis similis** sp. nov.

Green. Related to *virens* Thunberg, from which it differs in its somewhat smaller size and the very different subgenital plate of the abdomen of the male. Anterior tibiæ four-spined as in *P. mantispa* Bolivar.

Pale green, the tegmina somewhat pellucid. Pronotum unicolorous, the hind margin produced, rounded. Tegmina narrow, their tips about reaching the apex of the subgenital plate of the abdomen in the male, the costal area provided with about fifteen cross-veins. Anterior tibiæ four-spined on both margins, those in front rather blunt; the front femora three-spined in front and four-spined behind; middle tibiæ two-spined below. Male cerci moderately robust at their base, gently curved, not quite one-half the length of the subgenital plate. The latter large, broad, with the lateral margins nearly parallel on their basal three-fifths, roundly narrowing beyond, the apex deeply cleft and the two branches twisted, so that their upper surface is apposing somewhat after the fashion of the insect determined by me as *P. mantispa* Bolivar, their upper margin nowise angulate as stated in the descriptions of *virens* Thunberg and *abnormis* Redtenbacher.

Length of body, ♂, 9.5 mm., including subgenital plate 12.5 mm., of pronotum, 2.65 mm., of tegmina, 10 mm., of hind femora, 9 mm.

Habitat.—Bahia, Brazil, October 24, 1907. Collected "by sweeping grass in a garden in edge of the City, J. D. Haseman." The type is the only specimen at hand. It is in the Carnegie Museum, Pittsburgh, Pa.

107. **Phlugis caudata** (Redtenbacher)?

Thysdrus caudatus REDTENBACHER, Mon. Conocephal., p. 223 (1891).

Phlugis caudatus KIRBY, Syn. Cat. Orth. B. M., II, p. 285 (1906); KARNY, Revis. Conocephal., p. 102 (1907).

A single male specimen coming from Quatro Ojos, Department of Santa Cruz, Bolivia, where it was taken by J. Steinbach during November, 1913, is referred to this species with considerable doubt. The very abnormal form of the cerci and subgenital plate do not quite agree with the original description. Especially does this remark hold true regarding the sub-genital plates, which are more like long, somewhat flattened, and gently upwardly curved styles, which are widely separated from their base. The costal area of the tegmina is likewise abnormal, being much narrower than usual and with the median vein running lengthwise through its middle parallel to the costa.

108. **Phlugis nemoptera** Bolivar?

Phlugis nemoptera Bolivar, Mem. Soc. Zoöl. France, I, p. 153 (1888); Kirby, Syn. Cat. Orth. B. M., II, p. 284 (1906); Karny, Revis. Conocephal., p. 102 (1907).
Thysdrus nemoptera Redtenbacher, Mon. Conocephal., p. 221 (1891).

Three specimens coming from the "Province de la Sierra," Bolivia, are referred to this species with some doubt. While agreeing with the description of *P. nemoptera* in most respects, they have a rather prominent orange-colored line running length-wise of the disc of the pronotum, instead of the emerald-green line attributed to that species. They were collected during December by J. Steinbach.

109. **Phlugis teres** (de Geer).

Locusta teres de Geer, Mem. Ins., III, p. 458, Pl. 40, fig. 5 (1778).
Phlugis teres Stål, K. S. Freg. Eugen. Resa., Ins. Orth., p. 324 (1860); Kirby, Syn. Cat. Orth. B. M., II, p. 285 (1906).
Thysdrus teres Stål, Recens. Orth., II, p. 116 (1874); Redtenbacher, Mon. Conocephal., p. 222 (1891).

Three specimens, 1♂ and 2♀♀, from Chapada, Brazil, are referred to de Geer's species. They were taken by H. H. Smith in April and May. There is also a pair taken by J. Steinbach at "Sta. Cruz de la Sierra," Bolivia, at an elevation of 450 meters above sea-level.

110. **Phlugis mantispa** Bolivar.

Phlugis mantispa Bolivar; Orthopt. Cuba, p. 30 (1888); Kirby, Syn. Cat. Orth. B. M., II, p. 285 (1906).
Thysdrus mantispa Redtenbacher, Mon. Conocephal., p. 222 (1891).

A number of specimens of both sexes, coming from Bolivia, Brazil, and Paraguay have been referred to Bolivar's species *P. mantispa* originally described from Cuban material. These insects were collected by H. H. Smith and J. Steinbach, the latter having taken a specimen at Puerto Suarez, Bolivia.

111. **Phlugis irregularis** sp. nov.

Size medium, green, or greenish testaceous, the antennæ more or less fasciate with fuscous. Tegmina and exposed apical portion of wings somewhat coriaceous. Most closely related to *P. coriacea* Redtenbacher, but decidedly smaller, as will be seen by a reference to the foregoing table of species.

Pronotum somewhat produced behind, the posterior border evenly rounded. Tegmina of medium width, tapering but little apically, the tips extending beyond the apex of the hind femora, obliquely rounded from below. Costal area with the transverse veins somewhat irregular, the median vein reaching the costal margin at about the middle of the tegmen. Anterior femora below three-spined in front and four-spined behind; anterior tibiæ four-spined on both margins, the spines robust and blunt at tips, decreasing in length from base to apex; middle tibiæ two-spined externally and provided internally with two to three minute spines. Ovipositor normal, the cerci curved, evenly tapering, reaching a trifle beyond the middle of the slender portion of the ovipositor.

Length of body, ♀, 14 mm., of pronotum, 3 mm., of tegmina, 14.5–15 mm., of hind femora, 10.5 mm., of ovipositor, 3.5 mm.

Habitat.—Puerto Suarez, Bolivia, at 150 meters elevation above sea-level, November to January, 2 ♀ ♀, collected by J. Steinbach. Two others, also females, come from the "Province del Sara," at an altitude of 350 meters, where they were taken in December. Still a fifth example is at hand. This latter bears the label "São Luiz de Caceres, Rio Paraguay, Matto Grosso, Brazil, May 17, 1909." It was taken by J. D. Haseman. The type is in the Carnegie Museum.

Genus MACROMETOPON gen. nov.

The insect which is the type of the present genus is a representative of the family *Listroscelidæ*. It is related to *Carliella* Karney, and might be placed in that genus, were it not for the differences in the development of the mandibles.

The present genus may be characterized as follows: Head very large, considerably wider than the anterior portion of the pronotum, the occiput rounded, without a longitudinal median carina; fastigium of the vertex greatly compressed, much narrower than the diameter of the first antennal joint, its apex somewhat advanced and widely separated from the fastigium of the front; lower part of the face and especially the mandibles and labrum considerably elongated as in *Anostostoma* and one or two other genera of the family *Stenopelmatidæ*. Maxillary palpi elongate, slender. Eyes prominent, slightly elongate; ocelli small, the median situated just within a line drawn from the lower margin of the eyes. Pronotum broadest above the insertion of anterior legs with the anterior edge wider than the posterior, the latter elevated and almost straight behind, the front also nearly straight, principal sulcus very profound; lower edge of the lateral lobes nearly straight. Tegmina present but abbreviated, the stridulating veins well developed. Legs long, the anterior femora robust, fully twice the length of the pronotum, broadly sulcate beneath and spined as well as finely serrated on both margins; anterior tibia slenderer, and more elongate, somewhat bowed (the auditory openings on both sides linear), both edges provided with six long, strong, articulated spines, the apical pair much the shortest. Intermediate femora shorter and less robust, the under side also sulcate and both serrate and spined, the spines, however, being smaller. Hind femora long, robust on basal half, slender beyond, the genicular lobes minutely and bluntly spined, lower margins both spined with two series as are the anterior and middle pairs; hind tibiæ numerously spined both above and below, the spines of ordinary size, the apex above with a robust spine on each side, below with two on each side. Anterior coxæ above lengthily spined, intermediate and hind pairs below bluntly spined. Pro-, meso- and meta-sternum provided with two erect, rather long spines. Cerci robust, the apical half bent abruptly inwards and tapering to an acute point; subgenital plate provided with rather long finger-like styles.

112. **Macrometopon rantale** sp. nov.

For the size of this insect giving the general impression of being moderately graceful. General color brunneo-testaceous, the front transversely finely aciculate, and more nearly castaneous in color; mandibles black on apical half. Lower side of the anterior femora jet-black, the surface also finely transversely aciculate. Anterior and middle tibiæ castaneous at base of spines. Tegmina infuscated, the veins and veinlets brunneo-testaceous.

Length of body, ♂, 38 mm., of pronotum, 10 mm., greatest width, 9 mm., length of tegmina, 10 mm., length of anterior femora, 20 mm., of anterior tibiæ, 24 mm., of middle femora, 16 mm., of middle tibiæ, 17 mm., of hind femora, 29 mm.; of hind tibiæ, 31 mm.

Habitat.—The type, a male and only specimen examined, comes from Chapada, Brazil, where it was taken presumably by H. H. Smith in September. It is in the Carnegie Museum.

There is a female specimen at hand from the same general locality, but it seems to be somewhat immature. The ovipositor is rather long and slender as in the *Gryllacridæ*. The anterior legs are less robust and comparatively shorter than in the opposite sex described above somewhat in detail. This female specimen was taken in May.

Family CONOCEPHALIDÆ (Xiphidiidæ).

The representatives of this family are rather small, compared with the COPIPHORIDÆ, in which they have usually been included. It is unfortunate that so much confusion has arisen and still exists in connection with the nomenclature of these two families of the *Tettigonoidea*. In fact there is much confusion in the nomenclature throughout the entire order *Orthoptera*, as one soon learns when taking up the study of the insects of the group.

These insects live among grass and low herbage, where they may be found in rather large numbers throughout the summer and early fall. Representatives occur in all temperate and tropical countries. They are the chief "grass-hoppers" of all such regions. While the group is widely distributed there are comparatively few genera. Not more than four are found in South America. They may be separated as follows:

SYNOPSIS OF SOUTH AMERICAN GENERA OF CONOCEPHALIDÆ.

A. Pronotum strongly saddle-shaped [Peru]......*Paraxiphidium* Redtenbacher.
AA. Pronotum more or less even, not saddle-shaped.
- *b*. Tegmina not as in the alternative category.
  - *c*. Ovipositor very robust, somewhat falcate or sickle-shaped, the apex very acuminate. Tegmina lobate in both sexes; cerci of male abdomen without an internal tooth or spine..*Euxiphidion* gen. nov.
  - *cc*. Ovipositor less robust, straight, or a little curved, the apex not finely acuminate. Tegmina variable, but never lobate in the male; cerci of male abdomen provided with one or two inwardly-directed teeth. *Conocephalus* Thunberg.
- *bb*. Tegmina very broad, hiding the abdomen; costal field provided throughout with prominent parallel veins [Paraguay]......*Xiphelium* Caudell.

Genus EUXIPHIDION gen. nov.

Related to the genera *Odontoxiphidion* Morse and *Conocephalus* Thunberg (*Xiphidion* of various authors), but readily separated from them by the characters given in the generic synopsis above.

113. **Euxiphidion subapterus** sp. nov.

