70

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CONTENTS OF VOLUME IX.

LIST OF ILLUSTRATIONS.

Text figures.

Plates.

DATES OF PUBLICATION OF AUTHORS' SEPARATES.

Art. I, Feb. 23, 1897. Art. II, Feb. 26, 1897. Art. III, March 11, 1897. Art. IV, Feb. 26, 1897. Art. V, March 15, 1897. Art. VI, March 22, 1897. Art. VII, April 8, 1897. Arts. VIII and IX, April 26, 1897. Art. X, May 24, 1897. Art. XI, July 9, 1897. Art. XII, July 9, 1897. Art. XIII, June 16, 1897. Art. XIV, July 2, 1897. Arts. XV and XVI, July 16, 1897. Art. XVII, Aug. 13, 1897. Art. XVIII, Aug. 21, 1897, Art. XIX, Sept. 28, 1897. Art. XX, Nov. 19, 1897. Art. XXI, Oct. 20, 1897. Art. XXII, Nov. 16, 1897. Art. XXIII, Dec. 15, 1897. Art. XXIV, Dec. 22, 1897.

The edition of authors' separates from the present volume was 250—100 for the authors, 100 for the Library exchange list, and 50 placed on sale with the Librarian.

The distribution of the Bulletin in signatures has been discontinued.

LIST OF GENERA, SPECIES AND SUBSPECIES DESCRIBED IN VOLUME XI.

Genera.

Species and Subspecies.

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AMERICAN MUSEUM OF NATURAL HISTORY.

Volume IX, 1897.

Article I.—ON MAMMALS FROM YUCATAN, WITH DESCRIPTIONS OF NEW SPECIES.

By J. A. Allen and Frank M. Chapman.

During a brief stay at Chichen-Itza, Yucatan, March 3–23, 1896, the junior author collected the few mammals forming the basis of the present paper, numbering 43 specimens, and representing 11 species. Two of the species and one subspecies appear to be undescribed, and the others are of special interest on account of the dearth of literature relating to the mammals of the Yucatan peninsula. A few additional species observed but not contained in the collection are also included in the following paper.

The absence of surface streams and the comparatively arid character of the country about Chichen-Itza have been described in a previous paper.[1] During the dry season water can be obtained only from natural wells or 'cenotes,' which, except in certain localities, are by no means common. The vegetation

[1] Notes on Birds observed in Yucatan. By Frank M. Chapman. Bull. Am. Mus. Nat. Hist., Vol. VIII, pp. 271–290.

about these cenotes is rich and varied, in strong contrast to the scrubby second-growth of the surrounding country. These wells therefore attract animals of many kinds, and traps were at once set about them in the expectation of securing small mammals. The Black Rat (*Mus rattus*) was, however, the only species caught, and its abundance doubtless accounts for the apparent absence of other Muridæ at these cenotes.

The only special papers known to us relating to the mammalian fauna of Yucatan are Mr. Oldfield Thomas's 'List of Mammals obtained by Mr. G. F. Gaumer on Cozumel and Ruatan Islands, Gulf of Honduras' (P. Z. S., 1881, p. 129), enumerating five species from Cozumel, five from Ruatan, and one each from Bonacca and Meco Islands, making altogether 11 species; and Mr. D. G. Elliot's enumeration (Field Columbian Museum, Zoölogy, I, 1896, pp. 80–81) of six species collected by Mr. H. H. Brown at San Felipe and Rio Lagotos (*lege* Lagartos) on the northern coast of Yucatan. In the 'Biologia Centrali-Americana,' Mammals (1879–'82), reference is made by Mr. Alston to 14 species in the Boucard Collection, collected by Mr. Gaumer in Yucatan. These are nearly all additional to those collected by Mr. Chapman, and are, under the current names of to-day, as follows:

Sturnira lilium (E. Geoffroy). Biol., p. 208.
Felis eyra Desm. Biol., p. 64.
Urocyon cinereo-argenteus (Müll.).[1] Biol., p. 67.
Nasua narica (Linn.). Biol., p. 75.
Putorius frenatus (Licht.). Biol., p. 78.
Galictis barbara (Linn.). Biol., p. 79.
Spilogale, sp. indet. Biol., p. 83.
"*Cariacus toltecus* (Sauss.)." Biol., p. 117.
Sciurus yucatanensis (Allen). Biol., p. 125.
"*Geomys hispidus* Le Conte." Biol., p. 160.
Synetheres mexicanus (Kerr). Biol., p. 170.
Dasyprocta punctata Gray. Biol., p. 172.
Tatusia novemcincta (Linn.). Biol., p. 189.
"*Didelphis virginiana* Kerr." Biol., p. 196.

[1] Recently distinguished by Mr. D. G. Elliot as *Urocyon cinereo-argentatus fraterculus* (Field Columb. Mus., Zoöl., Vol. I, No. 3, May, 1896, p. 80, ex San Felipe, Yucatan).

Yucatan is also the source of the *Cervus yucatanensis* Hays (Ann. Lyc. N. Y., X, 1874, p. 218, pl. x), referred by Alston to *C. toltecus*. Also specimens of a small Hare, from Merida, Yucatan, have been referred to *Lepus sylvaticus aztecus* Allen (this Bull., III, No. 1, Apr., 1891, p. 191; also Elliot, *l. c.*, p. 80).

1. **Artibeus perspicillatus** (*Linn.*). Four specimens of a species of *Artibeus* from Chichen-Itza do not appear separable from specimens from other parts of Mexico and the West Indies, which we have heretofore referred to *A. carpolegus* Gosse.[1]

It is evident that a number of well-marked forms are covered by the term *Artibeus perspicillatus* (Linn.), as commonly used. Having an abundance of specimens from Cuba and Jamaica, and from various parts of Mexico and Trinidad, it seems desirable to attempt to decide whether or not any or all of them should be referred to the Linnæan *A. perspicillatus*.[2]

An examination of the literature of the subject shows that *Vespertilio perspicillatus* Linn. rests on the following basis. In the tenth (1758) edition of the 'Systema Naturæ,' from which the name *perspicillatus* must date, no characters are given beyond an indication that the species was a tailless leaf-nosed bat from America. The citations are: (1) Syst. Nat., 7th ed., 1748; (2) Mus. Adolphi Frederici, 1754; (3) Seba, Mus., 1734, who gives a short general description of a leaf-nosed bat, without specifying any locality; (4) Edwards, Birds, 1751, who gives a figure and a description of a leaf-nosed bat, which he says "was brought from Jamaica, by Mr. Harper, Surgeon, late of Plastow, Essex;" (5) Sloane, Jamaica, 1725, who briefly refers to a leaf-nosed bat as found in Jamaica, which Edwards supposes is the same as that he figures (Edwards, pl. cci, fig. 1).

Linnæus's *Vespertilio perspicillatus* must therefore be considered as based on Edwards and Sloane, as the other references are vague and practically meaningless. This definitely fixes the type locality of the species as Jamaica, and makes it clear that the species was the tailless leaf-nosed bat described later by Leach

[1] *Cf.* this Bulletin, III, No. 1, June, 1890, pp. 170–173, 181; VI, 1894, p. 341.

[2] On the so-called *Artibeus perspicillatus* from the Island of Trinidad, see the following paper in this volume relating to Trinidad mammals.

(1822) as *Artibeus jamaicensis*, and still later by Gosse (1851) as *Artibeus carpolegus*. It seems therefore certain that whatever the various forms of South American bats referred commonly to *perspicillatus* may be, the name is at all events strictly applicable to the Jamaican form, the synonymy of which will stand as follows:

Artibeus perspicillatus (*Linn.*).

? *Vespertilio, Americanus, vulgaris*, SEBA, Loc. Rer. Nat. Thes. I, 1734, p. 90, pl. lv, fig. 2.
Vespertilio, rostro, appendice auriculæ forma, donato, SLOANE, Nat. Hist. Jamaica, II, 1725, p. 330.
Bat from Jamaica, EDWARDS, Nat. Hist. Birds, IV, 1751, p. 201, pl. cci, upper fig.
Vespertilio perspicillatus LINN. Mus. Adol. Frid. 1754, 7 (ex SEBA and EDWARDS).
Vespertilio perspicillatus LINN. Syst. Nat. ed. 10, 1758, p. 31 (ex SEBA, SLOANE and EDWARDS); *ibid.* ed. 12, 1766, p. 47.
Artibeus perspicillatus CHAPMAN, Bull. Am. Mus. Nat. Hist. IV, 1892, p. 316 (Cuba).
Artibeus jamaicensis LEACH, Trans. Linn. Soc. XIII, 1822, p. 75; DE SAUSSURE, Rev. et Mag. de Zool. 1860, p. 428 (Mexico); ALLEN, Bull. Am. Mus. Nat. Hist. III, 1890, p. 173 (Porto Rico and Virgin Gorda).
Artibeus carpolegus GOSSE, Nat. Soj. in Jamaica, 1851, p. 271. pl. vi, fig. 5; ALLEN, Bull. Am. Mus. Nat. Hist. III, 1890, pp. 173, 181 (Mexico); CHAPMAN, *ibid.* VI, 1894, 341 (Florida).

A series of nearly 30 specimens from Jamaica, in alcohol, presented by Mr. Francis C. Nicholas, includes 10 old adults, and about 20 more or less immature, ranging in age from half-grown to full-grown young. They agree in color with the Yucatan specimens, and practically in size, when corresponding ages are compared. The fore arm averages 56 (54–57) mm. in length, as against 59 (57–62) mm. in a selected lot of very old Jamaican specimens.

A series of 60 Cuban specimens, mostly in alcohol, collected by Mr. Frank M. Chapman (*cf.* this Bull., IV, 316), average still smaller than the Yucatan specimens, the fore arm averaging in 31 females 55 (52–58) mm., and in 20 males 54.5 (52–56) mm. The range in color covers the whole range of variation in this respect shown by specimens from Yucatan and other localities in southern Mexico. In each series the females are found to average slightly larger than the males.

Dr. Dobson (Cat. Bats Br. Mus., 1878, p. 519) says: "Two longitudinal white streaks on the head are generally well-defined in all full-grown individuals, and also a white patch on each shoulder at the point of origin of the antebrachial membrane," in contrast with *A. planirostris*, in which these marks are generally absent. In none of the hundred or so examples of *A. perspicillatus* before us from Jamaica, Cuba and Mexico, is a white shoulder-patch present, and generally the head-stripes are either absent or so nearly obsolete as to be traced with difficulty; in a few only are they readily apparent.

Although the chambers of the numerous ruined temples and caverns in the limestone at Chichen-Itza offered excellent hiding places for these bats, they were apparently uncommon, not more than six being observed.

2. Nasua narica (*Linn.*).—A single specimen, a very old male, with the pelage much bleached.

Two other individuals of this species were observed playing about in the branches of small trees, showing surprising agility in their movements.

3. Sciurus yucatanensis (*Allen*).

Sciurus carolinensis var. *yucatanensis* ALLEN, Mon. N. Am. Roden. 1877, p. 705.—Merida, Yucatan.
Sciurus yucatanensis ELLIOT, Field Columbian Museum, Zoölogy, I, 1896, p. 80.

The present series of 4 adult specimens (2 males, 2 females) enables us to properly characterize this fine species, originally described by the senior author as a 'var.' of *S. carolinensis*. Through the kindness of Mr. F. W. True, Curator of Mammals, U. S. National Museum, we have before us the three specimens on which *yucatanensis* was originally based. The skulls are still in the skins, as left by the collector.

The four specimens from Chichen-Itza, taken March 7–18, and the three from Merida, measure as follows:[1]

[1] The first four in the table are from Chichen-Itza, the last three are from Merida. The measurements of the latter are from skins, and are transcribed (reduced to mm.) from Mon. N. Am. Roden., p. 711, Table XX.

		Head and Body.	Tail Vertebræ.	Tail to end of Hairs.	Total Length.	Hind Foot.	Ear.
Am. Mus.,	12033, ♀	230	230	307	537	55	30
"	12034, ♀	240	222	297	537	55	
"	12035, ♂	225	195	267	492	55	30
"	12036, ♂	218	222	287	506	55	23
Nat. Mus.,	8502, ♂	254	184	235	489	53	
"	8505,	229	190	241	470	50	
"	8503, ♀	267	216	267	534	53	

Sciurus yucatanensis differs from *S. carolinensis* externally in many important points, and still more strikingly in cranial characters. While similar in size and general proportions, the tail is much broader and heavier, and the ears are much narrower and more pointed, being scarcely more than half the breadth of the ears in *S. carolinensis*. The pelage is long, coarse, and harsh, instead of short, soft, and woolly, as in *S. carolinensis*, and everywhere lacks entirely the strong fulvous suffusion that pervades the pelage of *S. carolinensis*; also the brownish yellow dorsal area and lateral line, so characteristic of the latter. In *yucatanensis* the hairs of the dorsal surface are broadly *blackish* plumbeous at base, then broadly ringed with pale buffy gray, or soiled whitish, and conspicuously tipped with black, and the underfur is sparse. In *carolinensis* the underfur is abundant; the pelage is *grayish* plumbeous at base, and the hairs are ringed with dusky, tawny, black and white, successively from the base outward, with many hairs wholly black or wholly fulvous, or black crossed by a broad bar of fulvous.

The tail in *S. yucatanensis* is black above, the hairs broadly ringed in the middle and tipped with grayish white; below is a broad median area of grayish white, the hairs for the basal two-thirds being mainly of this color with two narrow bars of black; a broad band of black bounds the central area, and the hairs are finally tipped rather narrowly with whitish. In the tail of *carolinensis* there is much less black, the grayish white central area is replaced by tawny, and the hairs are broadly tipped with clear white.

In *S. yucatanensis* the skull (not before available for examination) is remarkably short and broad, the length of the facial portion being especially reduced, and the dorsal convexity of the parietal region is much depressed, in comparison with *S. caroli-*

nensis. Premolars $\frac{2}{1}$, as in *carolinensis.* The skull is smaller than in specimens of *carolinensis* of corresponding age, as shown by the following measurements of each: No. $\frac{12034}{10461}$, ♀ ad., Chichen-Itza; No. $\frac{1071}{801}$, ♀ ad., Frogmore, S. C.: Total length, 53, 59.5; basal length, 45, 47.5; length of nasals, 16.5, 20; least interorbital breadth, 18, 17.5; greatest zygomatic breadth, 32, 34; mastoid breadth, 24, 23.5; length of palatal surface, 23, 26; length of tooth row (crown surface), 9, 10.

Obviously, from the above comparison of the two forms, *S. yucatanensis* has no very close relationship to *S. carolinensis.*

These Squirrels were common at Chichen-Itza, and were daily seen 'budding' in the small, leafless trees.

4. Peromyscus affinis (*Allen*).

Hesperomys (*Vesperimus*) *affinis* ALLEN, Proc. U. S. Nat. Mus. XIV, 1891, 195.—"Barrio, Tehuantepec [=State of Oaxaca], Mexico."

Eleven specimens, of which 3 are in the cinnamon brown pelage of the old adults, 6 in the brownish gray pelage of young adults, and 2 in the clear gray pelage of the two-thirds grown young, are apparently referable to this species, agreeing well in size, color and proportions with the three specimens on which *P. affinis* was originally based (*cf.* Allen, *l. c.*). Most of the 'young adults' are females that have apparently suckled young, though still in the gray pelage, and fully equal in size the 'old adults' in the brown pelage. As none of the specimens shows any yellowish cast on the ventral surface, the yellowish tint mentioned in the original description of *affinis* as present in two of the specimens is doubtless due, as conjectured by both Dr. Coues and the describer (*l. c.*) to soiling.

The types of *affinis* came from Barrio, near Oaxaca. If the present specimens are correctly referred to this species, its range extends northeastward to northern Yucatan.

Peromyscus affinis bears some resemblance to *Peromyscus mearnsi* and *P. canus;* it is, however, somewhat smaller, with a shorter hind foot and more naked tail, and in adult pelage is much browner above, the back being strong cinnamon brown, instead of drab gray, as in *canus.*

The 7 adults (3 males, 4 females) from Chichen-Itza measure as follows: Total length, 162 (150–172); tail vertebræ, 72 (69–75); hind foot, 18.6 (17–19.5); ear, 14.7 (14–15).

Since writing the above we have been able through the kindness of Mr. F. W. True, Curator of Mammals, U. S. National Museum, to compare the three specimens on which *Peromyscus affinis* was originally based with the series from Chichen-Itza here referred to *affinis*, and fail to see any tangible differences between the two series.

5. Peromyscus yucatanicus, sp. nov.

Above fulvous, strongly varied with black-tipped hairs over the middle area of the back, passing into a well-defined clear fulvous lateral line; below white, the fur plumbeous at base; outer surface of limbs like the adjoining parts of the dorsal area; fore feet white to above the wrists; hind feet white to base of tarsus; ears large, brownish, naked; tail naked, nearly unicolor, slightly lighter below.

Total length (of type), 210; tail vertebræ, 100; hind foot, 22; ear, 20. Five additional specimens measure as follows: Total length, 204 (190–210); tail vertebræ, 97 (93–101); hind foot, 21 (19.5–22); ear from notch, 18 (17–20).

Skull.—Anterior portion of interorbital region markedly depressed medially; a well-developed supraorbital ridge extends to the posterior border of the parietals; posterior palatal border slightly depressed, with a minute median spine; postpalatal opening with parallel sides, not expanded anteriorly; audital bullæ large. Total length, 31; basal length, 25; least interorbital breadth, 5; greatest width of brain-case, 12; length of nasals, 12.

Type, No. $\frac{12001}{10434}$, ♂ ad., Chichen-Itza, Yucatan, March 17, 1896; Frank M. Chapman.

This species is based on 6 specimens, taken March 15–27, all adult, four of them being breeding females. They are all, however, in gray pelage, except the type, which is in the 'old adult' fulvous pelage. The gray specimens all show a faint wash of fulvous on the sides, with traces of a fulvous lateral line, as yet not well defined.

Peromyscus yucatanicus differs from *Peromyscus aztecus* (De Saussure) in its naked and unicolor tail, but appears to resemble it in size and proportions. It also appears to agree essentially in size and proportions with *P. gymnotis* Thomas (Ann. & Mag.

Nat. Hist. (6), XIV, Nov., 1894, p. 365), from "Guatemala," and in the nakedness of the ears and tail, but to differ from it in color and in cranial characters.

6. Reithrodontomys mexicanus gracilis, subsp. nov.

Above yellowish brown, slightly varied over the median area with blackish tipped hairs, passing into fulvous brown on the sides, and becoming clear fulvous where the coloration of the dorsal area joins the pure white of the lower surface ; upper surface of fore feet whitish, of hind feet soiled white. Ears large, brownish, naked on both surfaces ; tail brown, unicolor, naked except towards the tip, where the annulations are still distinctly visible through the very short hairs.

Total length (of type, ♀ ad.), 165 ; tail, 98 ; hind foot, 16 ; ear (from notch), 13. Another specimen, ♀ ad., measures : Length, 154 ; tail, 90 ; hind foot, 16 ; ear, 14.

Skull (unfortunately imperfect). Total length, 20 (?) ; greatest width of brain-case, 10 ; least interorbital breadth, 3 ; length of nasals, 7 ; length of upper tooth row, 3.

Type, No. $\frac{18018}{10481}$, ♀ ad., Chichen-Itza, March 10, 1896 ; Frank M. Chapman.

This delicate little Mouse differs from true *R. mexicanus* in its smaller size and nakeder ears and tail, and somewhat paler coloration. The ears are relatively larger, and the length of the hind foot is 16 mm. as compared with 19–20 mm. in true *mexicanus*.

This subspecies is represented by 4 specimens, one of which is an adult breeding female, another is practically adult, and the other two are just acquiring the fulvous tint on the sides.

7. Sigmodon hispidus toltecus (*De Saussure*).—Three specimens, about one-third grown, are provisionally referred to this subspecies.

8. Mus rattus *Linn.*—Common about the cenotes, to the exclusion of other Muridæ.

9. Heteromys gaumeri, sp. nov.

Size large. General color of dorsum dusky or dark smoky gray, mixed with fulvous, paler and more fulvous on the sides, with a broad bright orange-ochraceous lateral line extending from the side of the nose to the base of the tail, and sharply separating the dorsal from the ventral surface; ventral surface and fore and hind feet white; outer surface of fore limbs bright orange ochraceous, inner surface white; outer surface of hind limbs like the back, inner surface white; soles 6-tuberculate, hairy from the heel to the posterior tubercle; ears dusky, narrowly edged with white, thinly covered on both surfaces with short hairs; tail dusky above, grayish white below, slightly crested and tufted at the tip, but in general so thinly haired that the annulations are distinctly visible.

The pelage of the middle of the dorsal surface, from the crown to the base of the tail, forming a broad median area, consists of a dense covering of thick, grooved spines, black apically and whitish toward the base, mixed with slender, bright orange-ochraceous hairs; laterally the spines become gradually thinner, paler, and more like rigid hairs. Along the middle of the back the pelage consists almost wholly of stiff, grooved spines, with no, or only the slightest, admixture of ochraceous hairs, the quantity of these hairs varying much in different individuals.

Total length of type (♂ ad.), 292; tail vertebræ, 162; hind foot (with claw), 32; ear from notch, 14.5. Two adult females measure respectively as follows: Total length, 260, 265; tail vertebræ, 140, 142; hind foot, 30, 34; ear from notch, 15.5, 16.

Skull of adult ♂ (No. $\frac{12031}{10464}$), greatest length, 37; basal length, 31; greatest breadth, 16; interorbital breadth, 10.5; nasals, length, 16; interparietal, breadth, 11, length, 6; diastema, 10; palate, 20; crown surface of upper tooth series, 5.

Type, No. $\frac{12038}{10461}$, ♂ ad., Chichen-Itza, Yucatan, March 17, 1896; Frank M. Chapman.

This species is based on 7 specimens, 2 males and 5 females, taken at Chichen-Itza, March 11–20, 1896. Two of the females are not fully adult, being still in the rather soft pelage of the young, the dorsal pelage consisting of rather stiff blackish hairs, without spines, scantily mixed with softer, pale yellowish hairs; the lateral line is paler and narrower than in the adult, in one specimen, and obsolete in the other.

Heteromys gaumeri is one of the largest species of the group; though smaller than *H. anomalus*, it is larger than either *H. alleni* or *H. bulleri*. In general coloration it appears to resemble most nearly *H. bulleri*, but it has the ears rimmed with white, and the soles hairy and 6-tuberculate, instead of naked and 5-tuberculate. From *H. pictus* it differs in much larger size, and in the nasals and premaxillaries terminating posteriorly on the same line, instead of "the premaxillaries surpassing the nasals by 1.5 mm.," as in *pictus*.[1]

[1] Oldfield Thomas, in lit., Oct. 26, 1896.