Body moderately robust, minutely, but thickly, hirsute. Head large, a little wider than the anterior edge of the pronotum; fastigium as in representatives of both the genera *Orchelimum* and *Conocephalus*, touching the fastigium of the front; eyes subglobular, rather large and prominent; first antennal joint abruptly one-half wider on its apical third. Pronotum short, wide, the disc convex, with scarcely a trace of transverse sulci, truncate in the male, or sub-truncate in the female, both in front and behind; lateral lobes similar to those in *Conocephalus nemoralis* Scudder and *C. propinquus* Redtenbacher. Tegmina broadly lobate in both sexes, scarcely reaching the hind margin of the pronotum in the female, or the hind margin of the first abdominal segment in the male. Abdomen above glabrous, without a median carina. Cerci of male straight, a little tapering and rather short, the inner side without a tooth, but with the apex two-toothed, the inner one of these a trifle the shorter, blunt, the outer one acuminate. Subgenital plate rather broad, its apex bisinuate, the styles short and blunt. Ovipositor very robust, broadly sickle-shaped, the apex finely acuminate. Prosternum two-spined, mesosternum acutely lobate, the metasternum triangulately lobate. Legs normal, the anterior and middle tibiæ armed below with six pairs of spines, all the femora below spineless, the genicular lobes of the hind pair provided with a single blunt spine. Auditory openings of front tibiæ linear.

General color fusco-brunneous, paler beneath (obscure testaceous); front, cheeks, sides of pronotum and legs, profusely flecked with round ferruginous to piceous dots from the centers of which usually arise short pallid hairs. Fastigium of the vertex above, occiput and disc of the pronotum, together with a wide dorsal stripe on the abdomen, piceous in the male, much paler in the female, bordered on each side by a prominent testaceous line, the sides of pronotum above and sides of abdominal segments on the basal two-thirds piceous. Basal half of hind femora externally prominently fasciate longitudinally with fuscous.

Length of abdomen, ♂, 9.2 mm., ♀, 13 mm.; of pronotum, ♂, 2.55 mm., ♀, 3.1 mm.; of tegmina, ♂, 1.25 mm., ♀, 1 mm.; of hind femora, ♂, 8.75 mm., ♀, 12 mm.; of ovipositor, 8 mm.

Habitat.—The male specimen bears the label "Chapada, Campo, Oct.," the female "Corumbá, March (H. H. Smith)." The type specimens are the only representatives examined. They belong to the Carnegie Museum. Both specimens are somewhat broken.

Genus Conocephalus Thunberg.

Conocephalus Thunberg, Mém. Acad. Petersb., V, p. 214 (1815).

Xiphidion Serville, Ann. Sci. Nat., XXII, p. 156 (1831); Ins. Orthopt., p. 505 (1839).

Xiphidium Burmeister, Handb. Ent., II, p. 707 (1838).

The insects, which comprise the present genus, are among the long-horned grass-hoppers what the various species of the genera *Orphulella* and *Oxya* are among the short-horned grasshoppers, or locusts, the "common grasshoppers" of the grassy hillsides and meadows. They occur in nearly all quarters of the globe, and are fairly numerous in both species and individuals. Heretofore seventeen species have been credited to South American regions, and now two others are added. Very likely still others will be met with from time to time as different sections of the country are visited and worked over by collectors. These South American species may be separated as follows:

SYNOPSIS OF THE SOUTH AMERICAN SPECIES OF CONOCEPHALUS.

A. Anterior tibiæ armed below with five to seven spines.

b. Ovipositor rarely longer than the posterior femora, but, if longer, then the elytra are perfectly developed.

c. Cerci of the male heavy, the apex depressed, obtuse.

d. Posterior femora below armed with a single spine or without any.

e. Fastigium of the vertex narrow; viewed from the front, the lateral margins are subparallel. Tegmina in both sexes longer than the pronotum . . . . *truncatus* Redtenbacher.

ee. Fastigium of the vertex wider; viewed from the front with the lateral margins divergent.

f. Lateral lobes of the pronotum with their hind margin sinuate [Chili] . . . . *vitticollis* Blanchard.

ff. Lateral lobes of the pronotum with their hind margin nearly straight.

g. Tegmina abbreviated, in the male a little longer than the pronotum in the female. Ovipositor nearly straight [Galapagos Islands] . . . . *exitiosus* McNeill.[6]

gg. Tegmina perfectly developed or the ovipositor not straight.

h. Tegmina abbreviated, not entirely covering the abdomen. Ovipositor sickle-shaped.

i. Anterior margin of the elytra infuscated. *nemoralis* Scudder.

ii. Anterior margin of the elytra not infuscated. *propinquus* Redtenbacher.

hh. Tegmina longer, entirely covering the abdomen. Genicular lobes of the posterior femora bidentate. *fasciatus* de Geer.

[6] The species *strictoides* Caudell, described from Paraguay, is also brachypterous and related to both *strictus* Scudder and *exitiosus* McNeill. [See Proc. U. S. Nat. Mus., XXX, p. 242 (1906)]. It should be added to the list of South American species of *Conocephalus*.

dd. Posterior femora spined below.

e. Tegmina with their apex surpassing the abdomen.

f. Lateral lobes of the pronotum with their posterior margin rounded.

g. Styles of subanal plate of male spiniform, above each of which the plate is also produced into a very acute spine. Pronotum with a discal ferruginous band.
longipes Redtenbacher.

gg. Styles of subanal plate of male filiform, the subgenital plate of male not produced into spines. Disc of the pronotum concolorous, not provided with a ferruginous median longitudinal band. *unicolor* sp. nov.

ff. Lateral lobes of the pronotum with their posterior margin straight or nearly so.

g. Abdomen concolorous.

h. Fastigium of the vertex, viewed from in front with the lateral margins distinctly divergent [Panama].
saltator Saussure.

hh. Fastigium of the vertex, viewed from in front with the lateral margins nearly parallel [Ecuador].
æquatorialis Giglio-Tos.

gg. Abdomen variegated with black [Ecuador].
versicolor Redtenbacher.

ee. Tegmina with their tips not attaining the apex of the abdomen.

f. Fastigium of the vertex broad, viewed from in front with the lateral margins distinctly divergent.

g. Elytra in the male double, in the female less than double, the length of the pronotum. Ovipositor equal to, or shorter than, the hind femora.

h. Tegmina in the female longer than the pronotum. Ovipositor nearly straight.

i. Tegmina of the female a trifle longer than the pronotum. Ovipositor distinctly shorter than the posterior femora [South America].
brachypterus Redtenbacher.

ii. Tegmina of the female distinctly longer than the pronotum. Ovipositor of equal length with the hind femora [Brazil] . . . . *meridionalis* Scudder.

hh. Tegmina in the female shorter than the pronotum. Ovipositor sickle-shaped [Bolivia].
borellii Giglio-Tos.

gg. Elytra in both male and female more than twice the length of the pronotum. Ovipositor usually longer than the hind femora . . . . *recticaudus* sp. nov.

ff. Fastigium of the vertex narrow, viewed from in front with the lateral margins nearly parallel.

g. Green. Abdomen concolorous [Colombia].
angustifrons Redtenbacher.

gg. Ferruginous-yellow. Abdomen black, interrupted before the apex on the dorsum by a yellowish band.
festæ Giglio-Tos.

cc. Cerci of male slender, sensibly acuminate, the apex not, or but little, depressed .... *caizanus* Giglio-Tos.

bb. Ovipositor very long. Tegmina abbreviated (Uruguay).
doryphorus Karny.

AA. Anterior tibiæ armed below with nine to ten spines... *aberrans* Redtenbacher.[7]

114. **Conocephalus unicolor** sp. nov.

A large, pallid, robust insect, with fully developed tegmina and wings, in which there are no variations of coloration, as is the case in most of the species of the genus. Most nearly related to *longipes* of Redtenbacher, as may be ascertained by referring to the preceding synopsis of the species found in South America.

Fastigium moderately robust, viewed from in front with its lateral margins divergent. Antennæ robust and very long. Pronotum much as in *C. recticaudus* described hereafter. Tegmina fully developed and reaching the apex of the hind femora, in the male heavy and broad on the basal two-fifths, much narrowed beyond, in the female tapering evenly from the base, the apex rounded. Hind femora below provided externally with four to six rather prominent spines. Male cerci robust, tapering, the extreme apex depressed inwardly, toothed near the base. Subanal plate of male not, or very faintly, carinated at middle; the styles small, filiform; the apex of the plate subangulate. Ovipositor large, straight.

General color pale greenish, the wings faintly rose-tinted. Antennæ with the apex of joints narrowly fuscous. Apex of the hind femora briefly infuscated. Spines of hind femora and tibiæ dusky.

Length of body, ♂, 16 mm., ♀, 21 mm.; of pronotum, ♂, 3.1 mm., ♀, 3.6 mm.; of tegmina, ♂, 16 mm., ♀, 20 mm.; of hind femora, ♂, 13 mm., ♀, 16 mm.

Habitat.—The types come from Corumbá, Brazil, where they were taken in March. Additional specimens were collected during April (H. H. Smith). The female type bears the additional label "2166" on red. They are the property of the Carnegie Museum.

115. **Conocephalus recticaudus** sp. nov.

A moderately large and robust species with somewhat abbreviated tegmina and wings in both sexes. As indicated by the accompanying

[7] The *X. cinereum* Thunberg from Jamaica has not been placed.

synoptical key it is related to *brachypterus* Redtenbacher, *meridionalis* Scudder, and *borellii* Giglio-Tos.

Head large, the sides nearly parallel; front rounded, smooth, the fastigium of the vertex broad, viewed from in front with its sides strongly divergent; basal antennal joints large. Pronotum smooth, short, a little wider than long, its anterior and posterior margins above gently rounded, anterior margin of the lateral lobes rounded. Tegmina shorter than the abdomen, in female a little exceeding twice, in male fully thrice, the length of the pronotum. Ovipositor straight, nearly or quite as long as the hind femora. Cerci of male robust, the apex depressed, provided back of the middle with a large inwardly directed tooth; subanal plate rather large and carinated in the middle, its apex broadly angulated and its sides provided with fairly long and prominent filiform styles. Subanal plate of abdomen of female with its apex truncate, not emarginate. Hind femora three- to four-spined below on the outer margin.

General color pale testaceous; the fastigium, vertex, occiput, and disc of the pronotum provided with a dark ferruginous band, which broadens evenly to the rear. Tegmina unicolorous, without fuscous or ferruginous marking. Abdomen unicolorous. Apex of hind femora narrowly infuscated above. Spines of the femora and hind tibiæ black. Antennæ sub-fasciate, ferruginous basally, becoming infuscated beyond.

Length of body, ♂, 18 mm., ♀, 20 mm.; of pronotum, ♂, 3.5 mm., ♀, 4 mm.; of tegmina, ♂, 10.5 mm., ♀, 9 mm.; of hind femora, ♂, 14.5 mm., ♀, 16 mm.; of ovipositor, ♀, 15.5 mm.

Habitat.—The types, male and female, are from Corumbá, Brazil (H. H. Smith). They are in the Carnegie Museum.

116. **Conocephalus truncatus** (Redtenbacher).

Xiphidium truncatum Redtenbacher, Monog. Conocephalid., p. 208 (1891).
Xiphidion truncatum Karny, Revis. Conocephalid., p. 86 (1907).

There is a female representative of the present species in the collection. It comes from Chapada, Brazil, where it was taken by H. H. Smith.

117. **Conocephalus nemoralis** (Scudder).

Xiphidium nemorale Scudder, Proc. Bost. Soc. Nat. Hist., XVII, p. 65 (1875); Ent. Notes IV, p. 462 (1875) Ibd.

There is a specimen at hand of what seems to be the true *nemoralis* of Scudder as found throughout the United States east of the Rocky mountains. It bears the locality label "Bogotá, Colombia," and forms part of the Carnegie Museum Accession No. 2306.

118. **Conocephalus fasciatus** (de Geer).

Locusta fasciata DE GEER, Mem. Ins., III, pl. 40, fig. 4 (1778).
Xiphidium fasciatum SERVILLE, Revue Method., p. 159 (1831).

For further synonymy see Redtenbacher's Monographie der Conocephaliden, p. 192 (1891).

This very widely distributed species is represented by specimens coming from a number of South American localities. They were taken by different collectors. As would naturally be supposed, the specimens vary somewhat in size, coloration, and length of wing. The synoptical table of species given on a previous page will aid materially in the identification.

119. **Conocephalus longipes** (Redtenbacher).

Xiphidium longipes REDTENBACHER, Monog. Conocephalid., p. 505 (1891).
Xiphidion longipes KARNY, Revis. Conocephalid., p. 88 (1907).

The collection contains specimens of this insect, which were taken at Puerto Suarez, Bolivia. They were collected by J. Steinbach at an elevation of 150 meters above sea-level. The species is also common further south in both Paraguay and Argentina.

120. **Conocephalus saltator** (Saussure).

Xiphidium saltator SAUSSURE, Orth. nova Amer., I, p. 12 (1859); REDTENBACHER, Monog. Conocephalid., p. 193 (1891).
Xiphidium saltator KARNY, Revis. Conocephalid., p. 88 (1907).

The present species is quite widely distributed, having been recorded from several of the West Indian islands and in South America from Panama to Uruguay. Specimens of both sexes are at hand from Chapada and Gloria, Minas Geraes, Brazil (H. H. Smith), and "Province del Sara" and "Las Juntas, Dept. Santa Cruz, Bolivia." (J. Steinbach.)

121. **Conocephalus æquatorialis** (Giglio-Tos).

Xiphidium æquatoriale GIGLIO-TOS, Boll. Mus. Anat. Comp. Torino, XIII, pp. 91, 92 (1898).
Xiphidion æquatoriale KARNY, Revis. Conocephalid., p. 88 (1907).

A female from Pará is referred here.

122. **Conocephalus versicolor** (Redtenbacher).

Xiphidium versicolor REDTENBACHER, Monog. Conocephalid., p. 193 (1891).
Xiphidion versicolor KARNY, Revis. Conocephalid., p. 88 (1907).

A female of this insect is at hand. It was taken at Santa Cruz de la Sierra, Bolivia.

123. **Conocephalus brachypterus** (Redtenbacher).

Xiphidium brachypterum REDTENBACHER, Monog. Conocephalid., p. 209 (1891).
Xiphidion brachypterum KARNY, Revis. Conocephalid., p. 88 (1907).

Specimens classed here come from Pará, Brazil, and "Province del Sara, Bolivia." They were collected respectively by H. H. Smith and J. Steinbach.

124. **Conocephalus meridionalis** (Scudder).

Xiphidium meridionale SCUDDER, Proc. Bost. Soc. Nat. Hist., XVII, p. 460 (1875); REDTENBACHER, Monog. Conocephalid., p. 209 (1891).
Xiphidion meridionale KARNY, Revis. Conocephalid., p. 88 (1907).

A female specimen, collected by H. H. Smith at Chapada, Brazil, is referred here.

Family AGRŒCIIDÆ.

This family is small, when we consider the number of its representatives, as compared with such important groups as the Pseudophyllidæ, Copiphoridæ, and Phaneropteridæ. Nevertheless, as Dr. H. Karny remarks in his introduction to the paper dealing with the group in the "Genera Insectorum," it contains fifty-eight genera and two hundred and six recognized species. The family is almost entirely tropical. At least thirteen genera are known from the neotropical regions. These may be characterized as follows:

SYNOPSIS OF THE NEOTROPICAL GENERA OF AGRŒCIIDÆ.

A. Prosternum smooth, not armed with spines. Lobes of the mesosternum broad, either dull three-sided or rounded, not thorned or spined; the lobes of the metasternum rounded.
- *b*. Anterior tibiæ flattened above . . . . *Hyperomerus* Redtenbacher.
- *bb*. Anterior tibiæ rounded or terete above.
  - *c*. Tegmina well developed, or at least more than half as long as the abdomen.
    - *d*. Fastigium of the vertex surpassing the first antennal joint, the apex bent downwards . . . . *Erechthis* Bolivar.
    - *dd*. Fastigium of the vertex not surpassing the first antennal joint, conical.
      - *e*. Tegmina greatly surpassing the apex of the abdomen . . *Subria* Stål.

ee. Tegmina but little, or not at all, passing beyond the apex of the abdomen. . . . . *Parasubria* Karny.

cc. Tegmina greatly abbreviated, less than one-half as long as the abdomen. Middle tibiæ spineless. Tegmina covered by the elytra. *Paranelytra* Karny.

AA. Prosternum armed with two spines or teeth. Meso- and metasternum at most lobed, but without spines.

b. Tegmina at the apex truncate-emarginate. *Eppia* Stål.

bb. Tegmina rounded at the apex.

d. First antennal joint provided internally with a sharp tooth-like projection. . . . . *Eschatoceras* Redtenbacher.

dd. First antennal joint provided internally with a blunt tooth or entirely without any such attachment.

e. Pronotum more or less truncate or roundedly truncate behind.

f. Tegmina ordinarily constructed, without unnaturally enlarged nervures or deeply impressed points. Meso- and metasternal lobes triangular. . . . . *Agrœcia* Serville.

ff. Tegmina very rarely ordinarily constructed, either provided with extraordinarily thickened nervures or with deeply impressed pits between the anterior border and subcosta. . *Loja* Giglio-Tos.

ee. Pronotum roundly produced behind.

f. Tegmina strongly abbreviated. Fastigium of the vertex broadly rounded at the apex, wider than the first antennal joint. *Uchuca* Giglio-Tos.

ff. Tegmina fully developed, or at least almost the length of the abdomen.

g. Fastigium of the vertex laminately compressed, above armed with a spine [Ecuador]. . . . . *Paralobaspis* Giglio-Tos.

gg. Fastigium of the vertex above not armed with a spine.

h. Ovipositor angulately bent. . . *Nannagrœcia* Redtenbacher.

hh. Ovipositor ordinarily curved [Paraguay]. *Bertoniella* Rehn.

Genus ESCHATOCERAS Redtenbacher.

Eschatocerus REDTENBACHER, Verh. Zool.-bot. Ges. Wien, XLI, pp. 331, 448 (1891); KARNY, Revis. Conocephal., pp. 52, 64 (1907).

This is a tropical South American genus of Agrœciidæ and contains seven recognized species. Only one of these has been found in the present collection.

125. **Eschatoceras nigrospinosus** Karny.

Eschatoceras nigrospinosus KARNY, Revis. Conocephal., p. 64 (1907).

Habitat.—There is a single female specimen of Karny's *E. nigrospinosus* among the material coming from the "Province del Sara, Bolivia." It was collected by J. Steinbach at an elevation of 350 meters above sea-level.

Genus AGRŒCIA Serville.

Agræcia SERVILLE, Rev. Method., p. 152 (1831).

While several species of the genus *Agræcia* occur in South America, only two of them are contained among the material now being reported upon. Judging from the few references to members of the genus in entomological writings, they are comparatively rare. They are the following:

126. **Agrœcia vittipes** Redtenbacher?

Agræcia vittipes REDTENBACHER, Monog. Conocephalid., p. 140 (1891).

Habitat.—There is a single female among some material coming from Bogotá, Colombia, which is referred with some doubt to this species. It was among some other Orthoptera referred to me by the Carnegie Museum several years ago for study.

127. **Agrœcia abbreviata** Redtenbacher.

Agræcia abbreviata REDTENBACHER, Monog. Conocephalid., p. 142 (1891).

A single male example of this species is at hand. It bears the label "Rio de Janeiro," and was probably taken by H. H. Smith.

128. **Agrœcia** sp.?

Habitat.—Matanzas, Cuba. (J. A. Shafer.) 1♂ nymph.

Family COPIPHORIDÆ (*Conocephalinæ*).

The representatives of the present family are relegated to forty-four genera, of which nearly one-half are to be met with in tropical America. Aside from the families Phaneropteridæ and Pseudophyllidæ the representatives of this family are the most numerous of the Tettigonoidea. While these insects are mostly green, or greenish, and live among low vegetation, there are a few, which are brown or ferruginous, and live among fallen leaves and on the trunks of trees and stems of shrubbery. These insects, together with the representatives of the Conocephalidæ and Agrœciidæ are the chief musicians among the Orthoptera. The twenty-nine genera known to inhabit the region now under consideration are separated herewith by the subjoined synoptical table.

SYNOPSIS OF THE SOUTH AMERICAN GENERA OF COPIPHORIDÆ.

A. Pronotum spined or ruguloso-spinose.

b. Size larger. Posterior femora above not lobate. Ovipositor narrow, long, and nearly straight............................*Panacanthus* Walker.

bb. Size smaller. Posterior femora furnished above with a tooth-like lobe. *Loboscelis* Redtenbacher.

AA. Pronotum smooth or granulate, never spinose.

b. Tegmina greatly abbreviated, not extending beyond the metanotum or failing altogether.

c. Fastigium of the vertex short and broad, not passing the first antennal joint . . . . *Dectinomima* Caudell.

cc. Fastigium of the vertex longer.

d. Fastigium long and curved. The ovipositor at base broad, strongly curved . . . . *Acanthacara* Scudder.

dd. Fastigium of the vertex globular, carinated below. Ovipositor narrow, acuminate, much longer than the abdomen, naturally straight, with parallel edges . . . . *Dædalus* Redtenbacher.

bb. Tegmina fully developed or somewhat shortened, but not rudimentary.

c. Prosternum smooth.

d. Cheeks ruguloso-granulose or provided with tubercles.

e. Fastigium of the vertex elongate, acuminate, or short and spined at middle.

f. Middle tibiæ furnished above with one to six spines. *Copiphora* Serville.

ff. Middle tibiæ above spineless.

g. Ovipositor narrow, long, nearly straight, the apex obliquely truncate, acuminate . . . . *Acantheremus* Karny.

gg. Ovipositor shorter, broad, with the apex rounded. *Lamniceps* Bolivar.

ee. Fastigium of the vertex short, broad, eared, or trituberculate.

f. Fastigium of the vertex trituberculate . . *Lirometopum* Scudder.

ff. Fastigium of the vertex provided at sides with tubercles, eared. *Monesta* Walker.

dd. Cheeks smooth.

e. Fastigium of the vertex slightly passing the first antennal joint.

f. Pronotum with very prominent and deep transverse sulci. *Exocephala* Serville.

ff. Pronotum with the transverse sulci less prominent, not deep. *Eriolus* Bolivar.

ee. Fastigium of the vertex greatly surpassing the first antennal joint. *Gryporhynchus* Redtenbacher.

cc. Prosternum provided with two spines.