Named in honor of Dr. George F. Gaumer, of Izamal, Yucatan, to whom we are so largely indebted for our knowledge of the Yucatan fauna and flora.

10. **Heterogeomys torridus** *Merriam*.—A single two-thirds grown specimen of *Heterogeomys* is provisionally referred to *H. torridus*.

Gophers were particularly common at the bottoms of dry cenotes, where the soil was much deeper than over the general surface of the country. They were also common in little earth-filled hollows in the forest. During the winter they are said to be comparatively inactive. Lack of suitable traps prevented the capture of additional specimens.

11. **Dasyprocta punctata** *Gray*.—A single specimen was recognized but not captured.

12. **Cœlogenys paca** (*Linn.*).—A skull of this species was found at the entrance to a cavern which penetrated the walls of a cenote, and there were numerous signs of the presence of a large mammal, doubtless of this species.

13. **Lepus sylvaticus aztecus** *Allen*.—Two individuals were observed, but neither was secured.

This subspecies was originally based on specimens from the Isthmus of Tehuantepec, to which examples from Merida, Yucatan, were also referred (this Bulletin, III, No. 1, 1890, p. 191). We have also had an opportunity to examine the specimens referred to this form by Mr. Elliot (Field Columb. Mus., Zoöl., I, p. 80), collected at San Felipe.

14. **Mazama,** sp. ind.—Deer were common about Chichen, judging from the signs observed and reports of the Indians, but none were observed alive, although their flesh was often served at table at the hacienda.

This is probably the species described and figured by Hays under the name *Cervus yucatanensis* (Ann. Lyc. New York, X, 1874, p. 218, pl. x), but whether the same as De Saussure's *Cervus* *toltecus* (Rev. et Mag. Zool., 1860, p. 247, pl. xv, fig. 1) to which it has been referred, we are by no means assured. According to Hays, however, it "is found throughout Yucatan and the southern part of Mexico."

15. **Dicotyles tajacu** (*Linn.*).—Signs of Peccaries were seen, and the animals were said by the natives to be common. A semi-domesticated individual, about one year old, was kept as a pet at the hacienda.

Article II.—ON A SECOND COLLECTION[1] OF MAMMALS FROM THE ISLAND OF TRINIDAD, WITH DESCRIPTIONS OF NEW SPECIES, AND A NOTE ON SOME MAMMALS FROM THE ISLAND OF DOMINICA, W. I.

By J. A. Allen and Frank M. Chapman.

In 1894 the junior author made a second trip to the Island of Trinidad, for the purpose of investigating further the birds[2] and mammals of this interesting island. On the second trip, more especial attention was given to mammals, with the result of obtaining not only all but seven of the species collected on the first visit, but 13 additional species, including five here described as new, and three others not before recorded from the island. This raises the total number of species attributed to the mammalian fauna of the island to 70. One of these is now reduced to a synonym, and four should probably be deducted as based on unsatisfactory evidence, namely, *Cercoleptes caudivolvulus*, *Dicotyles labiatus*, *Cholœpus didactylus*, and *Myrmecophaga jubata*, respecting which no information could be obtained of their occurrence on the island. This leaves 65 as the number of thoroughly authenticated species.

The collection of 1894 numbers 323 specimens, which with the 200 specimens collected in 1893, forms a very satisfactory basis for a review of the mammals of Trinidad. Doubtless some others are still to be added, especially among the Bats.

About six weeks (March 12 to April 27) were spent in field work, about equally divided between Caparo, in the west-central part of the island, and Caura, at the head of the Caura Valley, in the mountains forming the northern coast-line of the Island.[3] The junior author desires to express his deep obligations to

[1] On a Collection of Mammals from the Island of Trinidad, with Descriptions of New Species. By J. A. Allen and Frank M. Chapman, Bull. Am. Mus. Nat. Hist., Vol V, 1893, pp. 203–234. Published Sept. 21, 1893.

[2] Further Notes on Trinidad Birds, with a Description of a New Species of *Synallaxis*. By Frank M. Chapman. *Ibid.*, Vol. VII, 1895, pp. 321–326.

[3] For a further account of the localities visited, see this Bulletin, Vol. VII, 1895, pp. 321, 322

Messrs. Albert B. Carr and J. E. Lickfold for the generous hospitality and assistance that rendered his sojourn at these localities so agreeable and his labors so successful. He is also greatly indebted to Mr. F. W. Urich for many favors.

An asterisk is prefixed to the species not taken in 1893.

1. **Mycetes seniculus** (*Linn.*).—Two specimens, adult male and female, were taken and presented by Mr. Arthur Carr. Not uncommon at Caparo.

2. **Saccopteryx bilineata** (*Temm.*).—Four specimens—Caparo, 1; Caura, 3.

3. **Saccopteryx leptura** (*Schreber*).—Eleven specimens—2 from Port-of-Spain, 2 from Caura, 4 from Caparo, and 3 from Caroni River, the latter collected and presented by Mr. F. W. Urich.

*4. **Saccopteryx canina** (*Wied*).—Six specimens, all from Port-of-Spain.

The species observed of the genus *Saccopteryx* are low-flying bats that course rapidly to and fro for insects through the openings in the forest or over tree-bordered roads. As at Princestown, they were sometimes seen feeding in the shade of the forest during the day.

5. **Molossus rufus** *Geoffr.*—Eleven specimens—5 from Caparo, 6 from Port-of-Spain.

This is one of the most common and by far the most frequently observed bats in Trinidad. Both at Caparo and Caura it appeared in large numbers just after sunset, flying rapidly to and fro and, as a rule, at such a height as to be out of gun-shot.

6. **Molossus obscurus** *Geoffr.*—This species was not observed at either Caparo or Caura, but it is apparently very common at Port-of-Spain, where one specimen was collected.

*7. **Pteronotus davyi** *Gray.*—One specimen, Port-of-Spain, presented by Mr. J. H. Hart.

*8. **Vampyrus spectrum** (*Linn.*).—Two specimens, from Cedros; presented by Mr. F. W. Urich. First record for the Island.

*9. **Phyllostoma hastatum** (*Pall.*).—Three specimens—2 from Caura and one from Caparo, the latter collected and presented by Mr. William Brewster.

*10. **Hemiderma brevicaudum** (*Wied*).—Represented by 21 specimens—9 from Caparo, 8 from Caura, and 4 from Port-of-Spain, the latter collected and presented by Mr. F. W. Urich. Common at both Caura and Caparo.

This is the only one of the fruit-eating bats which was commonly observed at Caparo. It frequented the vicinity of the house in numbers, and could be easily trapped by using a bit of ripe banana as bait. At Caura they were equally common, and large numbers nightly visited a small tree growing in the door-yard to feed on a small, green fruit with which it was laden. So quickly did they pick this fruit and fly away with it, that even with the luminous western sky as a background it was so difficult to shoot them that only one bat was killed during three weeks' stay at Caura, although the attempt was made every evening.

*11. **Glossophaga soricina** (*Pall.*).—Three specimens, from Port-of-Spain.

*12. **Artibeus planirostris** (*Spix*).—Twelve specimens, found hanging in a cluster in a large tree in the Botanic Gardens, Port-of-Spain, were collected with the assistance of Mr. W. E. Broadway, April 27, 1894.

*13. **Artibeus hartii** *Thomas*.—Two specimens, collected by Mr. A. B. Carr, at Caparo.

*14. **Artibeus bilobatus** (*Peters*).—Six specimens, from Caparo. Two females contained each a single embryo. These bats were found hanging in groups of four to seven individuals beneath the leaf of a palm or banana.

15. **Artibeus palmarum**, sp. nov.

Artibeus, sp. nov.? ALLEN & CHAPMAN, Bull. Am. Mus. Nat. Hist. V, 1893, p. 208.
Phyllostoma perspicillatum GEOFFROY, Ann. du Mus. XV, 1810, pp. 176, 185 (La Guyane). Not *Vespertilio perspicillatus* Linn. *Cf. anteà*, pp. 3–5.
Artibeus perspicillatus, in part, of recent authors, but not of Linnæus.

Color, both above and below, Prout's brown, the basal two-thirds of the fur lighter; on each side of the face a broad conspicuous white stripe runs from the outer posterior base of the nose leaf to a point opposite the middle of the ear; a short, narrower, but very distinct white stripe occupies the middle half of the distance between the angle of the mouth and the lower edge of the ear. Membranes dark brown, the metacarpals, phalanges and the wing tips lighter, the outer phalanx of the second digit nearly white. Short fur, colored like that of the adjoining parts extends to the middle of the fore arm, varying in amount in different specimens.

The color varies in different specimens from hair brown to light Prout's brown, rather duller below. In one specimen the head and body anterior to the shoulders is pale cinnamon brown, in rather sharp contrast with the rest of the body.

Measurements.—Adult male (type, No. 7481), head and body, 91; head, 33; nose leaf, 15x9.5; ear, from inner base, 21, from crown, 13.5; fore arm, 68; thumb (with claw), 13; 3d digit, metacarp. 64, 1st phal. 23, 2d phal. 38, 3d phal. 18; calcaneum, 9; foot, 14; width of interfemoral membrane, 17.

An adult female (No. 7480) is slightly larger, measuring as follows: Head and body, 90; head, 33; nose leaf, 13x8.5; ear from inner base, 21, from crown, 13; fore arm, 69; thumb (with claw), 13; 3d digit, metacarp. 68, 1st phal. 24, 2d phal. 39, 3d phal. 19; tibia, 30; calcaneum, 9; foot, 15; width of interfemoral membrane, 18.

Five females average: fore arm, 68; thumb, 12; 3d digit, metacarp. 67, 1st phal. 24, 2d phal. 38; tibia, 26.

Skull (♀ ad., No. 7478), total length, 31; basal length, 24; zygomatic breadth, 19; mastoid breadth, 16.

Type, No. 7481, ♂ ad., Port-of-Spain, Trinidad, April 27, 1894; Frank M. Chapman.

This species is represented by a skin, without skull, taken in 1893, and six specimens (1 male and five females) taken, with the assistance of Mr. W. E. Broadway, in the Botanic Gardens, at Port-of-Spain, April 27, 1894.

This is, in part, the *Artibeus perspicillatus* of most authors, but, as already shown (*anteà*, p. 3), it is not the *Vespertilio perspicillatus* of Linnæus, which was based practically on Sloane and Edwards (the other references given by Linnæus are valueless, because not identifiable), and is the tailless leaf-nosed bat of Jamaica, to which the name *perspicillatus* should be restricted. From true *Artibeus perspicillatus* the present species differs notably in color, particularly in the presence of two prominent broad white head stripes, and two narrower and shorter whitish cheek stripes. It is also very much larger, the fore arm measuring 68 mm. against 56 in true *perspicillatus*, with all the other dimensions proportionately larger. The skull is much more massive, at least one-third larger in general bulk, and about one-sixth larger in linear measurements.

As a specimen from Yungas, Bolivia, is practically of the same size as Trinidad specimens, and resembles it in the possession of head stripes, though much darker in general coloration, it is probable that the bat here described as *A. palmarum* has a wide range on the mainland of South America, subject doubtless to much local differentiation.

*16. **Felis tigrina** *Erxl.*—A two-thirds grown male, taken by Mr. Arthur Carr at Caparo, is provisionally referred to this species. (This is probably the species recorded in Mr. Thomas's List [Journ. Trinidad Field Naturalists' Club, No. 7, 1893, p. 7] as "*Felis*, sp.")

17. **Galictis barbara** (*Linn.*).—One specimen, adult female, Caparo, March 28. Shot by Mr. Arthur Carr, from a tree, in which were five or six others.

18. **Procyon (Euprocyon) cancrivorus** (*Cuv.*). — One specimen, young adult female, Caura, April 2.

19. **Sciurus æstuans hoffmanni** *Peters.*—One specimen, Caparo.

20. **Nectomys palmipes** *Allen & Chapman.*—Twenty-six specimens, of which 22 are from Caparo and 4 from Caura.

21. Rhipidomys couesi *Allen & Chapman.*

Tylomys couesi ALLEN & CHAPMAN, Bull. Am. Mus. Nat. Hist. V, 1893, p. 211.

Five specimens, Caura, three of which are young adults, and two are two-thirds grown young. The adults closely resemble the type in coloration, but are very much smaller. The young examples differ from the adults in being above dull hair brown, with a slight yellowish wash, most developed on the sides.

With only a single bad skin of *Tylomys*, with no skull, and no example whatever of the genus *Rhipidomys*, we were misled by external resemblances into referring this species to the genus *Tylomys*, as Mr. Oldfield Thomas has kindly pointed out to us (*in litt.*) on our sending a specimen to him for examination.

Three adults measure as follows:

	Total Length.	Tail Vertebræ.	Hind Foot.	Ear.
No. 5956 ♂	460	252	35	24
" 7320 ♀	378	196.5	30	21
" 7503[1] ♀	350	185	31	21

This is a tree-inhabiting rat, and is said to do considerable damage to cacao pods, which it gnaws in order to procure the seeds.

22. Oryzomys speciosus *Allen & Chapman.*—One specimen, not quite adult, Caparo. Differs from the adult type in being brown washed with yellowish, instead of being strong yellowish rufous, as in the adult.

23. Oryzomys trinitatis *Allen & Chapman.*—Thirty-four specimens—13 from Caparo and 21 from Caura.

24. Oryzomys velutinus *Allen & Chapman.*—Eight specimens—2 from Caparo, 6 from Caura.

25. Oryzomys brevicauda *Allen & Chapman.*—Thirty specimens—9 from Caparo, 21 from Caura.

[1] Alcoholic.

*26. Oryzomys delicatus, sp. nov.

Size small. Above yellowish brown, darker and more rufous brown medially, mixed sparingly with blackish-tipped hairs; rump clear yellowish rufous; sides paler, yellowish buff; beneath clear buff; legs like the adjoining parts of the body; feet yellowish white. Hind foot, 21.

Skull, total length, 23; basal length, 21; palatal length, 9.7; zygomatic breadth, 6.5; width of brain-case, 15; length of nasals, 8; length of upper tooth row, 3.

Type, and only specimen, No. $\frac{7817}{6025}$, ♂ ad., Caparo, Trinidad, March 20, 1894; Frank M. Chapman.

This species is based on a single specimen, which was unfortunately mutilated in the trap by some predaceous animal before it was secured, the tail, ears, and the skin of the nose and feet being defective. In general coloration it closely resembles *Oryzomys costaricensis* Allen, but is paler and grayer, especially on the sides, the hind foot is longer, and it was apparently a somewhat larger animal. The skull is larger, somewhat differently shaped, and differs throughout in minor details. The longer and much narrower nose, the narrower and much more delicate teeth are among the more striking differences. It is entirely unlike any other species known from Trinidad.

27. Akodon urichi, sp. nov.

Abrothrix caliginosus Allen & Chapman, Bull. Am. Mus. Nat. Hist. V, 1893, p. 217. (Provisional reference.)

Adult.—Above dark rusty chestnut finely punctated with black; below paler, more yellowish, with often a slight grayish cast. Ears large, black, naked externally, clothed on the outer margin within with short, dark rusty brown hairs, often quite thickly. Tail about one-third the total length, black, apparently naked, but with a lens short black hairs can be seen, which do not at all obscure the annulations. Feet entirely naked below; above clothed thinly with blackish hairs.

Young.—Darker, pelage softer and thinner, but in coloration not very different from adults.

Measurements (of type, ♂ ad.).—Total length, 200; tail, 68; hind foot, 24; ear (from notch), 15. Six adults, total length, 192 (188–196); head and body, 123 (121–125); tail, 69 (65–70); hind foot, 24.6 (23–27); ear, 13 (12–15).

Skull.—A slight raised line in old skulls over the posterior half of the orbits, continuing faintly posteriorly; anterior palatine foramina terminating opposite anterior third of m^1; interparietal very narrow antero-posteriorly. Total length (of type), 30; basal length (front border of premaxillaries to posterior border of occipital condyles), 27.5; from end of pterygoids to inner base of incisors, 17.5; palatal floor, 13; zygomatic breadth, 15; mastoid breadth, 12.5; length of nasals, 11.5; upper tooth row, 5; lower jaw (inner base of incisors to end of coronoid), 16; height of coronoid, 6.5; length of tooth row, 5.

Type, No. $\frac{7735}{6110}$, ♀ ad., Caparo, Trinidad, March 15, 1894; Frank M. Chapman.

Represented by 14 specimens, 11 of which are from Princestown, 2 from Caparo, and 1 from Caura. There is very little variation in coloration among the adults; some are a little darker and more ruddy than others. The young are darker—very dark yellowish brown with less chestnut.

With the accession of much additional material, including good skins with skulls, from Costa Rica, this species proves to have no real relationship with what we have heretofore identified as "*Abrothrix caliginosus.*" The Costa Rican species proves to be not even congeneric with the *Akodon* (=*Abrothrix*) here described from Trinidad, although the external resemblances are so close, especially in color, that the two forms are separable only after comparison. What the nearest relative of *A. urichi* may be among the thirty or more species of *Akodon* described from western and southern South America we are unable to say. Judging by descriptions it is not closely related to any of the forms recently described from Ecuador, the nearest locality to Trinidad from which the genus has been reported; but it presents a rather close resemblance, apparently, in coloration to Tomes's *Hesperomys caliginosus;* but the latter has a longer tail, and seems not likely to prove the same.

This species is named in honor of Mr. F. W. Urich, Secretary of the Trinidad Field Naturalists' Club.

*28. Akodon frustrator, sp. nov.

In general coloration quite similar to *Mus musculus.* Above dark brown, slightly washed with yellowish brown, slightly darker along the median line, lighter and grayer on the sides; sides of nose yellowish buff; lower surface plumbeous, the hairs slightly tipped with yellowish gray; no distinct line of demarcation between upper and lower surfaces; upper surface of feet dark brown, thinly haired; lower surface of feet naked, blackish in the hind feet, light brown in the fore feet; ears rather small, blackish externally, rusty brown internally, quite well haired, particularly on the inner surface; tail about half the length of head and body, naked, black above, brown below.

Length, 233; tail, 65; hind foot, 26; ear (in dried skin), 10.

Skull.—Total length, 26; basal length, 20.5; zygomatic breadth, 13; least interorbital breadth, 5; width of brain-case, 11; length of nasals, 9; length of palatal surface, 10.4; length of upper tooth row, 4.5; length of lower jaw, 13; height at condyle, 4.5; lower tooth row, 4.8.

Type (and only specimen), No. $\frac{7589}{6125}$, young adult, Caura, Trinidad, April 21, 1894; Frank M. Chapman.

This species is unfortunately represented by only a single specimen, a 'young adult,' apparently of mature size. At first sight it bears a striking external resemblance to a large *Mus musculus*, but closer inspection reveals many differences. It is widely different from *A. urichi* in coloration, from which it differs also in its much smaller ears and in the form of the skull, which is much more convex than in *A. urichi.* In coloration *A. frustrator* appears to resemble the usual style in this genus.

29. **Mus rattus** *Linn.*—Several specimens, more or less mixed with *M. alexandrinus*, were taken at Caura, where these two species appear to freely hybridize.

30. **Mus alexandrinus** *Geoffr.*—Three quite typical examples were taken at Caura; also two showing an evident *mésalliance* with *M. rattus*, and three other examples exhibiting about equally the characters of *M. rattus* and *M. alexandrinus.* Also a very young example from Caparo showing about the same mixture with *M. rattus.*

31. **Heteromys anomalus** (*Thompson*).—Forty specimens, of which 33 are from Caura and 7 from Caparo.

32. **Echimys trinitatis** *Allen & Chapman.*—Represented by 32 specimens, of which 14 are from Caparo and 18 from Caura.

33. Loncheres guianæ *Thomas.*

Loncheres castaneus ALLEN & CHAPMAN, Bull. Am. Mus. Nat. Hist. V, 1893, p. 232.

Seven specimens—5 from Caura and 2 from Caparo. Also 4 specimens from the Caroni River have been received from Messrs. Urich and Mole.

The reception of this additional material shows that our type of *Loncheres castaneus* was an exceptionally strongly colored example of the *Loncheres* found in the interior of Trinidad, and that the coast specimens, which we in the same connection identified with *L. guianæ*, represent the other extreme in coloration, being very pale, with almost none of the deep chestnut color that characterized the example of *L. castaneus*. The present series of 13 specimens completely bridges the former wide gap in coloration. The skull of the type of *L. castaneus* proves also to be exceptional in most of the features alleged as distinctive.

We have now also available for comparison a topotype of *L. guianæ*, which agrees with average Trinidad specimens in coloration and cranial characters.

*34. **Dicotyles tajacu** (*Linn.*).—One specimen, collected at Caparo, and presented by Mr. Carr.

35. Mazama[1] rufa (*F. Cuvier*).

Cariacus (*Coassus*) *nemorivagus* ALLEN & CHAPMAN, Bull. Am. Mus. Nat. Hist. V, 1893, p. 228. Not *Cervus nemorivagus* F. Cuv., Dict. Sci. Nat., VII, 1817, p. 485.

Represented by an adult female, skin and skull, taken at Caparo, March 13, and by an adult male skull obtained at Princestown in 1893.

The material now at hand renders it evident that the Trinidad Deer, as thus represented, is not *Mazama nemorivaga* but a form

[1] *Mazama* RAF. Am. Month. Mag. II, 1817, p. 44. Type, *M. tema* RAF. *Cf.* Merriam, Science, N. S., I, p. 19, Jan. 4, 1895.
Mazama antedates *Coassus* Gray, 1843 (=*Passalites* Gloger, 1841). *M. tema* Raf.=*Cervus rufinus* Bourcier and Pucheran, 1851.

closely allied to, but probably subspecifically separable from, *M. rufa* of the adjoining mainland. More material representing each form is necessary for examination before the separation can be satisfactorily made. As a slight contribution to the subject we present herewith a description of the adult female from Trinidad.

Adult female (Trinidad, as above).—Pelage thin, hairs short and rather harsh, the neck and much of the ventral surface very sparsely clothed. General color above, viewed at the distance of a few feet, liver brown; on closer inspection it is rufous brown, darker along the median line, paler on the flanks, and fading on the ventral surface to pale brown with very little rufous; top of head, ears and face dusky brown, without rufous; throat and posterior part of ventral surface (inguinal region) whitish; tail rufous above, pure white below; legs dull brown externally, somewhat lighter internally.

Measurements.—Total length to end of tail vertebræ, 1118; tail vertebræ, 127; height at shoulder, 645; girth, 711; fore leg, 396; ear, 89; tip of nose to base of ear, 205.5. Weight, 80½ pounds, including a fœtus which weighed 6 pounds.