d. Tegmina abbreviated, about the length of the pronotum. Fastigium of the vertex below without a tooth or carina [Costa Rica]. *Sphyrometopa* Carl.

dd. Tegmina and wings fully developed.

e. Lobes of the meso- and metasternum produced into a spine.

f. Fastigium of the vertex broad, blunt.

g. Pronotum posteriorly strongly produced, rounded. *Eurymetopa* Redtenbacher.

gg. Pronotum posteriorly little produced, truncate, or roundly truncate.

h. Fastigium of the vertex bituberculate.
Liostethus Redtenbacher.
hh. Fastigium of the vertex trituberculate.
Basileus Pictet & Saussure.
ff. Fastigium of the vertex acuminate.
g. Tegmina at the apex obliquely truncate. Ovipositor short, inferior margin somewhat curved, a little broadened.
Paroxyprora Karny.
gg. Tegmina at the apex rounded.
h. Fastigium of the vertex distinctly separated from the fastigium of the front..............*Oxyprora* Stål.
hh. Fastigium of the vertex joined to the fastigium of the front.
i. Fastigium of the vertex below concolorous. Ovipositor at middle strongly dilated.
Phoxacris Karny.
ii. Fastigium of the vertex below black. Ovipositor straight, narrow, not dilated.
Melanophoxus Karny.
cc. Lobes of the meso- and metasternum not lengthened into a spine or entirely wanting.
f. Fastigium of the vertex triangular, above plane.
Pyrgocorypha Stål.
ff. Fastigium of the vertex not triangular, or convex above.
g. Tegmina at the apex acuminate.
h. Fastigium of the vertex carinated on both sides.
Dorycoryphus Redtenbacher.
hh. Fastigium of the vertex rounded, not carinated. Fastigium of the vertex separated from the fastigium of the front..............*Coryphodes* Redtenbacher.
gg. Tegmina at the apex rounded, or obliquely truncated.
h. Metasternum compressed, the lobes obliterated. Stature very graceful.....*Caulopsis* Redtenbacher.
hh. Metasternum not compressed, provided with distinct oval or triangular lobes.
i. Posterior tibiæ above with the lateral margins not ampliated. Genicular lobes of the hind femora spined. Structure slender.
j. Fastigium of the vertex distinctly divided from the fastigium of the front. Lateral lobes of the pronotum often broader, with the lower margin obtusangulate or rounded. Tegmina with the costal vein obliterated or indistinct, often strongly divergent from the radial vein.
Neoconocephalus Karny.
jj. Fastigium of the vertex contiguous with the fastigium of the front. The former globular or rounded in front...*Homorocoryphus* Karny.

ii. Posterior tibiæ above with the lateral margins ampliated. Structure robust.

j. Ovipositor longer than the abdomen. *Bucrates* Burmeister.

jj. Ovipositor short.........*Parabucrates* Scudder.

Genus COPIPHORA Serville.

Copiphora SERVILLE, Ann. Sci. Nat., XXII, p. 147 (1831).
Copiophora BURMEISTER, Handb. Ent., II, p. 702 (1838), and authors since.
Copidophora AGASSIZ, Zoöl. Nomencl., Ind. Univ., p. 98 (1846).

The present genus is characteristic of tropical America and occurs from southern Mexico to Paraguay and Bolivia. It has been monographed by Redtenbacher, Pictet and Saussure, and Karny. All of these authors have added new forms. In the present paper two additional species are likewise characterized for the first time. Undoubtedly further collecting in the tropical regions of South America will bring to light still other species.

The annexed synopsis of the species is modified from H. Karny's table published in his *Revisio Conocephalidarum*, pp. 6–7, and includes the two insects described beyond.

SYNOPSIS OF THE SPECIES OF COPIPHORA.

A. Middle tibiæ above armed with two to three spines on the inner margin, externally with one to two spines.

b. Fastigium of the vertex cochleate near its apex....*cochleata* Redtenbacher.

bb. Fastigium of the vertex not cochleate...........*monoceros* Pict. et Sauss.

AA. Middle tibiæ above armed internally with one to six spines, externally without spines.

b. Fastigium of the vertex greatly surpassing the first antennal joint.

c. Intermediate tibiæ provided internally above with three spines.

d. Apex of the fastigium of the vertex rounded, not drawn out. *festæ* Giglio-Tos.

dd. Apex of the fastigium of the vertex acuminate.

e. Fastigium of the vertex below densely tuberculate or coarsely granulate.

f. Tegmina and wings fully developed, considerably surpassing the apex of the abdomen. [Northern South America and Central America].......................*cornuta* de Geer.

ff. Tegmina and wings abbreviated, about as long as the abdomen. Ovipositor very long [Bolivia].........*brevipennis* sp. nov.

ee. Fastigium of the vertex below smooth.

f. Apex of the fastigium compressed and carinated above. *cultricornis* Pictet.

ff. Apex of the fastigium plainly acuminate, not compressed, nor carinated above.

g. Tegmina broader and shorter. The fastigium distinctly curved downwards.................. *rhinoceros* Pictet.

gg. Tegmina narrower and longer. The fastigium not distinctly bent downwards.

h. Fastigium of the vertex elongate. Ovipositor very long, at least more than twice the length of the abdomen, greatly surpassing the tegmina. *longicauda* Serville.

hh. Fastigium of the vertex shorter. Ovipositor less than one-half longer than the abdomen, scarcely surpassing the tegmina by one-half...... *brevicauda* Karny.

cc. Intermediate tibiæ above armed internally with four to six spines.

d. Middle tibiæ armed above with five or six spines.

e. The middle tibiæ above furnished with six spines.

f. Anterior femora below provided with spines on both margins.

g. Anterior and intermediate femora five-spined on both margins; ovipositor distinctly shorter than the body. *cephalotes* Pictet et Saussure.

gg. Anterior femora on the posterior margin two-spined; the intermediate femora without spines on the hind margin. Ovipositor equal to the body in length. *brachyptera* Karny.

ff. Anterior femora below without spines on the hind margin. *capito* Stål.

ee. The middle tibiæ above provided with five spines. *producta* Bolivar.

dd. Middle tibiæ armed above with only four spines.

e. Fastigium longer (Bolivia).................. *steinbachi* sp. nov.

ee. Fastigium shorter (Peru, St. Vincent, Lesser Antilles). *brevicornis* Redtenbacher.

bb. Fastigium of the vertex only a trifle surpassing the apex of first antennal joint.

c. Front castaneous.................................. *brevirostris* Stål.

cc. Front pale............................... *coronata* Redtenbacher.

129. **Copiphora steinbachi** sp. nov.

A medium-sized insect, with fully developed tegmina and wings, most closely related to *C. producta* Bolivar and *C. brevicornis* Redtenbacher, as shown by the synoptical table just given.

Male.—Form somewhat slender, general color pale, yellowish green. Front smooth, the cheeks provided with the usual rugosities below the eyes; fastigium of the vertex rather long, smooth, tapering, acuminate, the apex gently depressed, scarcely rugulose near the base above and without carinæ, the lateral sub-basal teeth prominent.

Pronotum glabrous, rather short, the hind margin sub-truncate. Tegmina sub-pellucid, the veins numerous, prominent, and quite regular. Stridulating area transparent, smooth. Anterior femora five-spined in front, smooth behind; middle femora six-spined externally, smooth internally; middle tibiæ four-spined internally. Cerci something like those described for *brevicornis* Redt., but with the teeth concolorous, instead of ferruginous. Clypeus and labrum ferruginous; mandibles internally and suture at base of clypeus black.

Length of body, ♂, 42 mm., of fastigium 6 mm., of pronotum 9 mm., of tegmina, 42 mm., of hind femora, 20 mm.

Habitat.—The type, a single male, comes from Quatro Ojos, Department of Santa Cruz, Bolivia, where it was taken in November, 1913, by J. Steinbach at an elevation of 300 meters above sea-level. It is the property of the Carnegie Museum.

130. **Copiphora brevipennis** sp. nov.

This new species as the name indicates is short-winged. It is most nearly related to *C. cornuta* de Geer, as indicated in the synoptic key. Both sexes are at hand, but since the female specimen is in the best condition it is selected as the chief basis of the description.

Robust; head large, a little wider than the anterior margin of the pronotum, rugose, especially in front and at the sides below the eyes. Fastigium of the vertex strongly tuberculate above, below, and at sides, the apical portion smoother, carinated below, the extreme tip deflexed, ferruginous. Pronotum rugoso-granulose, the hind margin evenly rounded. Tegmina abbreviated, tapering, the apex rounded, coriaceous, the secondary veining irregular. Anterior femora five-spined in front, smooth behind; middle femora six-spined externally, smooth internally; hind tibiæ externally three-spined, smooth internally. Ovipositor longer than the body. Subgenital plate of abdomen of female small and tapering, its apex rather deeply and roundly emarginate. Male cerci small, bowed, the apex two-toothed, the upper tooth much the larger, the lower one long and slender, not greatly divergent from the upper. Last ventral segment of moderate size, somewhat tapering, coarsely bicarinate and terminating in rather prominent style-like teeth, the emargination rounded, but less profound than in the female.

General color pale greenish testaceous, possibly altogether greenish in life. Front from the base of the clypeus to the transverse depressed line between the eyes tinged with vinaceous, this patch decreasing in width upwards. Inner side of the mandibles, base of the clypeus and clypeal groove black, the clypeus and labrum dirty white. Ovipositor dark-tipped.

Length of body, ♂, 38 mm., ♀, 48 mm.; of fastigium, ♂, 5.5 mm., ♀, 7.65 mm.; of pronotum, ♂, 9.5 mm., ♀, 10.75 mm.; of tegmina, ♂ and ♀, 30 mm.: of ovipositor, 54 mm.

Habitat.—Province del Sara, Bolivia, during February, March, and April, 1913. Collected by J. Steinbach. 1♂, 3♀♀. The types are in the Carnegie Museum.

131. **Copiphora cornuta** (De Geer).

Locusta cornuta DE GEER, Mem. Ins., III, p. 441, Pl. 37, fig. 7 (1773); BLANCH., Hist. Ins., III, p. 26 (1840).

Copiphora cornuta SERVILLE, Ins. Orth., p. 514, pl. 10, f. 7 (1839); KARNY, Revis. Conocephal., p. 6 (1907).

Copiophora cornuta BURMEISTER, Handb. Ent., II, p. 703 (1838); CHARPENTIER, Orth., pl. 43 (1843); STÅL, Recens. Orth., II, p. 104 (1874); REDTENBACHER, Mon. Conocephal., p. 26 (1891); SAUSSURE & PICTET, Biol Cent.-Amer., Orth., I, pp. 376, 378 (1898).

Habitat.—The collection now being reported upon contains a specimen of this insect from Pará, Brazil. It was probably taken by H. H. Smith.

132. **Copiphora rhinoceros** (Pictet).

Copiophora rhinoceros PICTET, Mem. Soc. Genève, XXX (6), p. 44 (1888); REDTENBACHER, Mon. Conocephal., p. 342 (1891).

Copiphora rhinoceros KIRBY, Syn. Cat. Orth., II, p. 231 (1906); KARNY, Revis. Conocephal., p. 6 (1907).

Habitat.—There are two male specimens of the present species at hand. They come from Costa Rica, Central America.

133. **Copiphora producta** (Bolivar).

Copiocera producta BOLIVAR, Revist. Chileña, VII, p. 143 (1903).