Skull of female: Total length (from front border of premaxillaries to posterior border of occipital condyles), 202; basal length, 190; breadth across lower edge of orbits, 92; width of brain-case, 53; greatest interorbital breadth, 62; length of nasals, 65; length of molar-premolar series, 62; length of lower jaw, 167; height (angle to top of coronoid process), 82; length of tooth row (crown surface), 67.

36. Tatusia novemcincta (*Linn.*).—One specimen, adult male, Caparo, March 20, and 4 embryos from a female taken March 31, by Mr. Carr.

37. Didelphis karkinophaga *Zimmermann.*

Didelphis karkinophaga ZIMMERMANN, Geograph. Geschichte, II, 1780, p. 226. Based exclusively on *Le Crabier*, BUFFON, Hist. Nat. Suppl. III, 1776, p. 272, pl. liv, from Cayenne.

Didelphis cancrivora GMEL. Syst. Nat. I, 1788, p. 108. Based exclusively on Buffon, as above. Also *D. cancrivora* of TEMMINCK, WATERHOUSE, and probably of authors generally who have used the name.

The two collections from Trinidad include 8 specimens of this large Opossum, collected as follows: Princestown, collection of 1893, 3 specimens (2 males, 1 female); Caparo and Caura, collection of 1894, 5 specimens (3 males, 2 females), making a total of 8 specimens, all old adults.

Three specimens from the Island of Dominica, W. I., prove to be identical with the Trinidad form, which is presumably the same as the Cayenne animal, on which the names ***karkinophaga*** Zimmermann and *cancrivora* Gmelin were based.

As shown by the measurements given below, the tail averages nearly as long as the head and body, and the total length exceeds that of the very largest specimens in a large series of *D. virginiana* from various localities in the United States (as New York, Ohio and Florida). Yet the skull, in actual bulk, is found to be one-fourth to one-third smaller than in strictly comparable specimens of the northern animal. There are also other cranial differences besides size that are sufficiently constant to merit consideration. These are, notably, the position of the infraorbital foramina, which in *D. karkinophaga* are placed considerably nearer the anterior base of the zygoma than in *D. virginiana*—over the pm.[4] instead of over pm.[3]; the inner angle of the molars is shorter and blunter in *D. karkinophaga* than in *D. virginiana*, in the latter the width of the tooth being equal to the length, while in the former the width is much less than the length. The whole structure of the skull in *D. karkinophaga* is lighter and much more delicate, at all ages, which is strikingly noticeable in the slenderness of the zygoma.

There are also color differences that are noteworthy when Trinidad specimens are compared with northern (New York and Ohio) examples of *D. virginiana*, as the entire absence of white on the ears and feet, and the blackness of the general coloration; but these features in a measure disappear in the comparison of Trinidad and Texas examples. Yet the cranial differences already pointed out, in conjunction with the difference in size and proportions, render it desirable to treat these forms as species till material can be brought together in sufficient quantity from many different points in the wide range of the so-called '*marsupialis* group' to show clearly the character of the various forms of late combined under this name, and their interrelationships.

External Measurements of *Didelphis karkinophaga*, from Trinidad.

Mus. No.	Sex.	Total Length.	Head and Body.	Tail.	Hind Foot.	Ear.
6061	♂	810	385	425	55	—
6063	♂	920	455	465	66	—
7734	♂	955	500	455	64	55
7740	♂	910	470	440	57	65
6062	♀	740	350	390	55	—
7732	♀	830	400	430	57	52
7733	♀	850	468	382	58	53
Average of 4 males		874	452	446	60.5	—
" 3 females		807	406	401	57	—

External Measurements of *Didelphis virginiana*, from New York and New Jersey.

	Total Length.	Head and Body.	Tail.	Hind Foot.
	777	498	279	—
	770	497	273	—
	789	445	344	74
	670	383	287	64
	678	384	294	64
	655	388	267	—
Average	723	433	294	67

One of the largest male skulls (No. $\frac{7734}{6116}$) from Trinidad gives the following measurements: Total length, 111; basal length, 105; zygomatic breadth, 64; breadth at postorbital processes, 24.5; breadth of postorbital constriction, 10.5; breadth across m^3, 30. A skull of an old male (No. 316) from Long Island, N. Y., gives the following: Total length, 128; basal length, 118; zygomatic breadth, 71; breadth of postorbital processes, 28; breadth of interorbital constriction, 12; breadth across m^3, 35.

As noted above, the size of the body in *D. karkinophaga* is nearly one-third less in absolute bulk than in *D. virginiana*, while the tail is actually more than one-third longer. The ratio of tail length to total length is respectively as 51 to 100 and 41 to 100, the tail in *D. karkinophaga* being about equal to the length of the head and body, while in *D. virginiana* it is one-third shorter than the head and body, the tail averaging in the latter .68 of the length of the head and body.

38. Philander trinitatis *Thomas.*

Didelphis (Philander) philander ALLEN & CHAPMAN, Bull. Am. Mus. Nat. Hist. V, 1893, p. 230.
Didelphys (Philander) trinitatis THOMAS, Ann. & Mag. Nat. Hist. (6), XIII, May, 1894, p. 438.

A single specimen in the 1893 collection was provisionally referred to *P. philander*, with the suggestion that the "Trinidad animal....may prove separable from *D. philander* of the mainland—a point further material must decide." Some months later the Trinidad form was described as *Didelphys (Philander) trinitatis* by Mr. Oldfield Thomas (*l. c.*). As the present collection contains a series of 16 specimens, we are able to add some further particulars to his description, based on two specimens from Port-of-Spain. There is practically no sexual difference in size, as shown by the following measurements, taken from the fresh specimens.

Mus. No.	Sex.	Total Length.	Tail.	Hind Foot.	Ear from Notch.
7551	♂	475	282	30	31
7550	♂	483	290	31	33
7557	♂	490	290	31	34
7558	♂	500	305	32	34
7561	♂	503	303	29	31
7555	♂	525	308	30	35
7560	♀	480	285	30	33.5
7552	♀	480	286	30	30
7553	♀	485	292	30	31
7558	♀	495	294	30	32
7559	♀	504	302	31	34
7554	♀	520	310	32	35
Average of 6 males		496	296	30.5	33
" 6 females		494	295	30.3	32.7

Not only is the tail not light colored for the apical half, as in *P. philander*, but the general color of the upper surface of the body is also much darker, and the pelage less crinkled and woolly.

This species appears to be common only in the mountainous parts of the island. Only one specimen was secured at Princestown during the month's collecting, and none were secured at Caparo.

Five of the fifteen specimens taken at Caura had from five to seven young attached to their nipples. These young are large in proportion to the size of the parent, and measure 90 to 120 mm. in total length. Their eyes were as yet unopened.

The development of the pouch in this species varies greatly in different individuals. In a female having six young, which average 110 mm. in length, the opening of the pouch measures 55 mm. in the median line, and one side of the cavity is capacious enough to enfold two of the young.

39. **Marmosa murina** (*Linn.*).—Represented by a series of 25 specimens, from Caura and Caparo. It proved to be exceedingly abundant at both localities. Respecting size and coloration there is little to add to the account previously given, based on a series of 20 specimens from Princestown.

A female (No. 7428, Caparo, March 23) has six mammæ functionally developed; to each was attached a young one about 30 mm. long. A second female (No. 7429, March 31) has eleven functional mammæ, to each of which, when captured, a young one was attached, the average length of the young being about 20 mm.

It is surprising that such an arboreal animal, as this Opossum proves to be, can climb about in trees and bushes without injury to the large cluster of young attached to the nipples of its pouchless abdomen.

Young specimens show that the postorbital processes are well developed at an early age.

40. **Thylamys**[1] **carri**, sp. nov.

Above uniform drab brown, the hairs dark plumbeous for the basal four-fifths and tipped with brown; beneath grayish white, the hairs plumbeous basally and narrowly tipped with whitish, the basal plumbeous tinging the general surface; a blackish eye ring, extending forward as a broad dusky spot to the nose, and sometimes distinctly developed also behind the eye as a broad stripe running to the base of the ear. Front of fore limbs and outside of hind limbs like adjoining parts of body; feet whitish. Ears large, naked, dark

[1] **Thylamy's** *Gray*.

Thylamys GRAY, List Mamm. Br. Mus. 1843, p. 101. No description. Type, *Didelphis elegans* Waterhouse.

Without postorbital processes, and nasals not expanded posteriorly, but of nearly the same width throughout.

brown, antero-interior basal projection moderate, much longer than high; tail naked, pale brown, lighter below than above, rather longer than head and body.

Length (of type, ♂ ad.), 315 mm.; tail, 175; hind foot, 22; ear from notch, 27.5. The corresponding measurements of a second specimen (♂ ad.) are 310, 170, 20, and 29.

Skull.—No postorbital processes, nor supraorbital ridges; nasals not expanded posteriorly. Greatest length, 37.5; basal length (anterior border of foramen magnum to front border of premaxillaries), 34; greatest (zygomatic) width, 19; least interorbital width, 6; width of brain-case, 13; length of nasals, 17.5; greatest width of nasals, 2.5; least width of nasals, 2; length of palate (posterior border to gnathion), 20.5; breadth at m^3, 11; length of crown surface of molars, 7; length of upper tooth row (canine to m^4), 15.

Type, No. $\frac{7811}{6022}$, ♂ ad., Caparo, Trinidad, March 20, 1894; Frank M. Chapman.

This species is based on two adult males and a half-grown female, taken at Caparo, March 19 and 20 and April 17. They present no variation in coloration, except in respect to the prolongation posteriorly of the dusky eye spot, which is somewhat more developed in one of the specimens than in the others.

The only species with which this needs comparison is the Chilian *Thylamys elegans* (Waterhouse) and *T. marmota* (Oken = *griseus* Desm.) with which it agrees in the character of the nasals, but from which it differs decidedly in coloration.

This species is named in honor of Mr. Albert B. Carr, of Trinidad.

In our former paper on Trinidad mammals we gave at the close (*l. c.*, pp. 231–234) a nominal list of the mammals of Trinidad, based on Mr. Oldfield Thomas's 'Preliminary List,' then recently published, and on our own material. This list numbered 65 species, one of which (*Loncheres castaneus*), as shown above, proves untenable, and four others there is good reason to believe were included on insufficient evidence. In the present paper five species are either renamed or described as new. The list as now amended contains 65 species, the same number as before. The changes may be summarized as follows:

Eliminated, or Doubtful.

Cercoleptes caudivolvulus.
Loncheres castaneus (= L. guianæ).
Dicotyles labiatus.
Cholœpus didactylus.
Myrmecophaga jubata.

Changes in Nomenclature.

Mycetes, sp. = Mycetes seniculus.
Artibeus perspicillatus = Artibeus palmarum, sp. nov.
Felis, sp. = Felis tigrina.
Tylomys couesi = Rhipidomys couesi.
Abrothrix caliginosus = Akodon urichi, sp. nov.
Cariacus (Coassus) nemorivagus = Mazama rufa.
Didelphis marsupialis = Didelphis karkinophaga.
Didelphis (Philander) philander = Philander trinitatis.

Species Added.

Vampyrus spectrum.
Artibeus bilobatus.
Oryzomys delicatus, sp. nov.
Akodon frustrator, sp. nov.
Thylamys carri, sp. nov.

NOTE ON THE MAMMALS OF THE ISLAND OF DOMINICA, W. I.

While *en route* to Trinidad, the junior author spent three weeks (Feb. 1–21) at this island for the purpose of learning whether it possessed any indigenous small mammals. Traps were set daily at and about the head of the Roseau Valley, but beyond numerous specimens of *Mus* no mammals were caught.

This result, therefore, while negative, is nevertheless of value, for it seems to indicate that, with the exception of *Dasyprocta cristata*, which is distributed throughout the Lesser Antilles, Dominica has no indigenous terrestrial mammals, and this opinion is held by the residents of the island.

Mus rattus *Linn.*—Four typical examples, as regards coloration, but with longer tails than are usually seen in the United States specimens.

Mus alexandrinus *Geoffr.*—Two typical examples of this species.

Mus decumanus *Linn.*—Two specimens.

Dasyprocta cristata (*Desm.*).—A single specimen was purchased of a native. Said to be common in the interior of the island.

Didelphis karkinophaga *Zimmerm.*—Three specimens, bought of a native collector. They appear not to differ in any appreciable respect from Trinidad examples of this species, which would seem to render it certain that the animal was introduced from South America, as suggested by Colonel H. W. Fielden (Trans. Norfolk and Norwich Naturalists' Society, Vol. V, 1889, p. 39), rather than from Virginia, as some have supposed it might have been.

Article III.—ADDITIONAL NOTES ON COSTA RICAN MAMMALS, WITH DESCRIPTIONS OF NEW SPECIES.

By J. A. Allen.

Through the kindness of Mr. Anastasio Alfaro, Director of the Museo Nacional of Costa Rica, and Mr. George K. Cherrie, formerly assistant at the Museo Nacional, I have had the opportunity of examining much material relating to the mammals of Costa Rica, a considerable part of which material has been contributed to this Museum, either by Messrs. Alfaro and Cherrie personally or by the Costa Rica Museum. A small collection has also recently been purchased of Mr. Cherrie. These combined collections number about 300 specimens, and represent 65 species. In April, 1891, I published a paper entitled 'Notes on a Collection of Mammals from Costa Rica' (this Bulletin, III, pp. 203–218), in which 38 species were recorded as represented in the material then under review. This was followed in September, 1892, by a second paper, entitled 'Further Notes on Costa Rica Mammals, with description of a new species of *Oryzomys*' (this Bulletin, V, pp. 237–240), adding 9 species to the 38 previously recorded. Since the publication of this latter paper various small lots of Costa Rica mammals have been received from Mr. Alfaro, and a small collection purchased of Mr. Cherrie. These later sendings were found to contain a number of undescribed species, which have been published from time to time in this Bulletin. No general report has been made upon this later material, which is now taken as the basis of the present paper, and adds some 20 species to the number here previously recorded. As a matter of convenience for future reference, it has been deemed advisable to include in the present communication all of the species mentioned in the previous papers, with references to the place of mention, or description, in the case of the new species separately described.[1] This paper is, therefore, not only a report on the

[1] The new Costa Rican mammals already described in this Bulletin from material received from Messrs. Alfaro and Cherrie are 14 in number, to which 4 more are now added, and two new genera are characterized.

recent accessions, but a summary of my previous papers on Costa Rica mammals. The nomenclature is here revised to conform to numerous recent changes. A star is prefixed to the species not given in the former papers.

It is a pleasure in this connection to call attention to the excellent annotated list of Costa Rican mammals recently published by Mr. Anastasio Alfaro.[1] While doubtless not complete, it thoroughly represents our present knowledge of the mammalian fauna of Costa Rica, and forms an admirable basis for further work in this field. The total number of species enumerated is 121; of these 10 species are domesticated animals, and 4 are introduced species of *Mus*, leaving 107 as indigenous to Costa Rica. A few species, chiefly Bats, are introduced on general grounds as likely to occur from their known distribution both to the northward and southward of Costa Rica; but the basis of their inclusion is always duly indicated.

1. **Mycetes palliatus** *Gray.* (Bull. III, p. 204.)

2. **Ateles geoffroyi** *Kuhl.* (Bull. III, p. 204.)

3. **Cebus hypoleucus** (*Humb.*). (Bull. III, p. 204.)

4. **Adelonycteris fusca** (*Beauv.*). (Bull. III, p. 204.)

5. **Rhogeëssa parvula** *H. Allen.* (Bull. V, p. 237.)

6. **Atalapha borealis frantzii** *Peters.* (Bull. III, p. 204; V, p. 237.)

*7. **Vespertilio nigricans** *Wied.*—One specimen.

8. **Saccopteryx bilineata** (*Temm.*). (Bull. V, p. 237.)

*9. **Rhynchonycteris naso** (*Wied*).—Eleven specimens, without definite locality; G. K. Cherrie.

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[1] Museo Nacional | Mamiferos | de | Costa Rica | por | Anastasio Alfaro |—| Estudio | corregido y aumentado por el Profesor J. A. Allen |—| Impreso para | La primera Exposicion Centroamericana |—| San José, Costa Rica | Tipografia Nacional |—| 1897—12mo, pp. 51.

10. Diclidurus albus *Wied.* (Bull. V, p. 237.)—Also two additional specimens from La Palma, August, 1891, and October, 1892; G. K. Cherrie.

***11. Molossus rufus** *Geoffr.*—One specimen, ♀ ad., Boruca, Nov. 23, 1891; G. K. Cherrie.

12. Nyctinomus brasiliensis *I. Geoffr.* (Bull. V, p. 237.)—Another specimen, San José, August, 1889; G. K. Cherrie.

13. Hemiderma brevicauda (*Wied*). (Bull. III, p. 204; V, p. 238.[1])

14. Glossophaga soricina (*Pall.*). (Bull. III, p. 204.)—Also a specimen from Jimenez and another from San José; A. Alfaro.

15. Artibeus intermedius, sp. nov.

Artibeus carpolegus ALLEN, Bull. Am. Mus. Nat. Hist. III, No. 2, 1891, p. 205; *ibid.* V, 1893, p. 238.

Rather smaller than *A. palmarum*, and much darker, with the head stripes narrower and much less distinct, and the cheek stripes obsolete.

Adult above dark sooty gray, scarcely lighter on the ventral surface, where the hairs are indistinctly grayish tipped. Color of the pelage everywhere nearly uniform to the base. Membranes blackish brown, haired about as in *A. palmarum*.

Young.—Darker, blackish sooty gray, without any indication of head stripes.

Measurements (from skin, type, ♂ ad.).—Fore arm, 65; thumb (with claw), 15; 3d digit, metacarp. 57, 1st phal. 20, 2d phal. 31, 3d phal. 15; tibia, 22; foot, 17.

Skull.—Brain-case narrow and high, the dorsal outline remarkably convex. Total length, 29; basal length, ? (skull imperfect below); zygomatic breadth, 19; mastoid breadth, 16; breadth across mm^2, 12; length of palatal floor, 14.

Type, [illegible], ♂ ad., San José, Costa Rica, June 21, 1891; George K. Cherrie.

Represented by 2 adults from San José, and 5 nearly full-grown young from Limon (May 27, 1891), all collected by Mr. Cherrie. The young are darker (decidedly blackish) than the adults, and

[1] By some inadvertance, two specimens of this lot were here recorded as [illegible]. There is still a Costa Rican record for the species (cf. Dobson, Cat. Chir. Br. Mus., [illegible], p. 521), so that it is very properly included by Mr. Alfaro in his list of Costa Rican mammals.

are probably in first pelage, the outer pair of milk molars being still in place.

This form is apparently intermediate between *A. palmarum* and *A. perspicillatus*, but differs from either so much in the form of the skull as to warrant at least its provisional separation from both.

16. Vampyrops lineatus (*Geoffr.*). (Bull. V, p. 238.)

***17. Blarina nigrescens** *Allen.* (Bull. VII, p. 339.)

***18. Blarina orophila** *Allen.* (Bull. VII, p. 340.)

19. Blarina costaricensis *Allen.* (Bull. III, p. 205.)—As stated in the original description, there is little to distinguish *B. costaricensis* from *B. brevicauda*, except the alleged locality. For this reason Dr. Merriam (N. Am. Fauna, Nov. 10, 1896, pp. 10, 12) has referred *costaricensis* to *brevicauda*, considering that it doubtless came from Iowa instead of Costa Rica, and that the alleged type locality is due to accidental error. On the other hand, Mr. Cherrie, the collector of the type, still affirms that such an error was impossible, and that the specimen was actually taken at La Carpentera, Costa Rica, in October, 1890. Consequently Mr. Alfaro, in his 'Mamíferos de Costa Rica' (Jan., 1897, p. 15), has compromised the case by including *Blarina brevicauda* in his list of the mammals of Costa Rica. I enter it here under the original designation, awaiting further developments.

20. Felis pardalis *Linn.* (Bull. III, p. 204.)

21. Procyon lotor hernandezii *Wagler.* (Bull. III, p. 204.)

***22. Bassaricyon gabbii** *Allen.* (Proc. Acad. Nat. Sci. Phila., 1876, p. 23, pl. i.)

***23. Bassariscus sumichrasti** *Sauss.*—One specimen, without definite locality, collected by Mr. Cherrie.

24. Cercoleptes caudivolvulus (*Pall.*). (Bull. III, p. 204.)

25. Galictis barbara (*Linn.*). (Bull. III, p. 204.)

***26. Lutra felina** (*Mol.*).—A flat skin, without skull, ♂, La Palma, Feb. 12, 1892; G. K. Cherrie.

27. Conepatus marpurito (*Gmel.*). (Bull. III, p. 204.)

28. Sciurus hypopyrrhus *Wagler.* (Bull. III, p. 206.)

29. Sciurus æstuans hoffmanni *Peters.* (Bull. III, p. 206.)—An additional specimen, Tuis, July 17, 1894; G. K. Cherrie.

***30. Sciurus (Microsciurus) alfari** *Allen.* (Bull. VII, p. 333.)

***31. Mus rattus** *Linn.*—One specimen, San José; A. Alfaro.

***32. Mus alexandrinus** *E. Geoffr.*—One specimen, San José; A. Alfaro.

***33. Mus musculus** *Linn.*—Four specimens, San José; A. Alfaro. Unusually light colored.

34. Tylomys nudicaudus *Peters.* (Bull. III, p. 210.)

35. Akodon teguina (*Alston*). (Bull. III, 208; V, p. 238.)—Also 4 specimens, La Carpentera, September, 1891; G. K. Cherrie.

36. Peromyscus cherriei *Allen.* (Bull. III, p. 211; not V, p. 238, which is *Reithrodontomys costaricensis.*)

37. Peromyscus nudipes *Allen.* (Bull. III, p. 213; V, p. 239).

38. Peromyscus, sp. ind. (= *Hesperomys* (*Vesperimus*) *leucopus sonoriensis,* Bull. III, p. 211.)—The specimen recorded as above is probably not '*sonoriensis*' (= *texanus*) as that form is now understood. It is a short-tailed *Peromyscus*, of the size and general appearance of the *texanus* group. At present the specimen (in spirits) is drab brown above, lower parts and feet white, tail quite hairy and bicolored, being much darker above than below.

The specimen measures: Total length, 136; tail vertebræ, 58; hind foot, 18; ear (from notch), 13. The skull (that of a young adult) is not distinguishable from skulls of the *P. texanus* group of corresponding age.

*39. **Reithrodontomys costaricensis** *Allen.* (Bull. VII, p. 139.)

*40. **Reithrodontomys australis** *Allen.* (Bull. VII, p. 328.)