Copiphora producta KIRBY, Syn. Cat. Orth., II, p. 231 (1906); KARNY, Revis. Conocephal., p. 7 (1907).

Habitat.—A male from Rio de Janeiro, Brazil (H. H. Smith), and a female from the "Province del Sara, Bolivia (J. Steinbach)" are referred to Bolivar's *C. producta*.

Genus LAMNICEPS Bolivar.

Lamniceps BOLIVAR, Rev. Chileña, VII, p. 144 (1903); KIRBY, Syn. Cat. Orth., II, p. 232 (1906); KARNY, Revis. Conocephal., p. 2 (1907).

This monotypic genus occurs in Paraguay, southern Brazil, and southeastern Bolivia.

134. **Lamniceps giglio-tosi** Bolivar.

Lamniceps giglio-tosi BOLIVAR, Rev. Chileña, VII, p. 145 (1903).

Specimens of both sexes are before me. They come from Chapada, Brazil (H. H. Smith) and the Province del Sara, Bolivia (J. Steinbach).

Genus EXOCEPHALA Serville.

Exocephala SERVILLE, Ann. Sci. Nat., XXII, p. 160 (1831); *Ib.*, Ins. Orth., 507 (1839); BURMEISTER, Handb. Ent., II, p. 723 (1838); REDTENBACHER, Mon. Conocephal., pp. 14, 345 (1891); KARNY, Revis. Conocephal., pp. 2, 10, figs. 2, 3 (1907).

Moncheca WALKER, Cat. Derm. Salt., II, p. 289 (1869).

Vestria STÅL, Recens. Orth., II, pp. 97, 105 (1874).

This is another exclusively tropical American genus belonging to the family Copiphoridæ. Seven species are known.

135. **Exocephala bisulca** (St. Farg. et Serville).

Locusta ST. FARG. et SERV., Encycl. Meth., Ins., X, p. 342 (1825).

Exocephala bisulca SERVILLE, Ann. Sci. Nat., XXII, p. 160 (1831); REDTENBACHER, Mon. Conocephal., p. 346, pl. 3, fig. 7 (1891); SAUSSURE & PICTET, Biol. Cent.-Amer., Orth., I, p. 381 (1898).

Moncheca pretiosa WALKER, Cat. Derm. Salt. B. M., II, p. 289 (1869).

Habitat.—A single female coming from Santa Cruz de la Sierra, Bolivia, belongs here. It was taken by J. Steinbach.

136. **Exocephala viridis** Redtenbacher.

Exocephala viridis REDTENBACHER, Mon. Conocephal., p. 347 (1891).

Habitat.—Four female specimens of this rather attractive insect are at hand. They were collected at Quatra Ojos, Department of Santa Cruz, Bolivia, by J. Steinbach. They belong to the Carnegie Museum Accession No. 5059.

Genus ERIOLUS Bolivar.

Eriolus BOLIVAR, Orth. de l'Ile Cuba, p. 35 (1888); REDTENBACHER, Monog. Conocephalid., p. 34 (1891); KARNY, Revis. Conocephalid., pp. 2, 11 (1907).

The representatives of the genus *Eriolus* somewhat resemble those of *Conocephalus*. They are confined to tropical America, where species are to be met with in the regions embraced between 24° north and south of the equator. There is quite a variation among the species as regards the structure of the ovipositor as well as the fastigium of the vertex, as may be noticed in the synoptical key which is subjoined. About a dozen species have been recognized, one of them being here described as new.

SYNOPSIS OF THE SPECIES OF ERIOLUS.

A. Mesosternal lobes on both sides in front produced into an erect spine. Ovipositor with the apex obtuse.................... *spiniger* Redtenbacher.

AA. Mesosternal lobes smooth, not provided in front with erect spines. Ovipositor variable.

b. Fastigium of the vertex plain, or flattened above, its apex rounded. Pronotum produced behind [Costa Rica]......... *longipennis* Redtenbacher.

bb. Fastigium of the vertex rounded above, the apex more or less acuminate. Pronotum not produced behind.

c. Genicular lobes of the posterior femora acutely produced. The tegmina longer (23–37 mm.).

d. Ovipositor with the apex not acute, the apex either rounded or obliquely truncated.

e. Ovipositor with the apex of the upper valve rounded. Tegmina longer (34–37 mm.) [Island of Jamaica]... *jamaicensis* sp. nov.

ee. Ovipositor with the apex of the upper valve obliquely truncated.

f. Tegmina shorter (♀, 25 mm.) [S. America ?]. *frater* Redtenbacher.

ff. Tegmina longer (♀, 28–31 mm.) [Central America and Mexico].

g. Fastigium of the vertex acute. Anterior femora in front four-spined [Mexico]............. *mexicanus* Saussure.

gg. Fastigium of the vertex blunt. Anterior femora six-spined. [Guatemala, Panama].... *consobrinus* Saussure & Pictet.

dd. Ovipositor with its apex acute.

e. Front unicolorous, pallid.

f. Ovipositor longer (10.5 mm.), somewhat dilated back of its middle [Cuba]........................ *caraibeus* Bolivar.

ff. Ovipositor shorter (5.5–6.5 mm.), not dilated back of its middle.

g. Anterior femora below unarmed. Tegmina very slender, tapering to the apex [Panama]. *acutipennis* Saussure & Pictet.

gg. Anterior femora below four-spined. Tegmina graceful, but not remarkably slender [Guatemala]. *falcatus* Saussure & Pictet.

ee. Front with a large black maculation [Brazil]... *nigrifrons* Karny.

cc. Genicular lobes of the posterior femora but little produced, not slenderly acute.

b. Tegmina a little surpassing the tip of the abdomen, narrowed towards their apex [Guatemala]........ *brevipennis* Redtenbacher.

bb. Tegmina not surpassing the tip of the abdomen, the apex rounded. [Espirito Santo, Brazil]...................... *minimus* Karny.

137. **Eriolus jamaicensis** sp. nov.

A moderately large insect related to *E. frater* Redtenbacher, *E. mexicanus* Saussure, and *E. consobrinus* Saussure & Pictet, from all three of which it differs in having in a representative of this genus a remarkably long fastigium of the vertex.

Moderately robust, unicolorous, grass-green. Fastigium of the vertex more than twice the length of the basal antennal joint, rounded above, carinated, and provided with a well-developed tooth below, its apex acuminate. Pronotum minutely granulose, the disc flattened and with its sides nearly parallel, the anterior margin very shallowly and roundly emarginate, the hind margin rotundo-truncate. Tegmina ample, coriaceous, closely and irregularly veined, gently tapering, the apex reaching far beyond the tip of the abdomen and even beyond the tip of the ovipositor, the extreme point subacuminate. Legs robust, short; anterior and middle femora six-spined; hind femora furnished below with seven to ten inconspicuous spines on the external and as many as two very small ones on the inner margin; anterior and middle tibiæ strongly spined below on both margins, the hind pair weakly spined. Meso-sternal lobes each provided in front with a minute blunt spine; metasternal lobes unarmed. Ovipositor moderately heavy, but gently arcuate, its upper margin bisinuate, widest a little before its middle, the valves provided with a roughened area caused by a series of obliquely directed closely arranged depressed lines; apex broadly rounded, the lower valves much shorter, narrower, and oblique at the apex. Subgenital plate of abdomen of female short, carinated at the middle, the sides terminating in prominent style-like teeth, the apex sinuate. Cerci of male moderately heavy, fully twice as long as broad, bowed inwards, and a little upwards, terminating in two teeth, the lower one much the larger and directed inwards; subgenital plate large, nearly twice as long as the basal width, strongly depressed and minutely carinated at middle, the lateral halves triangular in cross-section, broadly wedge-shaped, terminating in a small, rounded, tooth-like spine, middle deeply and angulately emarginate.

Length of body, ♂, 27–30 mm., ♀, 32 mm.; of fastigium, ♂, 2.75 mm., ♀, 3 mm.; of pronotum, ♂, 7 mm., ♀, 7.25 mm.; of tegmina, ♂, 33–34 mm., ♀, 37 mm.; of hind femora, ♂, 12 mm., ♀, 12.5 mm.; of ovipositor, 11 mm.

Habitat.—3♂♂ and 1♀, Jamaica, West Indies. They belong to the collection of Dr. W. J. Holland, deposited in the Carnegie Museum, Acc. L. No. 131.

Genus GRYPORHYNCHUS Redtenbacher.

Gryporhynchus REDTENBACHER, Monog. Conocephal., p. 37 (1891); KARNY, Revis. Conocephal., p. 13 (1907).

138. **Gryporhynchus minor** sp. nov.

The present genus is a small one, and its representatives seem to be confined to Brazil, so far as known material would indicate. The type, a female, came from New Freiburg, Brazil. The specimen described as the male of the former is credited to Espirito Santo, which is in the interior; and now a second female is at hand with Rio de Janeiro as its habitat. Redtenbacher's female specimen was 25 mm. long, the fastigium 3.3 mm., the tegmina 30 mm. and the ovipositor 17 mm. Karny's male was 19.5 mm. long, the fastigium 2 mm. and it had tegmina only 17.5 mm. in length. The present female measures 22 mm. long, has the fastigium a trifle over 3 mm., the pronotum, 5.5 mm., the tegmina 19 mm., the hind femora 13.5 mm., and the ovipositor 14 mm. This last specimen being a female and varying so much from the measurements of typical *acutipennis* Redtenbacher, *l. c.*, p. 38, is considered distinct, and is given the name *Gryporhynchus minor*.

Karny's specimen may be the opposite sex of either of the females, but is most likely to go with the present. The short fastigium, however, seems to make this supposition somewhat doubtful. All three specimens are practically pale green, or faded testaceous. The type of *minor* is in the Carnegie Museum, Pittsburgh, Pa.

Genus OXYPRORA Stål.

Oxyprora STÅL, Œfv. Vet.-Akad. Förh., XIII (4), p. 50 (1873); *Ib.*, Recens. Orth., II, p. 98, 106 (1874); REDTENBACHER, Verh. Zool.-bot. Ges. Wien, XLI, p. 358 (1891).

The species of the present genus have some of the characteristics of representatives of both *Copiphora* and *Neoconocephalus*. As is the case in the preceding genus and many of those which follow they are tropical American.

139. **Oxyprora flavicornis** Redtenbacher?

Oxyprora flavicornis REDTENBACHER, Mon. Conocephal., p. 46 (1891).

Habitat.—There are a number of specimens of *Oxyprora* contained in the present collection. They have been referred to *flavicornis*

Redt. with a little hesitation. They come from Chapada, Brazil (H. H. Smith), and the Province del Sara, Bolivia (J. Steinbach).

Genus CAULOPSIS Redtenbacher.

Caulopsis REDTENBACHER, Verh. Zool.-bot., Ges. Wien, XLI, p. 376 (1891); SAUSSURE & PICTET, Biol. Cent.-Amer., Orth., I, p. 388 (1898).

This genus contains several species of rather small and comparatively slender insects, which resemble the much larger species of *Neoconocephalus*. At least five species are known from South American localities together with possibly two others. There are four supposedly distinct species at hand. They, with still another, may be separated as follows:

TABLE FOR SEPARATING THE SPECIES OF CAULOPSIS.