41. **Oryzomys alfaroi** *Allen.* (Bull. III, p. 214.)—Represented by 26 additional specimens, taken at Tuis, July, 1894, by Mr. Cherrie.

42. **Oryzomys costaricensis** *Allen.* (Bull. V, p. 239.)

43. **Oryzomys couesi** *Alston.* (Bull. V, p. 240.)

*44. **Oryzomys talamancæ** *Allen.* (Proc. U. S. Nat. Mus., XIV, 1891, p. 193.)

Through the kindness of Mr. F. W. True, Curator of Mammals in the United States National Museum, I have before me the type and only known specimen of this species for examination. In some features it appears to resemble Mr. Oldfield Thomas's recently described *O. melanotis* (Ann. & Mag. Nat. Hist. (6), XI, 1893, p. 404), particularly in its large ears and very short anterior palatine foramina, which occupy but about one-half the distance between the inner base of the incisors and the front border of m^1, instead of two-thirds to three-fourths, as is the rule in this genus. It is, however, a much larger animal than *O. melanotis*, with an absolutely, as well as relatively, much shorter tail, so that the two species are apparently not very closely allied.

There is little to add to the original description, except to give a few additional measurements of the skull, as follows:

Width of brain-case, 12; width of interparietal, 8.5; length of same, 3; distance from m^1 to inner base of incisors, 7.5; length of anterior palatine foramina, 3.8; greatest breadth of same, 2.3; length of lower jaw (inner base of incisors to posterior border of condyle), 16; height of same at condyle, 7.1.

45. Oryzomys chrysomelas, sp. nov.

Hesperomys (*Habrothrix*) *caliginosus* Allen, Bull. Am. Mus. Nat. Hist. III, No. 2, 1891, p. 210. Not *Hesperomys caliginosus* Tomes.

Adult.—Above dark (blackish) brown finely mixed with bright yellowish rufous, brighter and more rufous on the sides; below strong yellowish brown, with a slight grayish cast. Ears small, black, nearly naked within and without (a few short black hairs visible under a lens on both surfaces); feet blackish brown, naked below and nearly so above; tail about half the length of head and body, black, unicolor, naked (very short black hairs discernible with a lens); nails light horn color, in contrast with the dusky feet.

Young.—Nearly uniform blackish brown above, below somewhat lighter, with a tinge of gray.

Measurements (from skin).—Total length (of type), 187; tail, 90; hind foot, 25; ear (from notch), 10.5.

Skull (of type).—The skull is remarkable for the great breadth of the supraorbital ridges, considering the size of the animal, which are developed into a thin broad shelf. The anterior palatal foramina do not quite reach the line of the anterior base of the first molar. The teeth and the skull in general features are typically those of an *Oryzomys*. Total length, 28; basal length, 23.5; palatal length, 5.3; zygomatic breadth, 15; breadth of brain-case, 12; length of nasals, 9.5; length of upper tooth row, 5.3.

Type, No. $\frac{10777}{8678}$, ♂ ad., Suerre, Costa Rica, July 16, 1895; A. Alfaro.

In 1893 (*l. c.*, *supra*) I referred provisionally a number of skins in bad condition (skulls not available for examination) from San Carlos and Pacuare to Tomes's *Hesperomys caliginosus*, from Ecuador. All but one of these specimens soon passed out of my hands. Recently the Museum has purchased of Mr. George K. Cherrie a series of 5 very good skins with separate skulls in good condition. An examination of this material shows that the species is referable not to *Akodon* (=*Abrothrix*), but to *Oryzomys*. Externally *O. chrysomelas* appears to very closely resemble *Hesperomys caliginosus* Tomes, but if Tomes's species is properly referable to *Akodon*, the cranial characters of the two species must be very different.

O. chrysomelas somewhat approaches *O. alfaroi* Allen in coloration, but the latter is a much more slender animal, with the tail, both absolutely and relatively, very much longer, while the skull is much smaller and otherwise very different from that of *O. chrysomelas*.

Zygodontomys, gen. nov.

Type, *Oryzomys cherriei* Allen.

PLATE I, FIGS. 1–7.

Pelage full and soft, and with the general external appearance of *Sigmodon*. Skull characters in general much as in *Oryzomys*, but with a very different tooth-pattern. Teeth, in respect to relative size and general outline, as in *Oryzomys*, but the cross furrows between the successive pairs of cusps are cut off by a longitudinal bar of enamel, yoking together the pairs of cusps on the median line of the tooth. Thus the anterior cone of m^1 is connected with the two succeeding pairs of cones by a median longitudinal ridge, and the two pairs of cones in m^2 are similarly connected. The same structure also characterizes the lower molars. (Plate I, Figs. 2, 4, 6, 7.)

This peculiar arrangement of the enamel pattern of the teeth is combined with a pelage very different from that found in true *Oryzomys*, the external resemblance being more with *Sigmodon*. The type species, *Z. cherriei*, has the rostral portion of the skull very broad and short, with very broad anterior palatine foramina. A second species, *Z. brevicauda* (=*Oryzomys brevicauda* All. & Chapm.), from Trinidad, has the rostral portion of the skull narrower and longer, about as in *Oryzomys*.

*46. **Zygodontomys cherriei** (*Allen*).

Oryzomys cherriei ALLEN, Bull. Am. Mus. Nat. Hist. VII, 1895, p. 329. (Published Nov. 8, 1895.)

Sigmodontomys, gen. nov.

Type, *Sigmodontomys alfari* Allen.

PLATE I, FIGS. 8–14.

Pelage very thick and soft as in *Zygodontomys*, or as in the soft pelaged species of *Sigmodon* (*e.g.*, *S. borucæ*) and the voles (*Microtus*). Skull peculiar in many respects. Supraorbital ridges very strongly developed, thin and inclined upward at the orbits. Anterior plate of the zygoma very broad, but not developing a point at the anterior upper border, as in *Sigmodon*. Nasals rapidly tapering posteriorly, terminating in a narrow point beyond the premaxillary suture. Anterior palatine foramina broad, short, not nearly reaching the plane of the front molars. Posterior nares very broad, the pterygoids heavy and parallel, and the posterior palatal border only slightly hollowed; palate extending beyond the molars, and with the slight pits seen in *Oryzomys*. Interparietal very large, the length about one-half the breadth, rounded at the ends, with the anterior and posterior borders only slightly convex. Audital bullæ globular, of medium size. Dentition very heavy; quite as heavy as in *Sigmodon*, the teeth obliquely implanted. The enamel pattern of the molars is somewhat intermediate between that of *Sigmodon* and *Oryzomys*, but the teeth rather more approach in form and structure those of the latter. General outline and relative size of the teeth as in *Oryzomys*, m^3 being about one-third the size of m^2, but the tubercles are less prominent. On the outer border (teeth only slightly worn) there are no reëntrant angles; on the inner border they are deep, extending nearly to the median line, two in m^1, one in m^2, none in m^3. In the lower molars the plan, as usual, is reversed, there being no reëntrant angles on the inner surface, but on the outer there are two on m_1, and one on each in m_2 and m_3. The crown surface, however, shows a deep infolding of enamel on the inner half of the teeth—two on m_1, two on m_2 and a slight fold on m_3. (Plate I, Figs. 13 and 14.)

*47. Sigmodontomys alfari, sp. nov.

Pelage full, long and soft, much as in *Sigmodon borucæ*. Above strong yellowish brown, shaded with dusky brown over the middle region, lighter on the sides, passing into clear yellowish brown along the lower edge of the dorsal surface; the hairs are plumbeous at base, broadly tipped with yellowish brown, with a very slight intermixture of black hairs; below grayish white (fur plumbeous basally), sharply defined against the color of the upper parts; ears small, nearly hidden in the fur, naked, blackish brown; upper surface of fore feet pale brown, the toes grayish brown and nearly naked; hind feet grayish brown, nearly naked, the minute dusky scales, especially of the toes, distinctly visible; soles naked, blackish; tail unicolor, dark brown, naked.

Measurements (approximate, from skin).—Total length, 278; head and body, 123; tail, 155; hind foot, 37; ear (from notch), 14; ratio of tail length to total length, 56.

Skull.—Total length, 35.2; basal length, 25.4; zygomatic breadth, ?; least interorbital breadth, 12; width of brain-case, 13.2; length of nasals, 14.3; length of palatal surface, 15; distance from m^1 to inner base of incisors, 8.5; length of anterior palatine foramina, 5.3; length of upper tooth row (crown surface), 5.3; length of lower jaw (inner base of incisors to outer border of condyle), 18; height of jaw at condyle, 8.5; length of lower tooth row (crown surface), 6.

Type, No. [illegible], ♂ ad., Jimenez (altitude, 700 feet), Costa Rica; Anastasio Alfaro.

This species is based on a single specimen, collected at Jimenez, by Mr. Alfaro. Externally this species is strongly suggestive of a *Sigmodon*, particularly *S. borucæ*, described later in the present paper, which it greatly resembles in its long, soft, thick pelage, and in coloration. The tail, however, is more than half the total length, instead of considerably less, as in the longest-tailed species of *Sigmodon*. It is generically distinct from any other Central American species, but what its nearest relatives may be among the South American forms of the family, lack of material renders it impossible to determine. Its large, almost naked hind feet, long, hairless tail, relatively small ears, and peculiar dentition, seem to exclude it from any hitherto recognized genus.

This species is named in honor of Mr. Anastasio Alfaro, Director of the National Museum of Costa Rica, to whom I am so greatly indebted for the material that has served as the basis of this and my former papers on Costa Rican mammals.

48. Sigmodon borucæ, sp. nov.

Adult.—Pelage full and rather soft for a *Sigmodon*. Above yellowish brown, with a slight tinge of chestnut, grizzled with black and gray, darker over the median area, lighter on the sides; lower surface whitish gray, tinged with plumbeous, the plumbeous of the basal portion of the pelage showing more or less at the surface. Ears dusky, naked externally, thinly clothed with very short yellowish gray hairs within; fore and hind limbs like the adjoining parts of the body; feet dark gray; tail dark brown, a little lighter on the lower surface than above, nearly naked.

Young.—Pelage soft, above nearly uniform dark yellowish brown, with a slight reddish shade; below the tips of the hairs are more or less buffy, tinged with the gray of the under pelage. Ears, feet and tail darker than in the adult. In changing to the adult pelage the under surface presents a more or less patchy appearance, the buffy tints of the first pelage being mixed in irregular areas with the new whitish tipped hairs of the second pelage.

Size medium. The type (♀ ad.) measured in the flesh: Total length, 275; tail, 115; hind foot (in skin), 30; ear, from notch (in skin), 15. Eleven specimens, mostly young adults (none very old), measured in the flesh by the collector, give the following: Total length, 248 (230–275); tail, 110 (100–125); ratio of tail to total length, 44.2.

Skull.—Nasals rather broad; infraorbital opening very broad, evenly and obtusely rounded above posteriorly; anterior palatal foramina extending to just behind the anterior base of m^1. Total length, 33; basal length, 29; zygomatic breadth, 18; least interorbital breadth, 6; width of brain-case, 13; length of nasals, 12; width of nasals, 3.8; palatal length, 15; length of upper tooth row, 5.5; length of palatal foramina, 8.

Type, No. $\frac{11781}{10048}$, ♀ ad., Boruca, Costa Rica, Dec. 12, 1891; George K. Cherrie.

This species is based on a series of 22 specimens, collected by Mr. George K. Cherrie at Boruca, Costa Rica, on the Pacific slope, not far from the coast, during the months of November and December, 1891. The series consists mostly of young adults, none of the specimens being apparently very old. It includes four examples in first pelage, and several young in change.

Sigmodon borucæ is very distinct from any of the forms of *Sigmodon* found in southern Mexico. In coloration it presents a singularly close resemblance to *S. hispidus*, as represented in the Carolinas and northern Florida. It differs, however, quite appreciably on close comparison, averaging much darker, with a thicker, softer pelage, and it has also a much longer tail, which in *S. hispidus* averages only 38 per cent. of the total length as against 44 per cent. in *S. borucæ*. It presents a pelage similar in character to that of the soft, heavily-furred species of the genus *Zygodontomys*; in fact, it bears so close a resemblance both in the texture of the pelage and in coloration to my *Z. cherriei*, from the same locality, that the two species are easily confounded on casual inspection.

I refer also provisionally to this species a series of 6 specimens from San José, Costa Rica, and 1 (♀ ad.) from Talamanca, C. R. Three of the San José specimens are adult and 3 are immature, one of the latter being in first pelage. They agree in all essential features with the Boruca specimens, except in possessing a coarse, hispid pelage, strikingly in contrast with the soft pelage of the Boruca series. As this greater coarseness and stiffness of the pelage characterizes both old and young alike, in contrast with the Boruca specimens, it seems to indicate that the San José form may prove separable from typical *S. borucæ*, but I am unable at present to distinguish any other tangible difference between the two forms. The San José specimens come from an altitude of

5000 feet, while the Boruca series was collected at nearly sea level.

The single Talamanca specimen was formerly referred by me to "*Sigmodon hispidus toltecus*" (this Bulletin, III, No. 2, April, 1891, p. 207), as also one of the San José specimens (*ibid.*, V, p. 238).

*49. **Macrogeomys cherriei** (*Allen*). (Bull. V, p. 337; VIII, p. 45, pl. i.)

50. **Heteromys longicaudatus** *Gray*. (Bull. III, pp. 215, 270.)—Also 1 specimen from Suerre, July 12, 1895; A. Alfaro; and 1 from Isla Nuevo, Irazu Range, Aug. 20, 1893; G. K. Cherrie.

*51. **Echimys centralis** *Thomas*. (Ann. & Mag. Nat. Hist. (6), XVIII, Oct., 1896, p. 312.)—One specimen, a nearly full grown female, taken at Suerre, July, 1895, by Mr. Alfaro, seems more likely to be referable to this species than to *E. semispinosus* Tomes.

Mr. Thomas's '*Echinomys*' *centralis* is based on two specimens from San Emilio, south end of Lake Nicaragua. He says: "No doubt they are the same as the examples of '*E. semispinosus*' recorded by Mr. True [Proc. U. S. Nat. Mus., 1888, p. 467] from Greytown, Nicaragua, and from Pecuare, Costa Rica; so that further details about the species may be learned from his paper."

52. **Synetheres mexicanus** (*Kerr*). (Bull. III, p. 216.)

*53. **Dasyprocta isthmica** *Alston*.—One specimen, Pozo del Pital, Rio Narango, March 12, 1893; G. K. Cherrie.

54. **Cœlogenys paca** (*Linn.*). (Bull. III, p. 216.)

55. **Lepus gabbii** *Allen*. (Bull. III, p. 216; V, p. 240.)—Also an additional specimen, San José, September, 1890; G. K. Cherrie.

56. **Bradypus infuscatus** *Wagler*. (Bull. III, p. 216.)

57. **Bradypus castaneiceps** (*Gray*). (Bull. III, p. 216.)

58. **Cholœpus hoffmanni** *Peters*. (Bull. III, p. 217.)

*59. **Xenurus gymnurus** (*Ill.*).—One specimen, ♀, Suerre, February, 1896; A. Alfaro.

This species was first recorded from Costa Rica by Dr. von Frantzius, on what was considered by Mr. Alston (Biol. Cent. Am., Mammals, p. 188) as unsatisfactory evidence. Mr. Alfaro, however, has had the good fortune to capture and record (Mamíferos de Costa Rica, 1897, p. 46) the specimen here mentioned, thus establishing beyond question the existence of the species in Costa Rica.

60. **Tatusia novemcincta** (*Linn.*). (Bull. III, p. 217.)

61. **Cyclothurus didactylus** (*Linn.*). (Bull. III, p. 217.)

62. **Didelphis aurita** *Wied* (=? *D. marsupialis* Linn.). (Bull. III, p. 217.)—The series of Costa Rican Opossums of the genus *Didelphis* available for examination is not sufficient to determine satisfactorily their relationships, but they appear to belong to the *aurita* type of the so-called *marsupialis* group. In two young specimens before me from San José, the ears are almost wholly white and the tail is quite as long as the head and body.

The name *marsupialis* is here recognized only provisionally, and in the belief that it should be discarded as indeterminable, in view of the fact that several quite distinct forms have been included under it. The original Linnæan species *marsupialis* is intricately composite; though based mainly, apparently, on early descriptions of Wied's *D. aurita*, it doubtless covered also *D. karkinophaga* Zimm. (= *D. cancrivora* Gmel.), and also the Philander. If we take Linnæus's diagnosis (Syst. Nat., ed. 10, 1758, p. 55) as the basis of the name, it seems to point to *D. aurita* rather than to *D. virginiana*—to an animal with the tail as long as the body and the ears black, tipped with white. It is clearly not *D. karkinophaga* (*cf. anteà*, p. 23).

63. **Metachirus quica** (*Temm.*). (Bull. III, p. 317.)

64. **Marmosa cinerea** (*Temm.*). (Bull. III, p. 318.)—Also 2 adults and 4 young, from Tres Rios, Aug. 17, 1893; G. K. Cherrie.

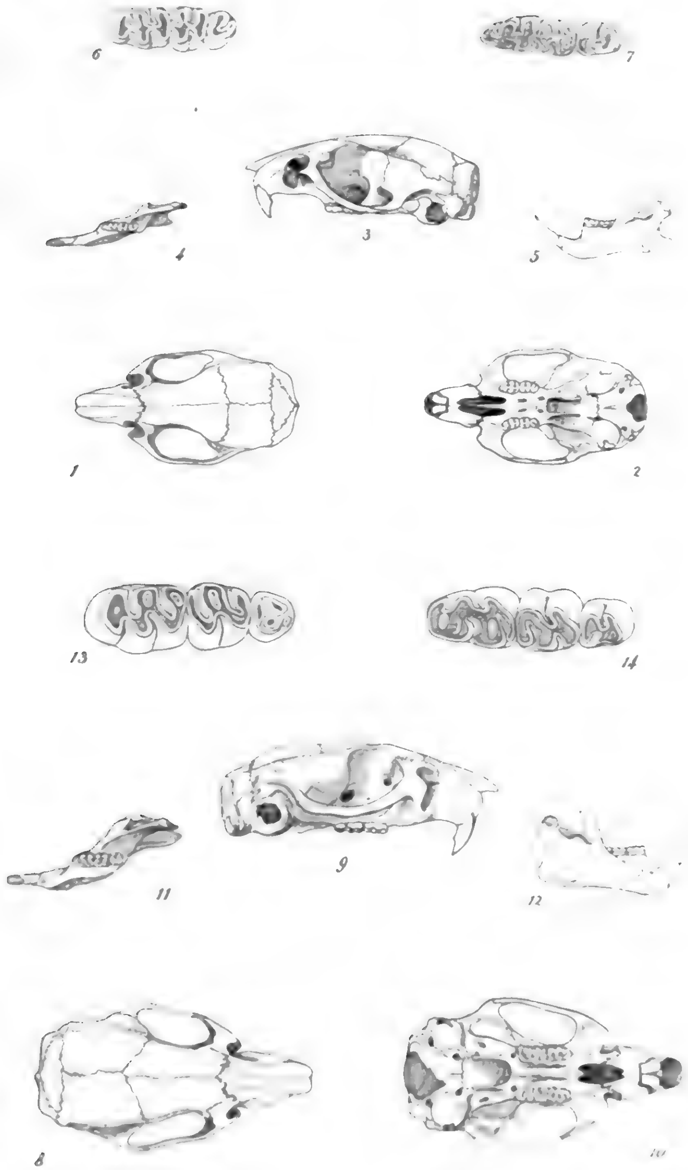
65. Marmosa murina (*Linn.*). (Bull. III, p. 218; V, p. 240.)—Also 1 specimen each from Jimenez and Boruca ; G. K. Cherrie.

66. Philander lanigera *Desm.* (Bull. III, p. 218.)—Two additional specimens—Boruca, Dec. 15, 1891, and Irazú Range ; G. K. Cherrie. The former is a very rufous example ; the latter is gray, tinged slightly with brown where the rufous tints ordinarily prevail.

DESCRIPTION OF PLATE I.

FIGS. 1–7, *Zygodontomys cherriei.*—Fig. 1, skull from above ; Fig. 2, side view of same ; Fig. 3, lower view of same ; Fig. 4, lower jaw, from above ; Fig. 5, lower jaw, from side ; Fig. 6, upper molar series ; Fig. 7, lower molar series. Figs. 1–5, natural size ; Figs. 6 and 7, enlarged 4½ times.

FIGS. 8–14, *Sigmodontomys alfari.*—Fig. 8, skull from above ; Fig. 9, side view of same ; Fig. 10, lower view of same ; Fig. 11, lower jaw, from above ; Fig. 12, lower jaw, from side ; Fig. 13, upper molar series ; Fig. 14, lower molar series ; Figs. 8–12, natural size ; Figs. 13 and 14 magnified 4½ times.



Figs. 1–7. ZYGODONTOMYS CHERRIEI.
Figs. 8–14. SIGMODONTOMYS ALFARI.

Article IV.—NOTE ON THE HYPOSTOME OF LICHAS (TERATASPIS) GRANDIS HALL.

By R. P. Whitfield.

In the Fifteenth Rept. State Cab. N. Y., p. 110, 1862, Professor Hall describes a species of trilobite under the name *Lichas grandis*, and in the 16th Rept. N. Y. State Cab. he founds the genus *Terataspis* on this same species.

All the remains yet noticed of this species have been fragments, and until the present time no remains of the hypostome have been described, but during the autumn of 1896 the Rev. S. Parsons, of Paterson, N. J., brought to me for identification two fossils obtained from loose boulders of Schoharie grit, obtained about one mile north of Paterson, N. J., which I take to be the separated hypostomes of that species. He has also obtained other parts of the organism, and many of the characteristic fossils of this peculiar bed of rock from the same series of boulders.

These hypostomes are quite large, even in proportion to the size of the trilobite, as compared with those of other species of *Lichas*, and are very broad in proportion to the length, being about one-third wider than long, whereas those of *L. boltoni* and

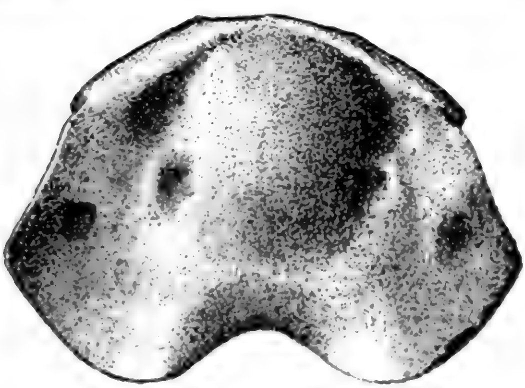


Fig. 1.

Fig. 2

Fig. 1. Upper surface of the plate, natural size

Fig. 2. An outline in profile showing the depth of the anterior border a

allied forms, like *L. avus* of Barrande, are always longer than wide, or nearly equal in length and width. They are, however, more like *L. pachyrhinus* Dalman and *L. celorrhin* Angelin. The central protuberance is not as well defined by the furrows as in *L. boltoni* Bigs., but is bordered by two rather deep pits on each side in the position of the median furrows and its inner extension, while the outer division backwards is so extremely faint as to be readily

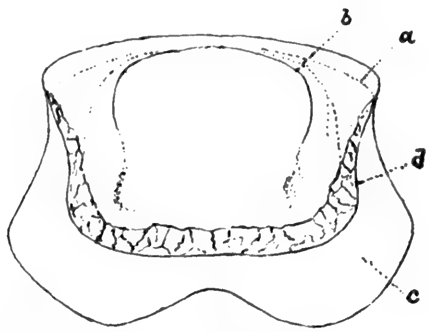


Fig. 3. Outline, natural size, of the under side of the second specimen: *a*, the line of the anterior margin; *b*, limit of the protuberance; *c*, the infolding of the crust of the lower surface, the line *d* being its forward extension.

overlooked. On the outer lateral portion of the plate near the margin there is a third deep pit unlike that of any other hypostome, and I am somewhat in doubt as to whether it may not be accidental. The transverse furrow limiting the protuberance behind is obsolete, and the central emargination of the posterior border is less than in *L. boltoni*, while the anterior border joining the rim of the head on the under side is unusually broad and deep. The under surface of the plate is exposed on the second specimen by breaking away the filling between the crusts, and shows that the infolding of the plate below extended on the under side to a distance equal to fully one-fourth of the length of the plate from the posterior margin.

The great difference between this plate and the corresponding parts of the ordinary forms of *Lichas* like *L. boltoni* Bigsby and *L. avus* Barrande would seem to warrant a generic separation of this from *Lichas*. And it is probable that the peculiar forms of the Lower Helderberg group corresponding to *L. pustulosus* Hall will be found to resemble this one whenever they may be discovered.

Article V.—FURTHER NOTES ON MAMMALS COLLECTED IN MEXICO BY DR. AUDLEY C. BULLER, WITH DESCRIPTIONS OF NEW SPECIES.

By J. A. Allen.

A collection of mammals recently purchased by the Museum, gathered in various parts of southern Mexico by the late Dr. Audley C. Buller, contains several species apparently as yet undescribed, and others of special interest. In preparing a report on this collection it seemed desirable to give a list of all the mammals collected for this Museum in Mexico by Dr. Buller,[1] and received from him at various times from 1889 to 1895. These number altogether over 300 specimens, and represent 55 species, of which 16 have been determined as new to science. In presenting this final catalogue occasion is taken to revise the nomenclature used in the original papers, where changes have since become necessary.

The collection here especially under notice was made chiefly at Mineral San Sebastian, and in the Valle de Bandera, Jalisco.

1. **Ateles vellerosus** *Gray*. (Bull. III, 176.)

2. **Antrozous pallidus** (*Le Conte*). (Bull. III, 176.)

3. **Corynorhinus townsendii** (*Cooper*). (Bull. III, 176.)

4. **Adelonycteris fuscus** (*Beauv.*). (Bull. II, 165 ; III, 176.)

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[1] The earlier collections made by Dr. Buller have been treated in this Bulletin in various papers, as follows:

1. Notes on a Collection of Mammals from Southern Mexico, with descriptions of new species of the genera *Sciurus*, *Tamias*, and *Sigmodon*. Bull. Am. Mus. Nat. Hist., Vol II, 1889, pp. 165–181. Published Oct. 21, 1889.

2. Notes on Collections of Mammals made in Central and Southern Mexico, by Dr. Audley C. Buller, with descriptions of new species of the genera *Vespertilio*, *Sciurus*, and *Lepus*. *Ibid.*, Vol. III. No. 2, 1890–91, pp. 175–194. Published Dec. 10, 1890.

3. Description of a new species of Opossum from the Isthmus of Tehuantepec, Mexico. *Ibid.*, Vol. V, 1893, pp. 235, 236. Published Sept. 22, 1893.

4. Remarks on specimens of *Chilonycteris rubiginosa* from Western Mexico, and on the color phases of *Pteronotus davyi* Gray. *Ibid*, Vol. VI, 1894, pp. 247, 248. Published Aug. 3, 1894.

5. **Atalapha cinerea** (*Beauv.*). (Bull. II, 165 ; III, 177.)

6. **Vespertilio lucifugus** *Le Conte.* (Bull. III, 177.)

7. **Vespertilio nitidus** *H. Allen.* (Bull. III, 177.)

8. **Vespertilio velifer** *J. A. Allen.* (Bull. III, 177.)

9. **Vespertilio melanorhinus** *Merriam.* (Bull. III, 178.)

10. **Saccopteryx plicata** (*Peters*). (Bull. III, 178.)

11. **Nyctinomus brasiliensis** *I. Geoffr.* (Bull. III, 178.)

12. **Chilonycteris rubiginosa** *Wagner.* (Bull. VI, 247.)

13. **Pteronotus davyi** *Gray.* (Bull. VI, 248.)

14. **Macrotus bulleri** *H. Allen.* (Bull. II, 166 ; III, 179 ; VI, 248.)

15. **Macrotus mexicanus** *De Saussure.* (Bull. III, 179.)

16. **Glossophaga soricina** (*Pall.*).—Two skins with skulls, and three specimens in spirits, Valle de Bandera, Terro Tepic, Jalisco, Mexico, Feb. 23, 1893.

In one of the alcoholics the tail is wholly enclosed within the interfemoral membrane ; in another the point is noticeable as a slight protuberance on the upper surface of the membrane, while in the third it projects 3 mm. above the surface.

17. **Artibeus intermedius** *Allen.*—Three specimens, Las Penas, Jalisco.

In the two adult males and one female (in spirits) the fore arm measures respectively 66, 65 and 63, and the third metacarpal respectively 64, 62 and 62, with all other measurements in proportion. The fore arm is thus one-fifth longer (10 mm.) than in a series of old adults of *A. perspicillata* from Jamaica, which are above the average for Cuba and eastern Mexico localities. The head stripes, as well as the size, are as in Costa Rica specimens (*cf. anteà*, p. 33).

18. **Sturnira lilium** (*E. Geoffr.*). (Bull. III, 181.)

19. **Felis onca** *Linn.* (Bull. III, 176.)

20. **Felis tigrina** *Erxl.* (Bull. III, 176.)

21. **Felis pardalis** *Linn.* (Bull. III, 176.)

22. **Felis yaguarundi** *Desm.* (Bull. III, 176.)

23. **Urocyon cinereo-argenteus fraterculus** *Elliot.* (Bull. III, 176.)

24. **Procyon lotor hernandezi** (*Wagler*). (Bull. III, 176.)

25. **Putorius frenatus** (*Licht.*). (Bull. II, 165.)

26. **Sciurus aureogaster** *F. Cuv.* (Bull. III, 181.)

27. **Sciurus leucops** (*Gray*). (Bull. III, 182.)

28. **Sciurus cervicalis** *Allen.* (*Sciurus aureogaster leucops*, Bull. II, 166; *Sciurus cervicalis*, III, 183.)

29. **Sciurus nayaritensis** *Allen.* (*Sciurus alstoni*, Bull. II, 167; *Sciurus nayaritensis*, II, vii; III, 185.)

30. **Tamias bulleri** *Allen.* (Bull. II, 173; III, 92, 186.)

31. **Spermophilus annulatus** *Aud. & Bach.* (Bull. II, 172; III, 186.)

32. **Spermophilus grammurus macrourus** (*Bennett*). (Bull. II, 170; III, 185.)

33. **Spermophilus spilosoma** *Bennett.* (Bull. II, 172; III, 185.)

34. **Mus rattus** *Linn.* (Bull. II, 179; III, 186.)

35. **Mus alexandrinus** *E. Geoffr.* (Bull. III, 186.)

36. **Mus musculus** *Linn.* (Bull. III, 186.)

37. Peromyscus mexicanus (*De Sauss.*). (Bull. II, 179.)

38. Peromyscus aztecus (*De Sauss.*). (Bull. II, 179; III, 187.)

39. Peromyscus spicilegus, sp. nov.

Texture of pelage and coloration very much as in *Peromyscus floridanus*, but size smaller, tail longer, and ears much smaller. Above yellowish brown, finely mixed with dusky tipped hairs, most numerous along the middle of the back, forming a slightly darker median area; sides more yellowish, passing gradually into a strong ochraceous lateral line, which is sharply defined against the white of the ventral surface; below white, the hairs broadly plumbeous at base. The bright fulvous of the sides extends over the outer surface of the fore limbs to the wrists, leaving the feet white; the color of the thighs extends over the outer surface of the hind limbs to the tarsus, which is dusky, leaving only the feet white. Ears dusky, nearly naked; tail distinctly bicolor, nearly naked, brown above, whitish below.

Total length (of type), 188; tail vertebræ, 92; hind foot, 21; ear (from notch), 15. Four adults measure as follows: Total length, 190 (181–200), tail vertebræ, 92 (86–98); hind foot, 20.5 (20–21); ear 15. (Measurements all from skins.)

Skull.—Total length, 28; basal length, 22; least interorbital breadth, 5; greatest width of brain-case, 13; length of nasals, 10.

Type, No. $\frac{8828}{6857}$, ♂ ad., Mineral San Sebastian, Mascota, Jalisco, Mexico, Dec. 27, 1893; Dr. Audley C. Buller.

Of the four specimens (same locality, Dec. 26–Jan. 2), three are adult, and the fourth is an old adult[1], differing from the others by being much more strongly fulvous, this color prevailing throughout the dorsal surface, which is inconspicuously darkened along the median line.

The pelage is very soft and thick, and both in texture and coloration closely resembles that of adults of *Peromyscus floridanus*. In size and proportions it resembles *P. yucatanicus* Allen & Chapman (*anteà*, p. 5), from which it differs in important cranial characters. The interorbital region is not depressed, as in that species, and it lacks the well-defined supraorbital bead; the maxillary branch of the zygoma is narrower, as is also the anteorbital foramen; the post palatal opening is broadly U-shaped anteriorly,

[1] There are also three additional adult skulls.

and then slightly converging, instead of narrow, with parallel sides; and the postpalatal spine present in *P. yucatanicus* is lacking. The skull as a whole is also shorter, with a broader brain-case.

40. Peromyscus banderanus, sp. nov.

Above rather pale yellowish brown, the middle of the back much varied with black-tipped hairs; a narrow fulvous lateral line; beneath white, the fur plumbeous at base. Fore limbs externally white, from shoulder to end of toes; hind limbs externally grayish, feet white to above the tarsal joint. Ears small, dull brownish, naked; tail long, nearly bicolor, brown above, much lighter below, naked.

Total length, 226; tail vertebræ, 112; hind foot, 24; ear, 15 (measurements from the skin). An old male in alcohol measures as follows: Total length, 238; tail, 132; hind foot, 28; ear, 14.

Skull.—Total length, 31; basal length, 25; least interorbital breadth, 5; breadth of brain-case, 13.5; length of nasals, 11.5. A strongly developed supraorbital ridge; postpalatal opening deeply convex anteriorly, with parallel sides; audital bullæ small.

Type, No. [illegible], ♀ ad., Terro Tepic, Valle de Banderas, Jalisco, Mexico, Feb. 23, 1893; Dr. Audley C. Buller.

This species is based on a skin and skull and three specimens in alcohol, from Valle de Banderas. It differs notably in size and proportions from *Peromyscus mexicanus* (De Saussure) and *P. melanophrys* (Coues). The former[1] is described as dark brownish mouse gray, with a silvery tint, not shown in the present species; the tail is about equal to the head and body, while in the present species it is much longer. *P. mexicanus* also came from the mountains of Vera Cruz, on the eastern slope of the Cordillera, while the present species is from the low west coast region. Comparison with the type of *P. melanophrys* shows that the two species are not at all closely related.

41. Peromyscus, sp. indet. (*Hesperomys leucopus sonoriensis*, Bull. II, 180.)

42. Rhipidomys sumichrasti (*De Sauss.*). (Bull. III, 187.)

[1] *Hesperomys mexicanus* De Saussure, Rev. et Mag. de Zool., 2e Sér., XII, Mars, 1860, p. 105, pl. ix, fig. 1, 1a. "Habite les même régions que les précédents." "Mexique." Vera Cruz.

43. **Oryzomys mexicanus,** sp. nov.

Oryzomys couesi Allen, Bull. Am. Mus. Nat. Hist. III, No. 1, Dec. 1890, p. 187; also *ibid.* III, p. 224 (in text), and p. 291 (in text). Not of Alston, nor of Thomas.

Size and proportions of *O. palustris*, but very different in coloration from any member of the *O. palustris* group.

Above strongly fulvous brown, lined with black-tipped hairs, darker mesially, paler on the sides, brighter on the rump; below white, with a grayish tinge; feet thinly covered on the upper surface with silvery gray hairs; ears dark brown, very thinly covered externally with very short hairs, and internally with longer yellowish brown hairs; tail practically naked, a little darker above than below.

Total length (measurements all from dry skin), 279; tail, 142; hind foot, 30; ear, 13.

Skull.—Supraorbital ridges rather heavier than in the *O. palustris* group; nasals longer and narrower; posterior nares narrower, and postpalatal border V-shaped instead of nearly squarely truncate; anterior palatine foramina broad, less produced anteriorly, and hence short. Skull as a whole rather narrower than in *O. palustris.*

Total length, 30.5; basal length, ? (basal portion of skull defective; also right zygoma wanting); least interorbital breadth, 5; width of brain-case, 12; length of nasals, 11.5; upper tooth row, 5; diastema, 7.7.

Type, and only specimen, No. $\frac{2650}{2125}$, ♂ ad., Hda San Marcos, Tonila, Jalisco, Mexico, Dec. 30, 1889; Dr. Audley C. Buller.

In preparing my former mention of this specimen (*l. c.*) I recognized its distinctness from *O. palustris*, and rather than describe it as new referred it provisionally to *O. couesi* Alston. Mr. Thomas has since shown (Ann. & Mag. Nat. Hist. (6), XI, May, 1893, p. 403) the composite nature of *O. couesi* Alston, and restricted it to include only one of the three specimens referred to it by Alston. He has also more clearly stated its characters. On reëxamination of the subject it becomes evident that the form here recognized as *O. mexicanus* has no close relationship to the *O. couesi* group, but is, on the other hand, rather closely related to the *O. palustris* group. It differs, however, strikingly in coloration from all of the known forms of *O. palustris*, and especially from *O. palustris texensis*, its nearest relative geographically, in the strong yellowish brown instead of pale grayish coloration above.

It hence resembles my *O. aquaticus*, from Brownsville, Texas, in the coloration of the upper parts, but it is clear white instead of deep buff below. The two agree essentially in the form of the posterior nares. Taking into account its geographical relations, *O. mexicanus* must be considered as a specifically distinct member of the *O. palustris* group, with perhaps its nearest ally in *O. aquaticus*.

44. **Oryzomys bulleri,** sp. nov.

Above pale chestnut brown, darkened by an intermixture of blackish hairs over the middle region of the back, paler and more ochraceous on the sides; below buffy white, the color of the lower parts gradually passing into that of the upper; upper surface of feet soiled whitish; ears brown, thinly clothed with hairs of the same color as the surrounding pelage; tail brownish above, lighter below, naked, longer than head and body.

Total length (of type, ♂ ad., from skin), 242; tail, 127; hind foot, 27; ear, 11. Another specimen (skin overstuffed), ♂ ad., measures: Length, 281; tail, 127; hind foot, 27; ear, 11.

Skull.—Maxillary plate of zygoma rather narrow; nasals narrowed posteriorly, terminating on a line with the intermaxillaries; anterior palatine foramina extend to about the first third of the first molar; facial portion of skull rather narrow. Skull in general that of a typical *Oryzomys*. Total length, 27.8; basal length, 23; zygomatic breadth, 15; least interorbital breadth, 4.5; width of brain-case, 12.5; length of nasals, 10.2; length of palate, 11; upper tooth row, 4.6.

Type, No. [illegible], ♂ ad., Valle de Banderas, Terro Tepic, Jalisco, Mexico, Feb. 23, 1893; Dr. Audley C. Buller, after whom the species is named.

In size and proportions *O. bulleri* resembles most closely *O. couesi* (Alston, as restricted by Thomas), but is darker brown; it has also the facial portion of the skull much narrower, with much narrower nasals and slenderer nose. It is much smaller than *O. fulgens* Thomas, and differs from the latter in the character of the pelage, in color, and in various cranial details. It agrees better in size with Mr. Thomas's *O. melanotis*, from the neighboring locality of Mineral San Sebastian, but the latter has very much larger ears, and the cranial differences show that the two species are not closely related.

The species is based on two specimens, both adult males, from Valle de Banderas, Jalisco. The second specimen is a little paler than the type, and, as the skins are made up, appears a little the larger; but this apparent difference in size is not borne out by the skulls.

45. Sigmodon fulviventer *Allen.* (Bull. II, 180.)—This specimen remains unique, so far as the Museum collection is concerned.

46. Sigmodon toltecus (*De Sauss.*) (Bull. III, 186—only the Tehuantepec specimen.)

47. Sigmodon mascotensis, sp. nov.

Adult.—Above pale cinnamon brown, darker along the median line and lighter on the sides, varied with dusky hairs; top and sides of the nose rusty brown. Ventral surface with the hairs broadly tipped with white. Fore and hind limbs externally like the adjoining portions of the body; feet dull yellowish gray. Ears yellowish gray-brown, well covered with short hairs internally, nearly naked externally; tail dark brown above, lighter on sides and below, very nearly naked.

Young.—Two young in first pelage are yellowish tawny brown above, soiled buffy gray below.

Total length (of type, ♀ ad., from skin), 272; tail vertebræ, 117; hind foot, 32; ear (from notch), 17. Another specimen, ♂ ad., measures: Total length, 273; tail vertebræ, 128; hind foot, 33.5; ear (from notch), 18. Ratio of tail to total length, 47.6.

Skull (of type).—Total length, 34.5; basal length, 30.4; zygomatic breadth, 19.5; interorbital breadth, 4.8; width of brain-case, 13.3; length of nasals, 13.5; palatal length, 16; anterior palatal foramina, 8; upper tooth row, 6.

Type, No. $\frac{8871}{6655}$, ♀ ad., Mineral San Sebastian, Mascota, State of Jalisco, Mexico, June 7, 1893; Dr. A. C. Buller.

This species is based primarily on two adults (♂ and ♀), from Mascota, taken June 7, 1893, by Dr. Buller. They differ from *S. colimæ* in much browner coloration and apparently rather longer tail. The two young examples, presumed to be the same as the adults here described, are from El Valle de Banderas, about 20 miles north of Mascota. Both the adults and the young differ from any other form of the genus known to me in the cinnamon brown coloration of the upper parts, which is stronger and especially pronounced in the young examples, in which the color is a strong yellowish tawny brown. It differs from *S. toltecus* markedly in coloration, and in the greater length of the tail. There appear to be no strongly pronounced cranial differences between this and other forms of the genus. While there is much variation in the details of the cranial structure, it is hard to find any that are sufficiently constant to prove useful in diagnosis.

48. Sigmodon colimæ, sp. nov.

Sigmodon hispidus berlandieri ALLEN, Bull. Am. Mus. Nat. Hist. III, No. 1, Dec. 1890, p. 186 (in part—the Colima specimens only).

Above gray tinged with very pale buff and conspicuously lined with black; beneath with the tips of the hairs clear white; sides of the nose buff; feet soiled whitish gray; ears pale brown, nearly naked externally, well covered with very short hairs on the inner surface; tail dark brown above, much lighter below, the annulations distinctly visible through the thin covering of very short hairs, which form a slight pencil at tip.

Measurements (of type, from skin).—Total length, 235; tail vertebræ, 105; hind foot, 32; ear (from notch), 15. The series of four specimens measures as follows: Total length, 245 (233–275); tail vertebræ, 109 (105–120); percentage of tail to total length, 45.3.

Skull (of type, ♂ ad.).—Total length, 35.5; basal length, 31; least interorbital breadth, 5; width of brain-case, 13; zygomatic breadth, 20? (right zygoma broken); length of nasals, 13.5; palatine length, 15.8; anterior palatal foramina, 7.6; length of upper tooth row, 6.2.

Type, No. [illegible], ♂ ad., Plains of Colima, State of Colima, Mexico, Jan. 11, 1890; Dr. A. C. Buller.

Sigmodon colimæ is based on 4 specimens (mostly young adults) taken on the Plains of Colima, Jan. 5–10, 1890, by Dr. Buller. They are very uniform in coloration, and are apparently all males, though one is sexed by the collector as a female. They are characterized by a peculiar shade of pale buffy gray, unlike that presented by specimens from other localities. I am unable to recognize any distinctive cranial features.

S. colimæ differs from *S. toltecus* in coloration through absence of the strong fulvous suffusion so characteristic of the latter. It differs similarly from *S. mascotenis*, except that in the latter the suffusion is more of a pale cinnamon than fulvous.

49. **Neotoma ferruginea** *Tomes.* (Bull. III, 186.)

50. **Hodomys alleni** *Merriam.* — Represented by 6 specimens, skins and skulls, and 3 specimens in alcohol, all old adults, collected at El Valle de Banderas, Terro Tepic, State of Jalisco, Mexico, Feb. 14–23, 1893. To this species I also provisionally refer 2 specimens, young adults, from Mineral San Sebastian, State of Jalisco, Mexico, Dec. 24 and 26, 1893. These may represent a smaller species, about the size of *H. ventulus* Merriam, but from which they differ in the tail being unicolor instead of bicolor.

51. Heteromys hispidus, sp. nov.

Pelage somewhat soft, hispid rather than spiny. Above reddish brown, finely and sparsely varied with black-tipped bristles ; sides lighter (in some examples) in consequence of the whitish basal portion of the pelage showing through ; beneath and feet white, or soiled yellowish white ; colors of the ventral area sharply defined against that of the upper parts, but with a narrow lateral line of bright reddish fulvous. Ears brownish, slightly rimmed with white ; tail very thinly haired, the annulations distinctly visible, pale brown above, much lighter below. Soles 6-tuberculate, hairy to the posterior tubercle. Mammæ 6—2 pectoral and 4 inguinal.

Total length (of type), 190 ; tail vertebræ, 116 ; hind foot, 26 ; ear from notch, 11 (measured from skins).