A. Fastigium of the vertex with the apex acuminate, carinated below.
- *b*. Size larger (♀, 37–44 mm.). Tegmina subacuminate.
  - *c*. Ovipositor fully one-half as long as the elytra (26 mm.). *gracilis* Redtenbacher.
  - *cc*. Ovipositor less than one-half as long as the elytra (13 mm.). *acuminata* sp. nov.
- *bb*. Size smaller (♀, 28 mm.). Tegmina with the apex rounded. *oberthuri* Bolivar.

AA. Fastigium of the vertex with the apex obtuse, rounded below.
- *b*. Smaller (♂, 24 mm.) . . . . *cuspidata* Scudder.
- *bb*. Larger (♂, 30 mm.) . . . . *attenuata* sp. nov.

140. **Caulopsis acuminata** sp. nov.

Most nearly related to *C. gracilis* Redtenbacher, but considerably smaller. Antennæ, as in that species, unusually robust and strongly hirsute at the base and very long. The fastigium slender, acuminate. Eyes round, depressed. Pronotum cylindrical, broadly and roundly emarginate in front, truncate behind. Tegmina narrow, with few veinlets, the costal field subhyaline, the apex somewhat acuminate. Anterior and middle femora unarmed below, hind pair five- to six-spined on the outer margin apically.

Length of body, ♀, 36 mm., of pronotum, 5 mm., of tegmina, 36.5 mm., of hind femora, 15 mm., of ovipositor, 13 mm.

Habitat.—The type and only specimen at hand comes from Corumbá, Brazil, where it was collected by H. H. Smith. This type belongs to the Carnegie Museum.

141. **Caulopsis oberthuri** Bolivar.

Caulopsis oberthuri BOLIVAR, Revista Chileña, VII, p. 146 (1903); KIRBY, Syn. Cat. Orth., I, p. 240 (1906); KARNY, Revis. Conoceph., p. 21 (1907).

Specimens of an insect which have been determined as the *C. oberthuri* of Bolivar are at hand from Corumbá, Brazil, and Province del Sara (350 meters), Bolivia. They were taken by H. H. Smith and J. Steinbach respectively.

142. **Caulopsis cuspidata** (Scudder)?

Conocephalus cuspidatus SCUDDER, Proc. Bost. Soc. Nat. Hist., XX, p. 88 (1879).
Caulopsis cuspidata REDTENBACHER, Verh. Zool.-bot. Ges. Wien, XLI, p. 377 (1891); KARNY, Revis. Conoceph., p. 21 (1907).

Several specimens are at hand of a species which seems to be the *cuspidata* of Scudder, although they come from a locality much farther south than has been recorded for it. From Corumbá, Brazil, March (H. H. Smith), and Quatro Ojos, Department Santa Cruz and Province del Sara, Bolivia, December (J. Steinbach).

143. **Caulopsis attenuata** sp. nov.

As shown by the table this species is related to the preceding, but is larger. The fastigium of the vertex is blunt at the apex and curved gently upwards. The eyes are round and prominent; antennæ slender and not hirsute basally. Stridulating field of tegmina tinged with ferruginous. Anterior and middle femora below on the anterior border one- to three-spined; hind femora below spined on both margins.

Length of body, ♂, 30 mm., of fastigium of vertex 4.75 mm., of pronotum, 5.2 mm., of tegmina, 40 mm., of hind femora, 17 mm.

Habitat.—Only the male is represented and that by but a single individual. It bears the label "Mogy das Cruzes, São Paulo, Brazil, July 21, 1908." It was collected by J. D. Haseman. The type is the property of the Carnegie Museum.

Genus NEOCONOCEPHALUS Karny.

Neoconocephalus KARNY, Revis. Conocephalid., pp. 4, 22 (1907).

The genus, or as H. Karny calls it, the subgenus *Neoconocephalus*, is practically confined to the New World. It is that portion of the old genus *Conocephalus* of Serville, *nec* Thunberg, in which the fastigium of the vertex and of the front are distinctly separated, and in which the costal vein of the elytra is obliterated or indistinct. The tegmina often lack the costal vein, or have it running obliquely towards the costa, instead of parallel to the radial vein. In his synopsis (*l. c.* pp. 22–29) he lists seventy-eight species. I am now adding three others. It is quite certain that a number of still undiscovered species will be found to inhabit the various parts of tropical America as they become better explored.

Many of these insects are quite similar in their general appearance and differ chiefly in the form and length of the fastigium as well as the color of the vertex, length of the wings, hind femora, in spine-characters and in the comparative smoothness or granulation of the pronotum, etc. The form and length of the ovipositor is also a diagnostic character. Most of the species live among grasses and other low herbage, but also frequently are to be met with among the foliage of trees. They are readily attracted to bright lights, and may be collected at night in cities and towns.

144. **Neoconocephalus crassus** (Bolivar).

Conocephalus crassus BOLIVAR, An. Soc. Españ,. X, p. 499 (1881); *Ib.*, Viaje al Pacif., Ins., p. 102, Pl. 3, fig. 6 (1884); REDTENBACHER, Monog. Conocephalid., pp. 379, 390 (1891).

Neoconocephalus crassus KARNY, Revis. Conocephalid., p. 23 (1907).

There is an almost grown female nymph at hand which is referred here. It bears the label "Benivides, Brazil," and was probably collected by H. H. Smith.

145. **Neoconocephalus nigrosignatus** Karny?

Neoconocephalus nigrosignatus KARNY, Revis. Conocephalid., pp. 23, 31 (1907).

A single female insect bearing the locality label "Pará, Brazil," is referred doubtfully to Karny's *nigrosignatus.*

146. **Neoconocephalus nigropunctatus** (Redtenbacher).

Conocephalus nigropunctatus REDTENBACHER, Monog. Conocephalid., pp. 380, 391, Pl. 3, fig. 32 (1891).

Neoconocephalus nigropunctatus KARNY, Revis. Conocephalid., p. 24 (1907).

Male specimens of a *Neoconocephalus* taken at both Benevides and Pará are referred to Karny's *nigropunctatus.*

147. **Neoconocephalus elongatus** (Redtenbacher).

Conocephalus elongatus REDTENBACHER, Mon. Conocephalid., pp. 66, 79 (1891).

Neoconocephalus elongatus KARNY, Revis. Conocephalid., pp. 24 (1907).

A female coming from the "Province del Sara," Bolivia, 350 meters above sea-level and collected during the period of November and

December, 1912, has been determined as *elongatus* Redt. which was described from Peru. The specimen at hand was collected by J. Steinbach.

148. **Neoconocephalus muticus** (Redtenbacher).

Conocephalus muticus REDTENBACHER, Mon. Conocephalid., pp. 66, 79 (1891).
Neoconocephalus muticus KARNY, Revis. Conocephalid., p. 24 (1907).

This insect was described from material collected in Cuba and St. Vincent, West Indies. The material now being reported was taken in the Island of Jamaica.

149. **Neoconocephalus irroratus** (Burmeister).

Conocephalus irroratus BURMEISTER, Handb. Ent., II, p. 705 (1838); REDTENBACHER, Mon. Conocephalid., pp. 66, 80 (1891).
Neoconocephalus irroratus KARNY, Revis. Conocephalid., p. 24 (1907).

The specimens in the present collection, which agree with Burmeister's description of *irroratus*, bear the label "Rio de Janeiro." They were taken by H. H. Smith.

150. **Neoconocephalus redtenbacheri** Karny?

Neoconocephalus redtenbacheri KARNY, Revis. Conocephalid., pp. 24, 32 (1907).

Two male Neoconocephalids from "Province del Sara," Bolivia, taken at a point with an elevation of 350 meters above sea-level are referred here with some doubt. They were collected by J. Steinbach during the month of November, 1913.

151. **Neoconocephalus mexicanus** (Saussure).

Conocephalus mexicanus SAUSSURE, Orth. Nova Amer., I, p. 11 (1859); REDTENBACHER, Mon. Conocephalid., pp. 66, 81 (1891).
Neoconocephalus mexicanus KARNY, Revis. Conocephalid., p. 24 (1907).

This widely distributed species is represented by a female specimen taken at Pará, Brazil.

152. **Neoconocephalus longicauda** Karny.

Neoconocephalus longicauda KARNY, Revis. Conocephalid., pp. 25, 33 (1907).

Specimens collected at Chapada, Brazil, are classified as this species. Karny's material came from Rio Grande do Sul.

153. **Neoconocephalus maxillosus** (Fabricius).

Locusta maxillosa FABRICIUS, Ent. Syst., II, p. 37 (1794).
Conocephalus maxillosus SERVILLE, Hist. Nat. Ins. Orth., p. 520 (1839). For further synonymy see KIRBY, Syn. Cat. Orth. Brit. Mus., II, p. 243 (1906).

The present species, which is widely distributed over tropical America, is represented by specimens from Benevides, Chapada, and Rio de Janeiro, Brazil. They were taken by H. H. Smith.

154. **Neoconocephalus heteropus** (Bolivar).

Conocephalus heteropus BOLIVAR, Notas Entomol., V, p. 50 (1881); REDTENBACHER, Mon. Conocephalid., pp. 67, 86 (1891).
Neoconocephalus heteropus KARNY, Revis. Conocephalid., p. 26 (1907).

This is another of the rather widely distributed species of the genus found in tropical America. The determination is based on a female bearing the label "Lagoa Feia, Tocos, in Espirito Santo, Brazil."

155. **Neoconocephalus infuscatus** (Scudder).

Conocephalus infuscatus SCUDDER, Ent. Notes, IV, p. 19 (1875); REDTENBACHER, Mon. Conocephalid., pp. 66, 84 (1891).
Neoconocephalus infuscatus KARNY, Revis. Conocephalid., p. 26 (1907).

Several males are referred to this widely distributed tropical American species. They were taken by J. Steinbach during October and November in the Province del Sara, Bolivia.

156. **Neoconocephalus nietoi** (Saussure).

Conocephalus nietoi SAUSSURE, Orth. Nov. Amer., I, p. 11 (1859); REDTENBACHER, Mon. Conocephalid., pp. 68, 91 (1891).
Neoconocephalus nietoi KARNY, Revis. Conocephalid., p. 28 (1907).

A female specimen of the genus coming from Jamaica, West Indies, has been referred to this species. It is quite typical. It also occurs in the southern part of the United States, Mexico, and Central America, and is common to all of the West Indian islands.

157. **Neoconocephalus gladiator** (Redtenbacher).

Conocephalus gladiator REDTENBACHER, Mon. Conocephalid., pp. 68, 92 (1891).
Neoconocephalus gladiator KARNY, Revis. Conocephalid., p. 29 (1907).

A female specimen of the genus coming from Chapada, Brazil, has been determined as this species.

158. **Neoconocephalus giganticus** sp. nov.

A very large, rather robust grass-green insect, with dusky feet and black spines on all the femora, in which the fastigium of the vertex is short and broadly rounded, and the ovipositor unusually long, broad, and gently decurved.