An adult male and an adult female in alcohol measure respectively, as follows: Total length, 230, 220 ; tail vertebræ, 115, 123 ; hind foot, 28, 27 ; ear from notch, 13.5, 13.5.

Skull (of type).—Total length, 30 ; basal length, 24 ; greatest (mastoid) breadth, 13.5 ; least interorbital breadth, 7 ; length of nasals, 12 ; length of palate, 12 ; length of diastema, 7 ; length of crown surface of tooth row, 5.

Type, No. $\frac{5332}{6687}$, ♀ ad., Compostella (Rcho. El Colomo), Terro Tepic, Jalisco, Mexico, Feb. 11, 1893 ; Dr. Audley C. Buller.

This species is based on three skins and two additional skulls, and four specimens in alcohol, collected at Compostella, Terro Tepic, Jalisco, Feb. 8–18, 1893. Its reddish brown color, hispid rather than spiny pelage, and small size, are sufficient to distinguish *Heteromys hispidus* from any hitherto described species, except perhaps *H. desmarestianus* Gray, from Coban, Guatemala, which is described as "chestnut-brown," but as having the soles naked (*apud* Thomas), and the tail shorter than the head and body (Alston), instead of very much longer, as in the present species.

The species of this genus thus far described may be tabulated under the divisions recognized by Mr. Oldfield Thomas,[1] as follows:

Soles hairy, 5-tuberculate.

1. ***Heteromys irroratus*** Gray, P. Z. S., 1868, p. 205. State of Oaxaca, Mexico.
2. ***Heteromys albolimbatus*** Gray, *ibid.*, p. 205. La Parada, Mexico.
3. ***Heteromys alleni*** Coues, Bull. Mus. Comp. Zoöl., VIII, No. 9, 1881, p. 187. Rio Verde, San Luis Potosi, Mexico.
4. ***Heteromys bulleri*** Thomas, Ann. and Mag. Nat. Hist. (6), XI, April, 1893, p. 330. La Laguna, Sierra de Juanacatlan, Jalisco, Mexico.

Soles hairy, 6-tuberculate.

5. ***Heteromys salvini*** Thomas, Ann. and Mag. Nat. Hist. (6), XI, April, 1893, p. 331. Dueñas, Guatemala.
6. ***Heteromys salvini nigrescens*** Thomas, *ibid.* (6), XII, Sept., 1893, p. 234. Costa Rica.
7. ***Heteromys gaumeri*** Allen & Chapman, *anteà*, p. 9. Chichen-Itza, Yucatan.
8. ***Heteromys hispidus*** Allen, *anteà*, p. 56. Rcho. El Colomo, Compostella, Terro Tepic, Jalisco, Mexico.

Soles naked, 6-tuberculate.

9. ***Heteromys anomalus*** (Thompson). Island of Trinidad, B. W. I.
10. ***Heteromys desmarestianus*** Gray, P. Z. S., 1868, p. 204. Coban, Guatemala.
11. ***Heteromys melanoleucus*** Gray, *ibid.*, p. 204. "Hondurus"=Venezuela, *apud* Alston.
12. ***Heteromys longicaudatus*** Gray, *ibid.*, p. 204. "Mexico."
13. ***Heteromys adspersus*** Peters, Monatsb. Ak. Berlin, 1874, p. 357. Panama.

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14. ***Heteromys bicolor*** (Gray). *Perognathus bicolor* Gray, P. Z. S., 1868, p. 202; *Heteromys bicolor* Alston, Ann. and Mag. Nat. Hist. (5), VI, Aug., 1880, p. 118. "Honduras"=Venezuela, *apud* Alston.

This last is possibly generically separable from *Heteromys*.

[1] Ann. and Mag. Nat. Hist. (6), XI, April, 1893, p. 329.

52. **Lepus sylvaticus aztecus** *Allen.* (Bull. III, 188.)

53. **Lepus insolitus** *Allen.* (Bull. III, 189.)

54. **Tatusia novemcincta** (*Linn.*). (Bull. III, 190.)

55. **Marmosa canescens** (*Allen*). (*Didelphis* (*Micoreus*) *canescens*, Bull. V, 235.)

Article VI.—THE GANODONTA AND THEIR RELATIONSHIP TO THE EDENTATA.

By J. L. Wortman, M.D.

In a recent paper in this Bulletin I have called attention to a primitive suborder of the American Edentata, under the title of the Ganodonta.[1] Although the genera composing this group have long been known, yet the materials have up to the present been so imperfect and fragmentary as to preclude in a great measure any very exact knowledge of their true affinities. It has been only by the aid of a fortunate discovery of a fore limb of one of the species (*Psittacotherium multifragum*) in association with the lower jaws and upper teeth, that I have been enabled to interpret the somewhat fragmentary remains of the other genera and make out what I believe to be, not only their affinities to each other, but what is still more important, *to demonstrate* their genetic relationship to the later appearing American Edentata.

Touching the question of the relationship of certain of the forms, associated in the suborder Ganodonta, to the Edentata, it is proper to add that the idea has been suggested before, but no attempt has to my knowledge ever been made to establish the truth of such a proposition by direct proof.

Marsh, in his original description of *Stylinodon*, says,[2] "These specimens resemble in some respects the corresponding parts of the genus *Toxodon* Owen from the Quarternary of South America; but may, perhaps, have some more affinities with the Edentates."

He further adds in his address before the American Association for the Advancement of Science, August, 1877, the following: "The Edentate mammals have long been a puzzle to zoölogists, and up to the present time no clew to their affinities with other groups seems to have been detected. A comparison of the peculiar Eocene mammals which I have called the *Tillodontia*

[1] Vol. VIII, Art. xvi, pp. 259–260, Nov. 30, 1896. Also Science, Dec. 11, 1896, p. 865.
[2] Amer. Jour. Sci. and Arts, Vol. VII, May, 1874.

with the least specialized Edentates, brings to light many curious resemblances in the skull, teeth, skeleton and feet. These suggest relationship at least, and possibly we may yet find here the key to the Edentate genealogy. At present the Tillodonts are all from the lower and middle Eocene, while *Moropus*, the oldest Edentate genus, is found in the middle Miocene and one species in the lower Pliocene."

Cope originally held that his suborder Tæniodonta, which includes the two genera *Ectoganus* and *Calamodon*, was related to the Edentata, but later he came to an entirely different conclusion, based upon the determination of the enlarged teeth in the front of both upper and lower jaws. These teeth have always been considered by him to be incisors, and seeing that incisors are practically absent in the Edentata, he was compelled upon this view to abandon the idea of Edentate affinity. His latest position is contained in his article,[1] 'The Mechanical Causes of the Origin of the Dentition of the Rodentia,' in which he says: "I have regarded (Naturalist, 1884, and earlier) the Tæniodonta as the ancestors of the Edentata. The objection to this view is the supposed absence of inferior incisors in the latter. But the middle incisors are disappearing from the Tæniodonta, while the supposed canines of the lower jaw of *Megalonyx* and allies may be true incisors. This is rendered probable by the genus *Diadomus* of Ameghino, where the large canine-like teeth are found close together at the *symphysis mandibuli*, like the incisors of the Tæniodonta and Rodentia." He further adds, on page 4 of the same article, "*Psittacotherium* is, then, a generalized type, and is not far from, if not directly in line of, the ancestry of all Rodentia."

Dr. Max Schlosser in discussing the relationship of various forms of mammalian teeth, remarks:[2] "It is true that there are in the Eocene of North America certain forms, *Esthonyx*, *Calamodon*, *Psittacotherium*, which on the one side are evidently related to the Creodonts, *Onychodectes* and *Hemiganus*, and which, on the other hand, in so far as their tooth-form is concerned, can be regarded as the ancestors of, at least, a part of the

[1] Amer. Nat., Jan., 1888, p. 4, foot-note.
[2] Die Differenzeirung des Säugetier Gebisses. Biolog. Centralblatt, June, 1890, p. 252.

Edentates, to the extent that, in such a line, the formation of prismatic teeth out of the tritubercular and tuberculo-sectorial type can be traced. The real genetic relationship of these forms cannot up to date, however, be proven."

It will be further noted that the genera which I herewith associate in the suborder Ganodonta have been variously referred. Marsh placed *Stylinodon* in the Tillodontia; Cope has considered *Calamodon* and *Ectoganus* to represent a distinct group, Tæniodonta, at the same time placing *Psittacotherium* in the Tillodontia. In a like manner he has classified *Hemiganus*, *Onychodectes* and *Conoryctes* with the Credonta. Zittel has grouped them all into the Tillodontia together with *Tillotherium*, *Anchippodus* and *Esthonyx*.

Now, before any definite understanding of the mutual affinities of these genera can be had, it becomes imperative at the very outset to gain a clear and concise understanding of the group Tillodontia. The second point of vital importance is the correct determination of the incisor and canine dentition in the various genera. I will now attempt the elucidation of these two important questions.

Characters of the Tillodontia.

Regarding the first of these, the Tillodonts, I will say that they form a restricted, clearly-defined group composed, as we now know them, of the genera *Esthonyx*, *Anchippodus* and *Tillotherium*, extending in time from the base of the Wasatch to the upper Bridger Beds. They are characterized, especially in their latest and most highly developed representatives (*Tillotherium*), by the possession of an incisor dentition like that of the Rodentia, *viz.:* the great enlargement, limitation of the enamel to the anterior surface, and growth from persistent pulps, of the *second* pair of incisors in both jaws, together with more or less complete disappearance of the first and third pairs, and the gradual reduction in size of the canines. With these characters are associated large and powerful premaxillaries extending backwards upon the superior surface of the skull, between the maxillaries and nasals, almost to the frontals.

The group is further characterized by molars and premolars with short, completely enamel-covered crowns, with a distinctive tritubercular pattern in the upper, and a tuberculo-sectorial pattern in the lower jaw. The feet were provided with claws, well curved and rounded, without any evidence of fissures.

The group Tillodontia, as we now understand it, begins in the lower Wasatch, in the genus *Esthonyx*, in which all the specialized characters of the later *Tillotherium* are clearly and distinctly foreshadowed.[1] In *Esthonyx* there are three pairs of incisors in the lower jaw, and two pairs in the upper jaw, and it is of the greatest importance to note that the third or outer pair of incisors in the lower jaw is extremely small and just upon the point of disappearing; that the second pair in the lower jaw is considerably enlarged, having great elongation of the enamel on the anterior face, and a narrow band upon the posterior face from which the enamel is absent. The first or middle pair in the lower jaw is considerably reduced in size. The lower canines are of good size, slightly exceeding the enlarged second pair of incisors.

In the upper jaw the first or middle pair of incisors is completely absent, no trace of them having been found as yet in any specimen, but the second pair is much enlarged, and there is a narrow vertical band on the posterior or lingual face in which the enamel fails. The third pair of incisors is of good size, but considerably smaller than the second pair. The canines of the upper jaw are somewhat smaller, relatively, than the corresponding teeth below, but yet show comparatively little tendency to degeneration. None of the teeth of the species of *Esthonyx* grew from persistent pulps, although the pulp cavities of the enlarged second pair of incisors in both upper and lower jaws remained open for a considerable time after the animal reached maturity.

From the Wasatch species of *Esthonyx* we pass to the Wind River representative *Esthonyx* (?) *acutidens* Cope, in which is to be remarked some important modifications in the direction of the still later or Bridger *Tillotherium*. All that is known of the Wind River form is the greater part of a superior dentition of one side. In this species it is important to note that the size has increased

[1] I pointed out this fact more than ten years ago, but it appears to have been adopted by palæontologists without any credit. See 'Teeth of the Vertebrata,' American System of Dentition, Philad., 1886, p. 434.

considerably; the premolars are more complex than in the Wasatch species, the second pair of incisors is still more enlarged, and the third or outer pair of incisors and the canines are still further reduced. The lower jaw is not known, but it can, with almost absolute certainty, be predicted that when found it will show complete absence of the third or outer pair of incisors, a fact which, as we are accustomed to estimate genera, would take it out of the true genus *Esthonyx*. It is, indeed, just such a transitional form as we would reasonably expect to find in this transitional bed between the Wasatch and Bridger.

The next form in the series is *Anchippodus* (*Trogosus*), from the lower Bridger horizon of Wyoming, which is known from an imperfectly preserved lower jaw only. It is very nearly related to *Tillotherium*, the only difference being in the possession of a small vestigial pair of first incisors. The second pair is greatly enlarged, with the enamel limited to the anterior face, and grew from persistent pulps.

Lastly we come to the final term in the series, *Tillotherium*, from the upper horizon of the Bridger formation, and here we find that the incisor dentition has undergone a still further change in the loss of the first pair of incisors in the lower jaw. The dentition, therefore, is expressed in the formula I. $\frac{2}{1}$, C. $\frac{1}{1}$, Pm. $\frac{3}{3}$, M. $\frac{3}{3}$. Three species have been described by Marsh, *viz.*: *T. fodiens*, *T. minor* and *T. latidens*, all from the Bridger beds of Wyoming. The group appears to have either become extinct or migrated at this time, since no remains referable to it have been found in any later deposits in this country.

It will thus be seen, therefore, that the Tillodontia represents a distinct, closely-connected phylum, reaching throughout the entire Wasatch, Wind River, and probably the greater part of the Bridger epochs. One of the main features of its evolution consisted in the production of a distinctly rodent-like incisor dentition, and the successive steps in that specialization form one of the most complete series to be found within the whole range of mammalian palæontology. Their earlier ancestry is at present completely unknown.[1]

[1] In this group we thus learn how the incisor dentition has been formed in the Rodentia, *viz.*: by the enlargement of the second pair in both jaws, and the discarding of the first and third pairs in all known forms, except the Lagomorphs, in which the first pair still remains

The Incisor and Canine Dentition of the Ganodonta.

In one section of the Ganodonta there is as complete a succession of forms as there is in the Tillodontia. This section I have defined as the family Stylinodontidæ; it begins in the lowermost Puerco deposits and continues into the Bridger, where it also disappears. It is composed of the following genera: *Hemiganus*, lower Puerco; *Psittacotherium*, upper Puerco; *Calamodon*, Wasatch; *Stylinodon cylindrifer*, Wind River; and *Stylinodon mirus*, Bridger.

Now, *Hemiganus* occupies the same position in relation to the succeeding genera of the Stylinodontidæ as the genus *Esthonyx* does with reference to the succeeding Tillodontia, and the evidence of descent is equally conclusive. It is, therefore, of the utmost moment, if we wish to understand correctly the enlarged teeth in the front of the jaws of the later forms of the Ganadonta, that we interpret properly the condition in this incipient or parental form.

Fortunately in the single specimen of *Hemiganus otariidens* known, there is preserved a portion of the right maxillary, with the premaxillary attached, which serves to locate definitely the superior canine. The alveolar border of the premaxillary is damaged, so it is not certain whether it supported one or two incisors; there were probably two, but at all events the incisors were much smaller than the large powerful canine, which is preserved *in place*, and is seen to lie in the maxillary immediately behind the maxillo-premaxillary suture. The canine of the opposite side is also present in the specimen, and likewise has a portion of the maxillary attached to it.

The specimen also contains both rami of the mandible, but here again the alveolar border is broken so as not to show the number of the incisors. There are, however, two enlarged teeth preserved which are undoubtedly the lower canines. They fit with tolerable accuracy in the damaged sockets, and when the two rami are placed in apposition they occupy a position so as to oppose the superior canines closing in front of them. It is, moreover, probable that there were not more than two pairs of lower incisors, and possibly but a single pair. Be this as it may, however, they were much smaller than the canines.

It is demonstrated, therefore, beyond any possibility of doubt, that the enlarged teeth in the upper jaw are canines, and not incisors; it is almost equally certain that the enlarged teeth in the lower jaw are also canines and not incisors. The proof of this lies in the fact that there is evidence of seven teeth behind the enlarged tooth on one side of the jaw; no case is known

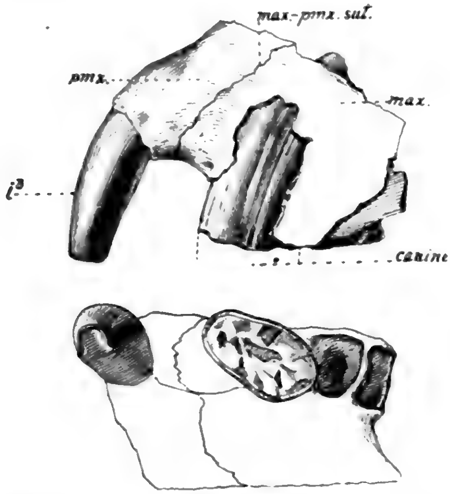

Fig. 1. Left premaxilla and part of maxilla of *Psittacotherium multifragum*. *I* 3, third or outer incisor; *c.*, canine; *pmx.*, premaxilla; *max.*, maxilla; *max.-pmx. sut.*, maxillo-premaxillary suture. (From Osborn and Scott's forthcoming book on American Fossil Mammals.)

among the mammalia in which an incisor becomes caniniform in the lower jaw to oppose a true canine in the upper jaw, although it not infrequently happens that a premolar is so modified.

From this lower Puerco representative we pass to the upper Puerco form, *Psittacotherium*, of which several complete lower jaws are known with all the teeth in place, together with a fragment of the upper jaw (No. 3414), including the entire premaxilla of the left side and a portion of the maxilla as far back as the second premolar (Fig. 1). This specimen fortunately contains an anterior tooth complete, and the root of the enlarged scalpriform tooth, which I have determined to be the superior canine. The specimen shows the free anterior border of the premaxilla, and, behind, a considerable diastema between the anterior tooth and the enlarged tooth behind. This space served to accommodate the enlarged tooth in the lower jaw, which is thus shown to have closed *in front* of the enlarged tooth above. The specimen unfortunately is of an old individual, and the maxillo-premaxillary suture is not very distinct. There are, however, distinctive appearances of a sutural line *in front of the enlarged tooth, and no traces whatever behind it*, as would undoubtedly be found in the considerable part of the palate preserved, if it existed in this situation.

It will thus be seen that while the evidence in this case is not in itself absolutely conclusive, yet it is so nearly demonstrative that when taken in connection with the corresponding teeth of *Hemiganus* we may conclude without fear of error that in the genus under consideration there was a single pair of superior incisors, and that the enlarged tooth is a canine. It would, therefore, follow that the corresponding tooth in the lower jaw is also a canine and not an incisor.

The premaxillary region is entirely unknown in the succeeding genera of this series, but if it is established that this enlarged tooth in *Hemiganus* and *Psittacotherium* is a canine, then it is quite certain that it is also a canine in the succeeding forms, especially when we remember their near relationship.

I have thus considered at some length the question of the determination of these teeth, because, as noted above, upon it depends a striking resemblance or a fundamental difference between them and the Edentata.

TABLE OF DISTRIBUTION OF THE GANODONTA IN TIME.

	Lower Puerco. 500 feet.	Upper Puerco. (Torrejon Beds.) 300 feet.	Wasatch. 2000 feet.	Wind River. 800 feet.	Bridger. 2000 feet.
STYLINODONTIDÆ.					
Hemiganus	1 sp.				
Psittacotherium		1 sp.			
Calamodon			3 (?) sp.		
Stylinodon				1 sp.	
Stylinodon					1 sp.
CONORYCTIDÆ.					
Onychodectes	2 sp.				
Conoryctes		1 sp.			

THE MUTUAL RELATIONSHIP OF THE GENERA OF THE STYLINODONTIDÆ.

Hemiganus otariidens Cope.

We come next to examine the characters of the separate members of this assemblage of genera, and determine if possible in what way they are related to each other. The first one to be considered is *Hemiganus otariidens*[1] Cope. The genus was origin-

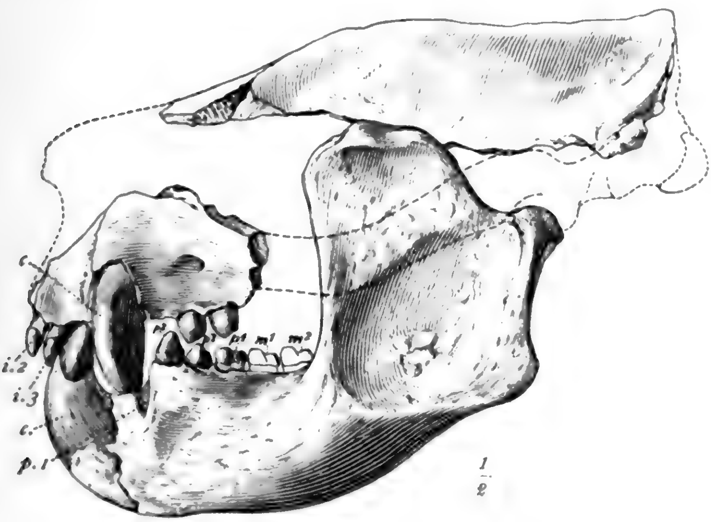

Fig. 2. Side view of skull of *Hemiganus otariidens.*

ally established upon an 'incisor' (=canine) tooth, and one species, *H. vultuosus*,[2] referred to it. Later an extensive description of a fragmentary skeleton of *H. otariidens* was published by Cope.[3] It is now evident from a careful examination of the specimens that *H. vultuosus* was founded upon a canine of *Psittacotherium multifragum* Cope, and must therefore be discarded. This leaves but a single species, represented by a single specimen, to represent the genus. It is important to note, in the first place, that it comes from the lowermost Puerco Beds, and is therefore the earliest

[1] Amer. Nat., 1885, p. 492
[2] Amer. Nat., 1882, p. 831.
[3] Proc. Amer. Philos. Soc., July 20, 1888, pp. 311, 316.

member of the group, appearing, as it were, at the very beginning of the Tertiary epoch.

It will be impossible for me to add anything to Cope's excellent description, and I will content myself merely with a statement of the principal characters as shown by this fragmentary skeleton. In the skull (Fig. 2), of which a considerable part is preserved, the face is short, the sagittal crest is long and not very prominent, the lower jaw is short, deep and robust, with a greatly enlarged coronoid and a pronounced angle. The tooth-line passes to the inside and slightly behind the root of the coronoid, so that the last molar is partly concealed in a side view; the condyle is situated unusually high above the tooth-line.

The complete dental formula cannot be stated at present, but it is certain that there were four premolars and three molars in the lower jaw. There was also a pair of canines and one or two pairs of incisors. In the upper jaw there was at least one pair of incisors and very probably two; there was also a pair of large and powerful canines; the upper molar dentition is unknown.