Head smooth, but little punctured or otherwise roughened, large and robust, fully as broad as the anterior part of the pronotum, the fastigium gently ascending, sub-globose, nearly as wide as long, toothed below and rather widely separated from the fastigium of the front, its anterior margin evenly rounded. Pronotum a little longer than wide, its surface somewhat rugoso-punctate, most decidedly so on the disc, the lateral lobes furnished with a large depressed more or less transparent and sub-glabrous area, anterior margin above broadly emarginate, the hind margin subtruncate, the lateral lobes heavily margined. Elytra broad, fully twice as long as the abdomen and one-half again as long as the hind femora, their apex subacuminate, the costal vein not prominent, strongly divergent from the radial. Anterior femora provided with three spines, the intermediate with four spines and the hind pair with numerous black tipped spines arising in advance of rather large black blotches. Ovipositor broad, long, gently decurved, the apex obliquely acuminate from below. Subgenital plate carinated at middle, tapering, roundly emarginate at its apex.

General color bright grass-green, the basal half of the hind femora, ovipositor, and occiput, together with the upper part of the front, and cheeks and antennæ ferrugineo-testaceous. Mandibles bright saffron-yellow, the labrum, labium, and apical joints of the palpi purplish. Femora below prominently punctate or maculate with deep black, the tarsi, tips of the femora and tips as well as base of the tibiæ infuscate. Anterior margin of the fastigium of the vertex yellow-banded, scarcely fuscous-bordered beneath. Apex of the ovipositor somewhat infuscated. Eyes walnut-brown. Tegmina provided centrally on the apical two-fifths with fuscous maculations, the anterior margin pellucid.

Length of body 43 mm.; of fastigium 2.25 mm.; of pronotum 9.5 mm.; of tegmina 65 mm.; of hind femora, 38 mm.; of ovipositor, 42 mm.

Habitat.—The type and only specimen at hand was taken by J. Steinbach in the "Province del Sara," Bolivia, at an elevation of 350 meters above sea-level. It bears the Accession Number 5058.

In Karny's synoptic table of the genus[8] the present species would run to the vicinity of *N. macropterus* and *N. necessarius* of Redtenbacher.

159. **Neoconocephalus chapadensis** sp. nov.

General structure slender and elongate. Tegmina very long. Fastigium distinctly conical, fasciate beneath. Related to *N. elon-*

[8] Abhandl. K. K. Zool.-bot. Ges. Wien, IV, 3, p. 27 (1907).

gatus of Redtenbacher. General color testaceous with a greenish tinge upon the elytra.

Head small, smooth, tapering evenly from below to the apex of the fastigium. Latter slightly longer than one of the eyes, the sides obliquely truncate, its tip rounded, bluntly toothed at its base and separated from the fastigium of the front. Pronotum granulose throughout, most closely so on the disc, the latter flat and gently and evenly tapering anteriorly, the lateral lobes attached by a well-defined angle of equal prominence throughout; anterior margin above subtruncate, the hind margin subangulate. Tegmina very long and slender, their apex rounded, the anterior margin pellucid. Anterior and middle femora neither infuscated nor fusco-maculate, the hind pair dotted with fuscous at the base of the spines; anterior femora three-spined, intermediate pair one-spined, the hind femora with several spines on both margins. Ovipositor long and slender, at its base bent gently upwards, the apical portion slightly bowed downwards. Subgenital plate gently tapering and broadly and roundly emarginate at the apex.

General color testaceous with a greenish tinge upon the tegmina—possibly greenish in living specimens. Tarsi and tips of the tibiæ somewhat infuscated. Fastigium of the vertex marked below with a narrow transverse apical band of fuscous. Antennæ with a few fuscous annulations beyond their basal third.

Length of body, 29 mm., of pronotum 7.5 mm., of tegmina, 47.5 mm., of hind femora, 24 mm., of ovipositor, 29 mm.

Habitat.—The type, and only specimen at hand, comes from Chapada, where it was collected during August (H. H. Smith). It is the property of the Carnegie Museum. It also bears the number 2155 on a red label.

160. **Neoconocephalus longifossor** sp. nov.

A rather small as well as moderately slender species with a very long ovipositor and short and rounded fastigium of the vertex, which is black below. Most nearly related to *N. redtenbacheri* Karny.

Vertex short and evenly rounded in front, plainly longer than broad, the entire under side black, or strongly infuscated, toothed, and separated from the fastigium of the front, its anterior margin flavo-fasciate. Pronotum quite evenly and closely granulose, its posterior margin rounded. Tegmina of medium width, about twice the length of the abdomen and extending beyond the apex of the hind femora fully one-fourth of their length, the tips sub-acuminate. Anterior femora spineless, or at most with two spines, middle femora one- to two-spined beneath, hind femora with several spines on both margins. Ovipositor long and slender, a little bent upwards. Subgenital plate, or last ventral segment, roundly and shallowly emarginate.

General color yellowish green or pale ferruginous, in the latter case with the anterior margin of tegmina infuscated; antennæ, tibiæ, and ovipositor testaceo-ferruginous, the underside of fastigium entirely black or fuscous, all of the tarsi and to some extent also the tips of the tibiæ infuscated; underside of hind femora fusco-maculate at base of the spines. Anterior margin of the elytra hyaline.

Length of body, ♀, 30–32 mm., of fastigium, 1.35 mm., of prónotum 7–7.3 mm., of tegmina, 40–42 mm., of hind femora, 24–25 mm., of ovipositor, 33–36 mm.

Habitat.—Chapada, near Cuyabá, Matto Grosso, Brazil, during May and June (H. H. Smith). Several specimens. Type in Carnegie Museum.

Several other specimens in the collection remain to be studied. Possibly there may be new ones among them, as well as species already known.

Genus HOMOROCORYPHUS Karny.

Homorocoryphus KARNY, Revis. Conocephalid., pp. 4, 41 (1907).
Conocephalus auct. (in part).
Conocephalus REDTENBACHER, Mon. Conoceph. (Species 73–101), pp. 70–72, 103–115 (1891).

The species of the present genus have the same general appearance as those belonging to *Neoconocephalus*, but can at once be recognized by the contact of the fastigium of the front with the base of the fastigium of the vertex.

161. **Homorocoryphus cocanus** (Bolivar)?

Conocephalus cocanus BOLIVAR, An. Soc. Españ. Hist. Nat., X, p. 497 (1881); *Ib.*, Viaje al Pacif., Ins., p. 97 (1884); REDTENBACHER, Mon. Conocephal., 70, 106 (1891).
Conocephaloides cocanus KIRBY, Syn. Cat. Orth., II, p. 248 (1906).
Homorocoryphus cocanus KARNY, Revis. Conocephal., p. 42 (1907).

Habitat.—A single female specimen of this genus now before me seems to belong to the *C. cocanus* of Bolivar. It was taken during the month of December, 1912. The locality label reads "Prov. del Sara, Bolivia, 350 meters" (J. Steinbach).

Genus BUCRATES Burmeister.

Bucrates BURMEISTER, Handb. Ent., II, p. 708 (1838); STÅL, Recens. Orth., II, p. 99 (1874); REDTENBACHER, Verh. Zool.-bot. Ges. Wien, XLI, pp. 330, 429 (1891); KARNY, Revis. Conocephal., p. 4 (1907).

The genus *Bucrates* is a small one, and contains insects which are confined to tropical America. Only two species are recognized so far.

162. **Bucrates capitatus** (De Geer).

Locusta capitata DE GEER, Mem. Ins., III, p. 455, Pl. 40, fig. 1 (1773).

Bucrates capitatus BURMEISTER, Handb. Ent., II, p. 709 (1838); REDTENBACHER, Mon. Conocephal., p. 115, pl. 3, fig. 48 *a*, *b* (1891); GRIFFINI, Boll. Mus. Zoöl. Anat. Comp. Torino, XI, no. 232, p. 26 (1896); KARNY, Revis. Conocephal., p. 115 (1907).

Conocephalus (?) *latifrons* WALKER, Cat. Derm. Salt. B. M., II, p. 310 (1869).

Habitat.—Specimens are at hand from Santarem, Pará, Munez Freire (Cachosiro) Espirito Santo, and Rio de Janeiro, Brazil.

Family DECTICIDÆ.

Up to the time when Caudell issued his paper on the group in the *Genera Insectorum* no representatives of the family *Decticidæ* seemed to have been recorded from South American localities. It is almost incredible, however, that these insects should be entirely absent from the whole of that large and varied continent, since they are known to occur in all other portions of the Earth which are at all extensive and possess more or less arid and somewhat open tracts. Forms should be met with along the table-lands of Ecuador, Peru, Chili, and Argentina, where these conditions prevail to a large extent. The members of the family can be located by the synopsis of families printed on a preceding page of this present paper should any be found.

Family GRYLLACRIDÆ.

The family known as Gryllacridæ is a rather extensive one if we include all the forms found in the Orient as well as the Occident. But when we limit ourselves to the Americas the genera are few. Of those which are known to contain South American species there are but five. These insects are also nocturnal in their movements and during the daytime usually conceal themselves in various nooks and crannies among rankly growing vegetation or among fallen leaves and other rubbish on the ground. The five genera referred to here may be separated as follows:

SYNOPSIS OF THE SOUTH AMERICAN GENERA OF GRYLLACRIDÆ.

A. Species winged.

b. Subgenital plate of the male provided with articulated or movable styles. *Gryllacris* Serville.

bb. Subgenital plate of the males not provided with jointed or movable styles.

c. Posterior tibiæ provided above with two large spines internally and five spines externally.......................... *Dibelona* Brunner.

cc. Posterior tibiæ above provided on both margins with seven equal spines.................................... *Hyperbœnus* Brunner.

AA. Species apterous or subapterous.

b. Tegmina, when present, lobiform.................... *Neanias* Brunner.

bb. Tegmina absent. Anterior and middle tibiæ below sometimes furnished with four spines on the apical third................ *Neortus* Brunner.

Genus GRYLLACRIS Serville.

Gryllacris SERVILLE, Ann. Sci. Nat., XXII, p. 138 (1831); *Ib.*, Hist. Nat. Ins. Orth., p. 392 (1839); BURMEISTER, Handb. Ent., II, p. 717 (1838); BRUNNER, Verh. Zool.-Bot. Ges. Wien, XXXVIII, pp. 316, 317 (1888); SAUSS. & PICT., Biol. Centr.-Amer., Orth., I, p. 285 (1897); and others.

Larnaca WALKER, Cat. Derm. Salt. B. M., I, p. 190 (1869).

The genus *Gryllacris* is distributed throughout the tropics. It is represented by over two hundred known species and others are being added at short intervals from time to time as collections from various new regions are studied. The representatives of the genus, as mentioned in the introductory remarks for the family, are all nocturnal in their movements. While some of the species have abbreviated tegmina and wings, I believe that none are entirely apterous, as is the case with some representatives of the other genera of the family.

The genus *Gryllacris* is without doubt one of the oldest of the Orthopteroid insects. This we assume from the fact of its wide distribution, continental, and insular. While the center of distribution seems to be Oceanica and the adjoining portions of Asia, there are many representatives also in both Africa and tropical America. Nine years ago there were at least a dozen species known from tropical American countries. Since then fully that many more have been added.

The material now being reported upon contains several specimens.

163. **Gryllacris lævigata** Brunner?

Gryllacris lævigata BRUNNER, Verh. Zool.-bot. Ges. Wien, XXXVIII, p. 344 (1888); KIRBY, Syn. Cat. Orth., II, p. 143 (1906).

Habitat.—A single female specimen of a *Gryllacris* coming from Rio de Janeiro, Brazil, is referred here with some doubt. It was taken by H. H. Smith during the month of November.