In structure several isolated incisors show a long tapering root closed at its extremity, and having the enamel limited to the anterior face of the crown. The lower canines also exhibit a long tapering root closed at the base, and having the enamel limited to the anterior of face of the crown. Just how much this limitation of the enamel is due to wear, however, is not easy to say; it is more than probable that in a perfectly unworn young tooth, the entire crown is covered with enamel, but upon the posterior surface it is very thin and is soon worn away. The superior canine shows complete investment of the crown with enamel, although the covering upon the posterior portion of the crown is very thin. Of the premolars, two of the inferior ones (3d and 4th) are in place, together with the first molar. The third premolar consists of a principal cone with a slight cingulum, situated internal and posterior to the principal element of the crown, while in the fourth the internal cusp is larger and more posteriorly situated. It is highly probable that this posterior cusp is the incipient heel, the greater development of which would produce the posterior part of the true molar.

There are three lower molars preserved, the crowns of which are so much worn as to obscure considerably the pattern of the grinding surface; it can be stated, however, that it is composed of the usual four cusps which go to make up the quadratubercular crown. The four cusps were apparently fused into two transverse crests, the posterior of which is much the lower. The anterior cusp of the trigon is persistently absent, and there is much evidence of the fact that the molars did not pass through the typical 'tuberculo-sectorial' stage to reach the quadratubercular form. The superior molars are entirely unknown. All the molars of the lower jaw had well-developed roots with divided fangs.

It is a fact worthy of note, to which Cope has called attention, that the superior surface of the premaxillary is marked by a suture throughout its entire extent. This would indicate that the snout was, in some degree at least, tubular. The only similar condition that I have met with in the mammalia is that of the Armadillo, in which the nasals cover in the premaxillæ throughout their entire extent above.

A number of cervical vertebræ are represented by their centra, which are remarkable for their great transverse diameter in comparison with their antero-posterior dimension, as in the living Armadillos. The arches are not preserved, so it is impossible to determine their characters.

Of the fore limb the proximal parts of both ulnæ, a nearly complete radius, a lunar, the metapodial of the second digit, and a terminal phalanx, are represented in the specimen. The proximal end of the ulna shows a marked resemblance to that of the Gravigrada, especially *Mylodon robustus*, the olecranon being relatively short and the sigmoid portion for articulation with the humerus wide. The radius is short and robust, with a well-excavated head and an ulnar articulation which permitted free pronation and supination of the manus. It increases in diameter distally, and in its ridges and surfaces resembles both that of *Mylodon* and *Megalonyx*.

The lunar (Fig. 11) is free, presenting a convex proximal facet for the radius, a posterior extended portion, a cup-shaped facet for the head of the magnum, and lateral facets for the scaphoid and cuneiform; its proportions and relations to the surrounding bones of the carpus are very similar to those of the corresponding bone of *Mylodon robustus.*

The metapodial of the index (Fig. 3) or second digit[1] is remarkable for its brevity; it shows a fore and aft grooved articular facet for the trapezoid, and facets upon either side for the articulation of the first and third metapodials. The meta-

Fig. 3. Second metacarpal and ungual phalanx of *Hemiganus otariidens.*

podial keel is but faintly indicated, and is confined wholly to the palmar aspect of the distal facet.

The single ungual phalanx (Fig. 3) is proportionally very large, exceeding the second metapodial in length; it is compressed and high, with a marked dorsal curvature. The articular surface for the second phalanx is deeply excavated, having a median vertical ridge, and a backwardly prolonged overhanging upper portion. The whole facet describes almost a semicircle. The subungual process is large, and is perforated by a considerable foramen.

Of the hind limb only the proximal two-thirds of a femur and a complete tibia are known. The femur is a short, stout bone

[1] Cope has determined this metapodial to be a metatarsal, but there can be little doubt that it not only belongs to the fore foot but that it is the second metacarpal.

with a short, globular, sessile head, which does not rise above the great trochanter; the whole bone is markedly flattened from before backwards; there is a strong lesser trochanter and a weak third trochanter. The general shape of the bone recalls at a glance the femur of the Edentates, especially the Ground Sloths.

The tibia,[1] in comparison with the femur, is short and small. The proximal portion is crushed so as to obscure the form of the head of the bone, but the distal end is well preserved. The distal trochlea for articulation with the astragalus is not very well grooved, but yet the grooves are better developed than in any other Puerco mammal of corresponding age. The internal malleolus is well developed. The whole character of this part of the tibia resembles the corresponding part of this bone in the Armadillo.

Psittacotherium[2] *Cope.*

Remains of this genus have been found, so far, only in the upper Puerco (Torrejon Beds), and, as the stratum in which it is found is separated vertically from that of *Hemiganus* by from four to five hundred feet of sediment, one would naturally look for important modifications. Cope referred this genus to the Tillodontia, and has described three species as belonging to it, *viz.: P. multifragum*, *P. megalodus*, and *P. aspasiæ*. After a careful study of all the materials now known, I am convinced that there is but a single species, *P. multifragum*. *P. megalodus* was founded upon a fragment of lower jaw of a rather large individual of *P. multifragum*, but the difference in size between it and some of the later specimens of the latter is so very slight that it cannot be regarded as a specific modification. On the other hand, *P. aspasiæ* was based upon a jaw fragment of a young individual in which the teeth were just being erupted. A second specimen of similar nature was referred to it, but until some more important differences are shown to exist, the species cannot be regarded as well established. I think it much more likely that both specimens are examples of immature individuals of *P. multifragum*, which would account for their small size.

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[1] Cope makes out that this bone, of which there are two pieces, pertains to both sides, the head to the left and the distal half to the right side. When the matrix was removed, and the two ends fitted together, they were found to make a complete bone of the left side.

[2] Amer. Nat., 1882, p. 156.

Of the materials now extant there are no less than three nearly perfect lower jaws, together with numerous fragments of others. In one specimen (No. 754) a complete lower jaw and a part of the skull are represented; in another (No. 2456) the lower jaw, the upper teeth of one side, and a good part of the fore limb, are preserved; in numerous others there are fragments of upper and lower jaws, teeth and a few bones.

In the skull (Fig. 4), the facial portion is seen to be short and deep, the sagittal crest low and inconspicuous, and there is but a faint indication of postorbital processes upon the frontals. The anterior root of the zygoma is situated well forward; it has a

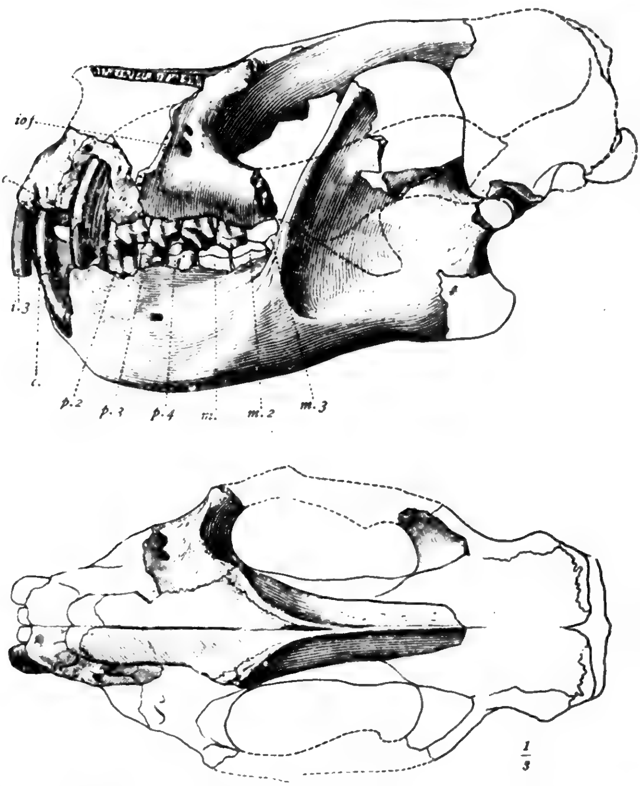

Fig. 4. Side and top views of skull of *Psittacotherium multifragum*. The outline of the lower jaw is completed after a perfect specimen, and the premaxilla of another specimen, the one represented in Fig. 1, has been used in the drawing.

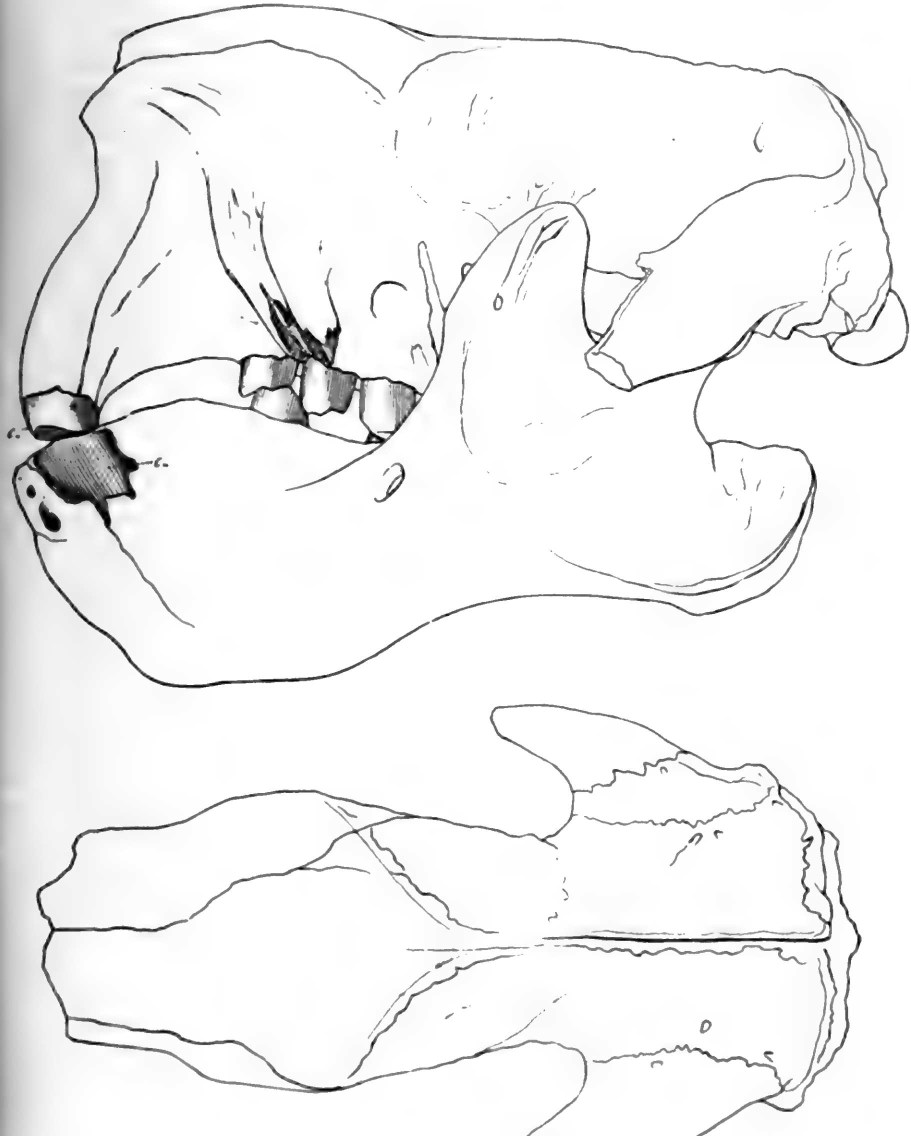

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Fig. 5. Top and side views of the skull of *Megalonyx jeffersoni*. (After Leidy.)

considerable vertical depth and projects outwards, downwards, and backwards. In front of and below the zygomatic root is a shallow fossa, at the upper extremity of which is the anterior opening of the infraorbital canal, which is double. Leidy describes two foramina in this situation in *Megalonyx* (Fig. 5), and it is not an infrequent occurrence for this foramen to be double in the modern sloth. In *Psittacotherium* the main canal is below and the smaller one above. Both, however, are placed unusually high upon the face. No evidence of a distinct lachrymal foramen is to be seen.

The lower jaw is short, heavy and robust; the symphysis is deep and powerful, and there was early bony union of the two rami of the mandible. The coronoid is unusually strong and broad, and the tooth line passes well behind its anterior border. The condyle is not situated so high above the level of the tooth-line as in *Hemiganus*, and the angular portion of the jaw is better developed.

The dental formula is not completely known, the discrepancy being in the number of superior molars and premolars. It is certain, however, that there were five, and possibly there were six teeth behind the canine. In the lower jaw there are nine teeth upon either side. The dental formula can therefore be written: I. $\frac{1}{1}$, C. $\frac{1}{1}$, Pm. $\frac{3(?)}{4}$, M. $\frac{3(?)}{3}$. I have already discussed at length the determination of the incisors and canines, and there only remains to notice the structure of these teeth. The upper incisors are strong, curved teeth, deeply implanted in the premaxillary bones, with the anterior face covered with a thick layer of enamel, and the posterior portion having the dentine exposed. It results from this arrangement of the dentinal tissues that the tooth wears to a chisel point, as in the typical rodent incisor. They did not, however, grow from persistent pulps, although some specimens show that the dentinal pulps were active throughout a large part of the animal's life.

The incisors of the lower jaw (Fig. 6) are relatively smaller. In the younger specimens the entire crown is covered with enamel, but owing to its thinness and small extent upon the posterior surface, it is soon worn away, leaving an external enamel covering only; the tooth then wears into the typical chisel point. They likewise were not of persistent growth.

The canines are large, powerful, curved teeth, being deeply imbedded in the maxillary bones; the anterior surface is covered with a thick layer of enamel, but the posterior surface is devoid of any enamel. The canines did not grow from persistent pulps, but the cavities remained open and the pulps were active long after the animal was adult.

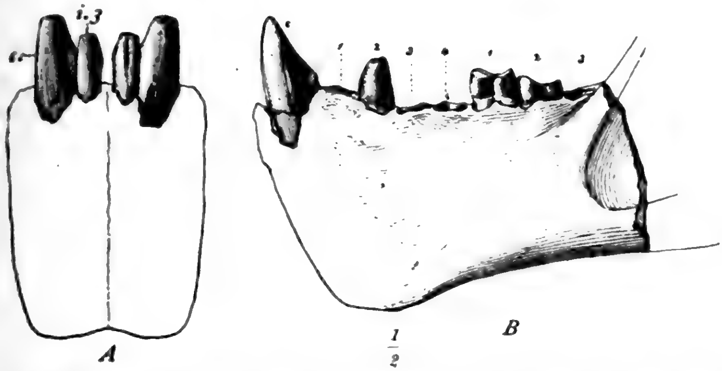

Fig. 6. Front and side view of the jaw of *Psittacotherium multifragum*. (From Osborn and Scott's forthcoming book.)

It frequently happens that the crowns of the molars and premolars are so much worn that the average specimen does not give one any clue to their pattern, but there are, fortunately, a few specimens in the collection from which a tolerable idea of the crown pattern can be had. This applies, however, only to the lower teeth, that of the upper teeth being totally unknown.

In one specimen (No. 3413) of a lower jaw (Fig. 7), the second premolar and the first and second molars are preserved in place, and the crowns are sufficiently unworn to permit of a determination of their structure. The second premolar displays two conical cusps placed at right angles to the long axis of the jaw; of these the external or labial cusp is the larger, and has its apex bent slightly inward, giving to it a distinct hook-shaped appearance;

Fig. 7. Side and crown views of the second lower premolar, and the first and second lower molars of *Psittacotherium multifragum*. (From Osborn and Scott's forthcoming book.)

the internal or lingual cusp is smaller and stands vertical. There are in the collection a number of loose teeth of this pattern, and it is more than probable that they represent both superior and inferior premolars. It is, moreover, highly improbable that any of the premolars, with the possible exception of the fourth, reached a further stage of complication than that just described, *viz.:* the bicuspid stage.

The true molars of the lower jaw present a crown pattern identical with that of *Hemiganus* already described. In the younger specimens, in both molars and premolars, there is more or less evidence of a division of the root into fangs, but as the animal approached maturity the crowns of the teeth were rapidly worn away, and the fangs of the root completely disappeared. The appearance of the molars and premolars at this stage may perhaps best be likened to a row of pegs planted deeply in the jaw. There was a strong tendency to the formation of a prismatic or hypsodont dentition. In the upper teeth, however, evidence of a more or less divided fang persisted even in the oldest individuals.

Of the skeleton there is known only a part of a fore limb, including a complete ulna and radius, an unciform, lunar, cuneiform, magnum, the third and fourth metacarpals with their full complement of phalanges, together with the phalanges of the second digit more or less complete. To these should be added a few fragments of metapodials in the collection, which can now with certainty be identified as belonging to *Psittacotherium.*

The ulna (Figs. 8 and 9) of the most complete specimen (No. 2453) is somewhat damaged in the region of the olecranon and the articular surface for the humerus, but enough of it is preserved to determine its general characters. The bone is short and stout, exceeding the radius somewhat in size ; the shaft presents a strong lateral flattening, and an unusual antero-posterior depth ; it tapers but little from the sigmoid humeral articulation to its distal extremity, and the posterior edge has but a slight curvature.

The olecranon is not complete, but enough of it remains to show that it was of moderate length and but slightly incurved at its proximal end. The sigmoid articulation is spaciously excavated, with but a very prominent posterior edge, but there is evidence of a well-expanded inner lip to receive and support the broadened humeral surface with which it was articulated ; beneath this lip there is a deep groove, as is usual in the mammalia. The articular surface for the head of the radius is

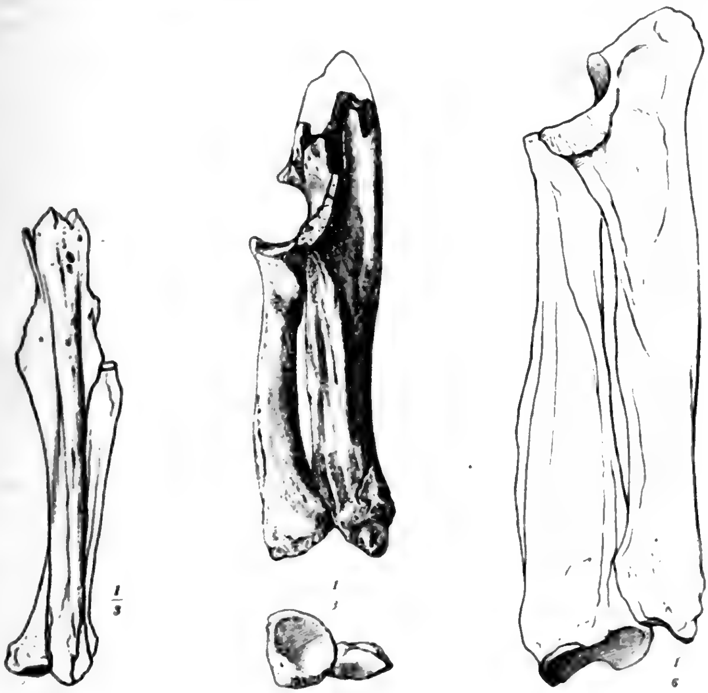

Fig. 8. Fig. 9. Fig. 10.

Fig. 8. Posterior view of ulna and radius of *Psittacotherium multifragum.*
Fig. 9. Side view and distal end view of ulna and radius of *Psittacotherium multifragum.*
Fig. 10. Side view of ulna and radius of *Megalonyx jeffersoni.* (After Leidy.)

concave from side to side, and receives accurately the head of this bone. The distal end of the ulna is but moderately expanded; it terminates distally in an obtuse styloid process, in front of which is the very oblique articular face looking downwards, outwards and forwards, for articulation with the cuneiform and pisiform bones of the carpus.

The radius (Figs. 7 and 8) is short and robust, with a more or less cylindrical shaft, especially in its proximal half. The head is considerably expanded, but does not completely cover the anterior surface of the ulna. Its humeral articular surface is cup-shaped, and the facet for articulation with the ulna is convex from side to side, indicating that there was power of complete pronation and supination of the manus. The tubercle for the insertion of the

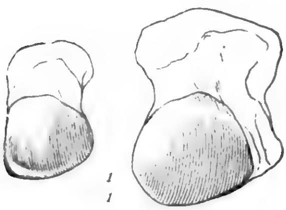

Fig. 11.

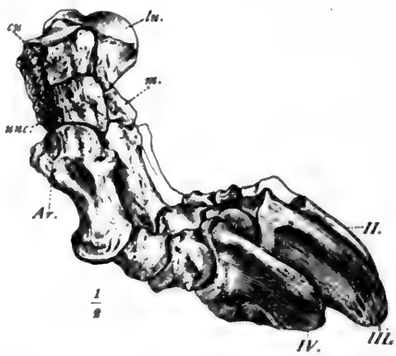

Fig. 12.

Fig. 11. Top view of the lunar of *Psittacotherium multifragum* (right) and *Hemiganus otariidens* (left).

Fig. 12. Side view of part of right fore foot of *Psittacotherium multifragum*: *lu.*, lunar; *cu.*, cuneiform; *unc.*, unciform; *m.*, magnum; *ar.*, articular surface for the fifth metacarpal.

biceps is situated high up on the ulnar aspect of the shaft, and in its distal third there is a well-marked and roughened ridge for the insertion of the pronator muscles. Distally, just before the shaft expands into its strong carpal extremity, it assumes a more or less quadrate outline in cross section. The carpal articular facet has a shallow cup-shaped form, but no dividing ridge separating the scaphoid from the lunar facets is apparent. Altogether the bone recalls that of *Megalonyx* (Fig. 10) or *Mylodon* in the most striking manner.

It is, however, in the organization of the manus (Figs. 12 and 13) that the most pronounced resemblances to the Edentates are seen. Indeed, if an anatomist had no other part of the skeleton than that of the foot to guide his judgment, and he should fail to detect a most striking similarity between it and that of the

Edentata, especially the Ground Sloths, he would not only lay himself open to the criticism of being lacking in the ordinary powers of observation and comparison, but would be suspected of placing the matter upon a basis other than that established by such a method.

The bones of the carpus preserved are the lunar, cuneiform, unciform, and the magnum ; all of them are more or less dam-

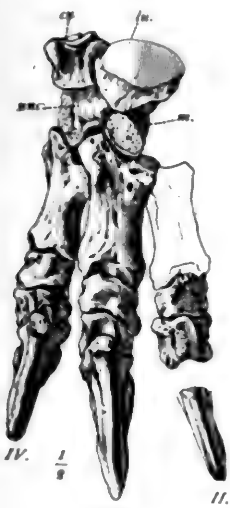

Fig. 13.

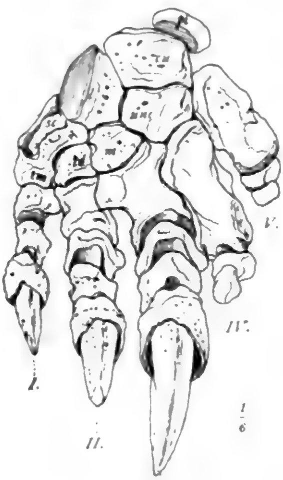

Fig. 14.