Other specimens of the genus are reserved for study, until I shall have had time to go over the extensive writings of Dr. Achille Griffini, who has been doing much original work on the family during the past six or eight years.

Genus HYPERBÆNUS Brunner.

Hyperbænus BRUNNER, Mon. der Stenopel. u. Gryllacr., p. 123 (1888); GRIFFINI, Spec. Gen. Hyperbænus, Redia, VII, pp. 187–203 (1911).

The present genus is confined to tropical America, where forms occur from Panama to Bolivia and Paraguay. According to Dr. Achille Griffini there were known at the time when he monographed the genus eight species and one variety. The present collection contains an additional form. All of the described forms are tabulated in Griffini's monograph on pages 190–192.

164. **Hyberbænus virgo** Brunner.

Hyperbænus virgo BRUNNER, Mon. Stenopel. u. Gryllacr., p. 194 (1888); GRIFFINI, Redia, VII, pp. 190, 192 (1911).

There are specimens of both sexes of this insect at hand. They come from Santa Cruz de la Sierra, Bolivia, where they were collected by J. Steinbach at an elevation of 450 meters above sea-level. There is also a nymph of what is considered to be the same species. It was taken by the same collector at Puerto Suarez, Bolivia, during the month of November.

165. **Hyperbænus minutipennis** sp. nov.

Characterized at once by the greatly abbreviated tegmina and wings, which reach only to the apex of the first abdominal segment, and the very slender, tapering, and nearly straight ovipositor.

Tegmina lobate, their apex rounded, their upper or inner margins not quite touching, scarcely one-third the length of the hind femora. The hind femora externally four-spined, internally five-spined, the three apical spines of the latter as large as those on the outer margin, the other two minute. Subgenital plate roundly triangular, the middle depressed from beneath, its apex not emarginate. General color flavo-testaceous with the abdomen above irregularly variegated with transverse fuscous streaks.

Length of body, ♀, 17 mm., of pronotum, 4 mm., of tegmina, 4 mm., of hind femora, 11 mm., of ovipositor, 16 mm.

Habitat.—A single female, the type, comes from the "Province del

Sara," Bolivia, where it was taken during the month of October, 1913, by J. Steinbach at an elevation of 350 meters. It is in the Carnegie Museum.

166. **Hyperbænus bohlsi** Giglio-Tos.

Hyperbænus bohlsii GIGLIO-TOS, Zoöl. Jahrb. Syst., VIII, p. 815 (1895); GRIFFINI, Redia, VII, pp. 191, 196 (1911).

Several specimens of the two sexes of this species are at hand. They were collected at Puerto Suarez, Bolivia, by J. Steinbach during the months of November, December, and January.

167. **Hyperbænus juvenis** Brunner?

Hyperbænus juvenis BRUNNER, Mon. Stenopel. u. Gryllacr., p. 124 (1888); GRIFFINI, Redia, VII, pp. 192, 201 (1911).

Habitat.—A male specimen coming from Corumbá, Brazil, is doubtfully referred to Brunner's *juvenis*. It was collected by H. H. Smith during the month of April.

Genus NEANIAS Brunner.

Neanias BRUNNER, Mon. Stenopel. u. Gryllacr., pp. 72, 129 (1888).

While the representatives of the genus *Neanias* have all been credited to the Orient, where the various forms are distributed over Africa, Asia, and Australasia, there seems to be one at hand bearing a South American locality label.

168. **Neanias (?) americanus** sp. nov.

General color (after long immersion in spirits) uniformly pale cinereo-testaceous, with the hind margins of the abdominal segments paler, or rather more nearly testaceous, the consistency of the chitin being denser and not permitting of the gray under color shining through. Genicular lunules and base of hind tibiæ piceous. Head a little wider than the front margin of the pronotum, the vertex roundly depressed, the fastigium of the vertex linearly joined to the front, about twice as wide as the basal antennal joint. Pronotum short, broadest in front, the anterior margin of the disc a trifle roundly advanced upon the occiput at the middle, behind truncate. Tegmina present as very minute lateral scale-like lobes, which partly cover the suture between the dorsal and lateral portions of the mesothorax and extend only one-half the distance towards its hind margin. Anterior and middle tibiæ below five-spined in front, four-spined behind; hind tibiæ five-spined internally, six-spined externally.

Length of body, ♂, 12 mm., of pronotum, 3 mm., of hind femora 8 mm.

Habitat.—The type, a male, bears the label "Salto Grande de Paranapanema, São Paulo, Brazil, October, 12, 1908" (J. D. Haseman collector). This insect belongs to accession No. 3768 of the Carnegie Museum.

Family STENOPELMATIDÆ.

Although widely distributed over the surface of the earth, this family of the Tettigonoidea is represented in South America and nearby regions by only five genera, so far as at present known. Other representatives of the family are found in Mexico and the United States to the north. Not much is known concerning their food-habits, but some of them at least are supposed to be predaceous or carnivorous. The various species undoubtedly are largely nocturnal in their movements. Some burrow in the earth, while still others live under stones, tree-trunks, boards, and different kinds of encumbrances affording shelter, while some are dwellers in caves and underground passages.

The following synoptical key will aid in the recognition of the genera which are known to occur in South American territory:

SYNOPSIS OF THE SOUTH AMERICAN GENERA OF STENOPELMATIDÆ.

A. Anterior tibiæ provided with an auditory opening on both sides.
- *b*. Vertex viewed from above compressed. Fastigium of the vertex narrower than the first antennal joint, sulcate. Occiput provided with a longitudinal carina.............................. *Schœnobates* Saussure.
- *bb*. Vertex viewed from above plane or rounded. Fastigium of the vertex as wide or wider than the first antennal joint, not sulcate.
  - *c*. Anterior tibiæ above on the inner margin two or three-spined.
    - *d*. Pronotum behind truncate, not covering the mesonotum. Front tibiæ above three-spined on the outer margin. *Pherterus* Brunner.
    - *dd*. Pronotum produced behind, entirely hiding the mesonotum. Front tibiæ above on the outer margin unarmed, with the exception of the apical spine................ *Licodia* Walker.
  - *cc*. Anterior tibiæ above on both margins, with the exception of the apical spines, unarmed........................ *Glaphyrosoma* Brunner.

AA. Anterior tibiæ without auditory openings. Fastigium of the vertex between the antennæ deflexed, compressed, sulcate. Posterior tibiæ robust, provided above with very strong spines............. *Cratomelus* Blanchard

Genus LICODIA Walker.

Licodia WALKER, Cat. Derm. Salt. B. M., I, p. 210 (1869); KIRBY, Syn. Cat. Orth., II, p. 119 (1906).

Apotetamenus BRUNNER, Mon. Stenopel. u. Gryllacr., p. 39, Pl. 6, fig. 16 (1888).

In general appearance the insects, which comprise the present genus, remind one somewhat of several North American representatives of the family Raphidophoridæ, viz., the species of the genus *Udeopsylla* Scudder. The genus is strictly tropical American. Four species have been described, a possible fifth is represented in the present collection. These species may be separated as follows:

SYNOPSIS OF THE SPECIES OF LICODIA.

A. Anterior tibiæ two-spined above on their anterior margin. Piceous, pale beneath [Hayti] . . . . *palipes* Walker.

AA. Anterior tibiæ one-spined above on the anterior margin.

- *b.* Sides of the pronotum marked with two oblique testaceous bands on each side . . . . *obliqua* Walker.
- *bb.* Sides of the pronotum with a single longitudinal pale patch on each side near the lower margin.
  - *c.* Pronotum not longer than one-half the length of the hind femora. Fastigium of the vertex pale margined . . . . *amazona* Brunner.
  - *cc.* Pronotum somewhat shorter than the hind femora. Fastigium of the vertex entirely piceous.
    - *d.* Hind femora more robust, shorter, without a longitudinal piceous band along the lower outer face . . . . *clypeata* Brunner.
    - *dd.* Hind femora less robust, longer; provided with a prominent longitudinal, piceous line on the lower edge of outer face. *polita* sp. nov.

169. **Licodia clypeata** (Brunner).

Apotetamenus clypeatus BRUNNER, Mon. Stenopel. u. Gryllacr., p. 39 (1888).

Licodia clypeata KIRBY, Syn. Cat. Orth., II, p. 119 (1906).

A single female specimen from the "Province del Sara," Bolivia, is referred here. It was taken by J. Steinbach at an elevation of 350 meters above sea-level. This specimen has one of the anterior tibiæ two-spined above on the anterior margin.

170. **Licodia polita** sp. nov.

Most nearly related to *clypeata*, from which it differs in the somewhat less robust and longer hind femora, and in having all of the legs rather strongly tinged with piceous near the apex of the femora and on the basal portion of the tibiæ. Outer face of the hind femora prominently marked externally with a longitudinal piceous vitta.

Length of body, ♂, 18 mm., ♀, 19 mm.; of pronotum, ♂, 11.75 mm., ♀, 12 mm.; of hind femora, ♂, 17 mm., ♀, 18 mm.; of ovipositor, 10.5 mm.

Habitat.—The types, ♂ and ♀, come from Chapada, near Cuyabá, Matto Grosso, Brazil, where they were taken during November (H. H. Smith). Another specimen comes from "Province del Sara," Bolivia (J. Steinbach). The types are in the Carnegie Museum.

Family RHAPHIDOPHORIDÆ.

The family Rhaphidophoridæ is composed of apterous rather active insects usually known as "cave crickets" and "camel crickets." Like the various species belonging to the preceding family most, if not all, of the representatives of the present family are nocturnal, or at least crepuscular in habit. The majority live in caverns, crevices, underground passages, beneath stones, logs, etc., while the remainder burrow in the ground. Only two genera of these insects appear to have been recorded as belonging to South America. They are the following:

SYNOPSIS OF SOUTH AMERICAN GENERA OF RHAPHIDOPHORIDÆ.

A. Supra-anal plate of male abdomen transverse, very short, the apex on each side terminating with a straight, acuminate appendage. Cerci straight, pilose. The subgenital plate triangulately and lengthily produced, the styles very short . . . . *Udenus* Brunner.

AA. Supra-anal plate of male abdomen roundly produced. Cerci slender, not hirsute, the apex blunt. The subanal plate produced into a cylindrical tubercle, at the sides furnished with very small styles. *Heteromallus* Brunner.

Representatives of neither of these genera are contained in the material, upon which report is now being made.

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ANNALS

OF THE

CARNEGIE MUSEUM

Vol. IX. Nos. 1-2.

September, 1914.

For sale by Messrs. Wm. Wesley & Sons, 28 Essex St. Strand, London, England; Messrs. R. Friedländer u. Sohn, 11 Carlstrasse, Berlin, N. W. 6., Germany; and a the Carnegie Museum, Schenley Park, Pittsburgh, Pa., U. S. A.

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Publications of the Carnegie Museum Serial No. 85

ANNALS

OF THE

CARNEGIE MUSEUM

Vol. IX. Nos. 3-4.

March, 1915.

For sale by Messrs. Wm. Wesley & Sons, 28 Essex St. Strand, London, England, Messrs. R. Friedländer u. Sohn, 11 Carlstrasse, Berlin, N. W. 6., Germany; and at the Carnegie Museum, Schenley Park, Pittsburgh, Pa., U. S. A.

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