Fig. 13. Front view of same as Fig. 12. Lettering the same as in that figure.

Fig. 14. Front view of left fore foot of *Mylodon robustus* (after Owen). Lettering same as in last two figures.

aged, with the exception of the lunar, which is in an almost perfect state of preservation. This bone (Fig. 11), when viewed from above, shows an anterior globular articular surface for articulation with the radius, and a posterior more or less expanded portion behind ; the bone shows a marked constriction where these two portions join. Upon the anterior or dorsal aspect the surface is imperfectly triangular, with the apex of the triangle directed downwards. Upon the radial side there is a convex articular surface for the scaphoid and on the ulnar side a double facet by which it joins the cuneiform above and the unciform below. Its lower surface shows a deeply excavated, oblong, cup-shaped cavity, which receives the head of the magnum, and in front of this a plain facet where it joins the anterior shelf-like projection of the magnum and a part of the scaphoid.

The *cuneiform* is so much damaged, particularly upon its ulnar side, as to preclude in a great measure the exact determination of its shape. Above, there are two facets by which it articulates with the pisiform behind, and the ulna in front. Upon its radial side there is a prominent lateral facet for articulation with the lunar. Below, it presents an excavated articular surface to the rounded head of the unciform.

The *unciform* is also in a damaged condition, but enough remains to satisfactorily determine its relationship to the surrounding bones. When looked at from above it displays a convex facet directed upwards, backwards and outwards for articulation with the cuneiform, and a slightly concave inner facet for articulation with the lunar. Below and to the radial side there are also two facets, imperfectly distinguished from each other, by which it joins the magnum above and the strong lateral process upon the ulnar side of the large third metacarpal. Upon its outer distal surface it offers a cup-shaped cavity to the globular head of the fourth metacarpal. The ulnar surface is so much weathered that it does not show an articular surface for the fifth metacarpal.

The *magnum* is relatively small and covers only a portion of the head of the third metacarpal. Its superior or proximal aspect shows a globular head, which occupies the posterior or palmar moiety of the bone, and an anterior shelf-like projection, which presents above a horizontal facet for articulation with the corresponding part of the lunar already mentioned. It articulates with the following bones: the lunar above, metacarpal III below, the unciform upon the ulnar side, and probably with both the scaphoid and trapezoid upon the radial side. Owing to the damaged condition of the bone, however, this latter statement cannot be verified.

Of the metacarpals there are present the third and the fourth in a tolerable state of preservation. *Metacarpal III* is remarkable for its relative shortness and robust character. Proximally it has a somewhat saddle-shaped articular surface, which rises much higher upon the ulnar than upon the radial side. This surface is occupied by the magnum. Upon the ulnar side of the proximal extremity is seen a large, somewhat lateral facet, by means of which it joins the unciform. Beneath this facet is another excavated articular surface of considerable size for union with the fourth metacarpal. Distally it is somewhat expanded, having a well-curved articular extremity, by means of which it joins the first phalanx. On the palmar aspect there is a weakly developed metapodial keel. The great extent of this facet indicates an unusual amount of flexion and extension of the phalanges.

Metacarpal IV is relatively longer and more slender than the third; its proximal surface is occupied by two facets of almost equal dimensions, both of which are directed upwards and inwards; the facet upon the radial side of the bone is but little convex, and abuts against the strong overhanging process on the ulnar side of M. III. The facet upon the ulnar side is much rounded, and is received into the cup-shaped distal extremity of the unciform. Upon its extreme outer or ulnar edge the head of the bone presents another shallow articular depression, which marks the point of articulation of M. V; this latter bone, however, is not preserved in the specimen under consideration.

The *proximal phalanges* are strikingly short, deep and broad; they are moderately excavated to receive the distal extremities of the metapodials, and at their distal ends are received into deep concavities of the second row (Fig. 14).

The *median phalanges* are likewise short and deep; their articulation with the claws is by means of a deeply grooved facet, which describes almost a semicircle.

The *terminal phalanges* are immense compressed claws without any trace of fissures at the ends; they show a considerable dorsal curvature, and on their palmar aspect are provided with powerful subungual processes, which indicates great strength for the flexor tendons. The articular surface of the claw is deeply excavated, and the dorsal portion of this articular surface overhangs the lower considerably. At the proximal extremity of the dorsal curvature is seen a roughened area, which served for the attachment of the extensor tendon. The length of the third claw exceeds that of the corresponding metapodial by considerable, but that of the fourth digit is about equal to its metapodial in length.

Among the specimens collected last summer by the Expedition, is one found by my assistant, Mr. Barnum Brown, in the Torrejon Beds or the Upper Puerco, consisting of two posterior dorsal, three lumbar and nine caudal vertebræ, together with a nearly complete pelvis. It was thought at first that these bones belonged to a large Creodont, probably a species of *Dissacus*, but they were so much broken that it was impossible to form any correct judgment of their true characters at the time of collection. Since they have been cleaned and mended it is now very evident that they do not belong to any known species of Creodont. The only other species occurring in this horizon to which they could be referred on account of size are *Pantolambda cavirictis* and *Psittacotherium multifragum.* A comparison with the corresponding bones of the smaller species of *Pantolambda* shows such great and fundamental differences that it is certain that the specimen in question does not belong to *Pantolambda.* There remains then only *Psittacotherium multifragum* to which the specimen can be referred, and if we can judge from the peculiar characters which these bones present, I think there can be no mistake in referring them to this species.

The most anterior *dorsal vertebra* (Fig. 15) preserved in the specimen I take to be the ante-penultimate, although it may have a more anterior position than this. At all events it is that dorsal in which the character of the zygapophyses changes abruptly from the flat to the involute form, and corresponds with the change in the direction of the neural spines, so noticeable in many forms, especially the Carnivora. This varies in different species, ranging from the third from the last to the fifth from the last of the dorsals. The centrum is somewhat depressed, and is slightly concave at either extremity. There are strong rib facets in the usual positions, showing that the ribs attached to this vertebra were articulated with the centrum in advance as well. The transverse processes are short and stout, and are occupied at their extremities by tubercular facets which look forwards and outwards. The anterior zygapophyses are flat and directed upwards,

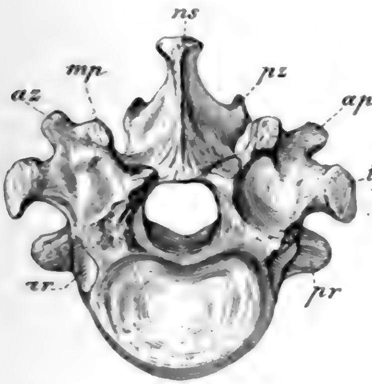

Fig. 15.

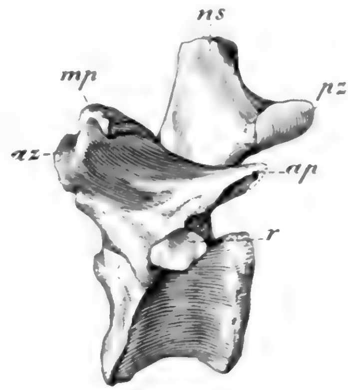

Fig. 16.

Fig. 15. Front view of a posterior dorsal of *Psittacotherium multifragum*: *ns.*, neural spine; *mp.*, metapophysis; *az.*, anterior zygapophysis; *ar.*, anterior rib facet; *pr.*, posterior rib facet; *tp.*, transverse process; *ap.*, anapophysis; *pz.*, posterior zygapophysis.

Fig. 16. Side view of posterior dorsal of *Psittacotherium multifragum*. Lettering same as in last figure.

but the posterior zygapophyses present a strong outward convexity, and, as is usual in many forms of mammals, look downwards and outwards. There are well-developed metapophyses, as well as strong processes, which represent the anapophyses. The spine is low and moderately heavy, with an almost vertical direction.

The *last dorsal* (Fig. 16) is slightly larger than the one just described; there are single rib facets at the junction of the pedicles with the centrum, and the anterior zygapophyses are deeply concave, with the posterior as strongly convex. There are well-developed metapophyses and anapophyses, the latter projecting well backward, beneath and to the outside of the succeeding zygapophyses.

The *lumbar vertebræ* are three in number, and as they were found locked in position with the last dorsal there is reason to believe that this is the formula forthis region of the spine. They increase slightly in size from before backward, have low spines, well-developed transverse processes and strongly involute zygapophyses. The complex articulations of the vertebræ of this region of the spine, so constant a feature of the later Edentata, are not present, but the presence of the strong, backwardly projecting anapophyses furnish a combination of structures which could have easily given rise to this peculiarity in the vertebral articulation.

Only a fragment of the *sacrum* is preserved, so that it is impossible to say anything of the number of vertebræ intering into its composition.

Fig. 17. Front and side view of ninth caudal of *Psittacotherium multifragum.*

Of the *caudal* vertebræ (Fig. 17) the first nine are preserved; the first is poorly preserved, being represented by the centrum only. The bodies of the remaining vertebræ are remarkable for their short, stout, cylindrical form, differing in this respect from those of all the cotemporary Creodonts, in which the bodies of the caudals are longer and much more slender. There are strong transverse processes on the first four or five, which are also provided with complete arches. Well-developed cheverons are present, as in the Gravigrada. Altogether the tail bones bear a marked resemblance to those of the Gravigrada.

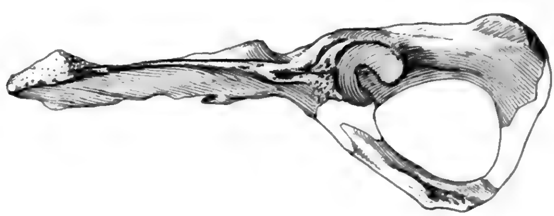

Fig. 18. Side view of pelvis of *Psittacotherium multifragum.* $\frac{1}{2}$.

The *pelvis* (Figs. 18, 19 and 20) is so characteristic that it requires but a passing glance on the part of an anatomist at all familiar with the osteology of the Edentata to demonstrate its marked

Fig. 19.

Fig. 20.

Fig. 19. Top view of pelvis of *Psittacotherium multifragum.* [illegible].
Fig. 20. Ventral view of pelvis of *Psittacotherium multifragum.* [illegible].

similarity to the corresponding parts of these forms ; this is most strikingly apparent in the direction of the gluteal surfaces of the ilia, the lengthened pubic bones, the character of the obturator foramen, and the deeply impressed, roughened surface for the attachment of the sacrum.

The *ilia* are well expanded, with nearly flat, dorsally directed gluteal surfaces and a prominent hook-shaped anterior superior spine. The inner border is nearly straight, and its posterior moiety is occupied by the deeply impressed rugose auricular sur-

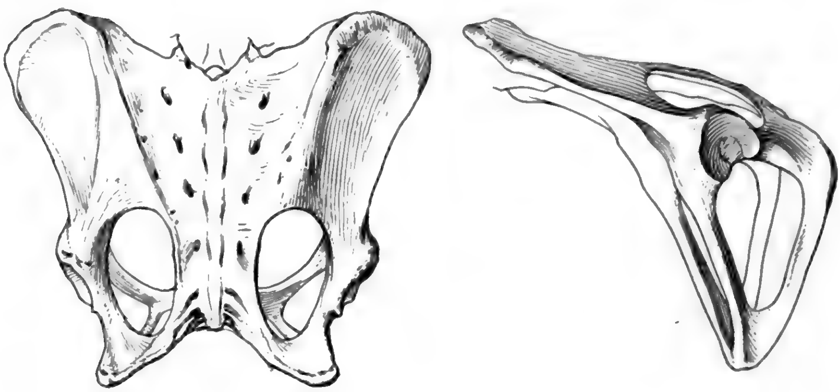

Fig. 21. Dorsal and side views of pelvis of modern Sloth, *Bradypus tridactylus*.

face for the attachment of the sacrum. This unusual rugosity foreshadows the coössification of the sacrum with the ilia, which is a marked and constant feature of all the later Edentates (Fig. 21). The acetabula are more or less damaged, but enough of them are preserved to indicate that they were wide and roomy.

The *ischia* are somewhat more elongated than in the modern Edentates, and there was no bony union between these bones and the sacrum, so that the sacro-sciatic foramen was not completed by bone hehind, as in all the later Edentates, but was closed by ligament, as in all the other mammalia.

The *pubic bones* are relatively long and slender, giving to this region of the pelvis an unusual vertical depth, a feature so highly characteristic of the later Edentates. They meet in a tolerably elongated symphysis, which is firmly united by bone. It results from the elongation of the pubic elements that the vertical diameter of the obturator foramen is much increased; in all the modern Edentates the vertical always greatly exceeds the antero-posterior diameter, but in the pelvis under consideration the two diameters are almost equal. It will thus be seen that in *Psittacotherium* the incipient changes leading to the Edentate peculiarity in this respect are already evident.

Comparison of Psittacotherium with Hemiganus.

It now remains to make an accurate comparison between these two important genera, and learn, if possible, in what their resemblances and differences consist. One of the most important facts to be borne in mind is their relative positions in time. *Hemiganus*, as before stated, comes exclusively from the lower Puerco Beds, while *Psittacotherium* is as distinctly confined to the upper Puerco (Torrejon Beds), the respective strata of the two being separated by several hundred feet.

The points of resemblance may be stated as follows: (1) The facial portion of the skull is short, and the sagittal crest is long and low; (2) the lower jaw is short, deep and massive, with a powerful symphysis, a broad high coronoid, and a prominent angle; (3) the condyle is placed high above the level of the tooth line, and the posterior termination of the tooth line passes behind the border of the coronoid; (4) the molar pattern in the lower jaw is identical in the two genera, and the premolar pattern of the one is clearly a derivative of the other; (5) the ulna and radius are very similar in the two forms; (6) the form and relationship of the lunar are identical; (7) the metapodials are short and stout, and (8) the terminal phalanges consist of greatly enlarged, compressed claws, identical in pattern in both.

The differences so far as we know them are slight, and consist, at best, in modifications of only generic significance. They are as follows: In *Hemiganus* the crown of the superior canine is completely invested in enamel, whereas in *Psittacotherium* it is limited to the anterior face of the tooth. In *Hemiganus* the roots of the lower molars possess distinct fangs, while in *Psittacotherium* the fangs become connate, especially in the older specimens, and there is little trace of them left. In *Hemiganus* again, the condyle is placed somewhat higher, and the angle of the jaw is less developed than in *Psittacotherium;* and lastly the lower premolars of *Hemiganus* possess but one principal cusp, with only a rudiment of the second; whereas in *Psittacotherium* the premolar crown is strongly bicuspidate.

It will thus be seen, and I hold that the demonstration is complete, that *Hemiganus* is the ancestor of *Psittacotherium*, the one having been derived directly from the other by descent.

Calamodon[1] *Cope.*

We come next to consider the Wasatch representative of this family, *Calamodon.* Three genera have been described from this horizon, *viz.: Ectoganus*[2] Cope, *Calamodon* Cope, and *Dryptodon*[3] Marsh. It is possible that two of these names are synonymous, *viz.: Calamodon* and *Dryptodon*,[4] and it is a matter of great uncertainty whether *Ectoganus* is distinct. According to Cope, the chief difference consists in the development of an oblique crest connecting the two cross crests in the lower molars, but as this distinction rests upon the evidence of a single much-worn tooth, it would seem the best course to regard it as synonymous until we have better material upon which to base a diagnosis. A species of the genus *Calamodon* has been described by Rütemeyer from Switzerland under the specific title of *C. europæus.* That it is a species of *Calamodon*, or some nearly related genus, there can be little doubt, but the specimen is so fragmentary that little more can be said of it.

Owing to the fragmentary condition of the materials it is well-nigh impossible to say just how many species should be recognized, but it is more than probable that there were at least two,

[1] U. S. Geolog. Surv. W. 100th M., p. 118, 1874.
[2] U. S. Geolog. Surv. W. 100th M., p. 116, 1874.
[3] Amer. Journ. Sci., Vol. XII, p. 403, 1876.
[4] A careful examination of Prof. Marsh's type specimen shows apparently some important differences from *Calamodon* in the arrangement of the enamel bands of the molars and premolars. Thus, in $pm._4$ of *Dryptodon* the crown is completely surrounded by enamel, whereas in *Calamodon* the enamel is interrupted. There seem to be other differences, but owing to the bad state of preservation of the teeth, they cannot be determined with certainty. The generic validity of *Dryptodon* cannot be regarded as fully established until we have better specimens; it appears, however, probable.

and possibly three, modifications which can be regarded as of specific value. The best known species is *C. simplex* Cope, from the Wasatch Beds of the Big Horn, which is represented by an almost complete pair of lower jaws, together with numerous other fragments of teeth. This species also occurs in the Wasatch of New Mexico in association with *C. arcamnæus*, and is further represented from this locality by fragments of the jaws and teeth, together with a fragmentary fore limb, including parts of the humerus, ulna, and radius, part of a metapodial, and a fragment of a terminal phalanx or claw.

The lower jaw (Figs. 22 and 23) displays practically the same characters in its general outline as those already described in

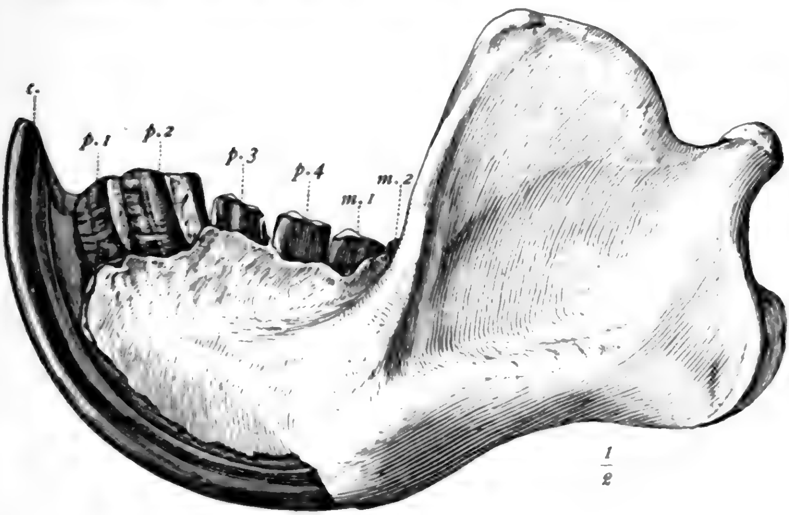

Fig. 22.

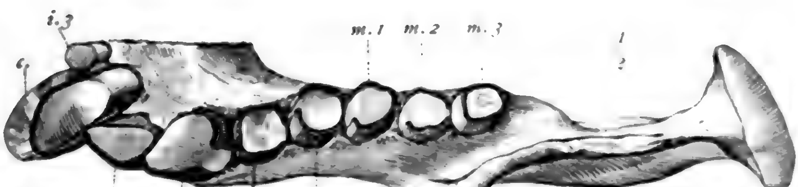

Fig. 23.

Fig. 22. Side view of lower jaw of *Calamodon simplex*.
Fig. 23. Top view of lower jaw of *Calamodon simplex*.

Psittacotherium. It is remarkably short, massive and deep, with a powerful coronoid and a prominent angle. The condyle is situated unusually high above the tooth line, the posterior termination of which passes well behind the anterior border of the coronoid, so as to completely obscure the last molar tooth and a good part of the second, in a side view of the ramus.

In the single complete specimen of the lower jaws known there is a pair of small incisors from which the enamel has completely disappeared, whether through wear or otherwise is not known.

The large curved scalpriform canine grew from a persistent pulp, and is covered with a thick layer of enamel upon its anterior face only. This tooth is followed, without the intervention of a diastema, by the first premolar, a relatively large tooth, imperfectly triangular in cross section, with the apex of the triangle directed outwards and covered with enamel upon its antero-external surface only. Immediately behind this is a large second premolar, more or less oval in cross section, and implanted in such a manner that the long axis of the crown is directed obliquely to the long axis of the jaw. It is provided with two vertical bands of enamel, one of which is external and the other internal. Behind this follows the third premolar, which has an imperfect quadrate cross section, and shows a complete enamel investment, with the exception of a narrow band upon its posterior face. The fourth premolar is similar to the third, and shows a complete investment of enamel, with the exception of a narrow band upon its anterior face. The first two molars are similar to the last-described tooth in size and shape, and have broad external and internal vertical bands of enamel. The last molar is somewhat smaller than the others, and its crown has a complete enamel investment. Neither the molars nor premolars grew from persistent pulps, but the roots are elongated, with scarcely any indication of the fangs, and the whole structure may be said to be decidedly hypsodont.

It is a noticeable feature in the teeth of this species that in addition to the vertical striation of the enamel surface, there is also a series of fine horizontal ridges, giving it a somewhat checkered appearance. It is also a fact worthy of note that in those situations where the enamel fails there is a thick deposit of cementum.

It is in very young specimens only that the pattern of the molar crown can be distinguished; in a perfectly unworn tooth (Fig. 24) the crown is seen to be made up of four subequal rounded cusps placed in the form of a square. The two anterior and posterior cusps are separated from each other by slight notches only, but the two anterior are separated from the two posterior cusps by a profound transverse valley,

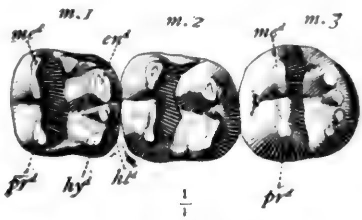

Fig. 24. Crown view of unworn lower molars of *Calamodon simplex*: me^{d}., metaconid; pr^{d}., protoconid; hy^{d}., hypoconid; hl^{d}., hypoconulid; en^{d}., entoconid.

which reaches entirely across the crown. When the crown is a little worn it presents the appearance of two transverse crests, and when still more worn, so as to obliterate all traces of the crown pattern, there is a flat surface of dentine more or less completely surrounded by a ring of enamel.

The structure of the premolars has hitherto been completely unknown, but there is now contained an unworn crown of a second premolar; it is made up of a strong more or less hook-shaped external cusp and a subequal vertical inner cusp, thus recalling at a glance the structure of the second premolar already described in *Psittacotherium*. The structure of the crowns of the upper molars and premolars is quite unknown.

The fragment of humerus, as figured by Cope, indicates a short, stout bone, with a considerable distal expansion, and without doubt an entepicondylar foramen. The ulna and radius exhibit striking resemblance to that of *Psittacotherium* and *Hemiganus*, and like the corresponding bones in these genera, are devoid of a medullary cavity. Enough of a metacarpal is preserved to show that it also had a similar form to that of the last-named genera, as did also the terminal phalanx or claw.

The differences between *Calamodon* and *Psittacotherium*, while they are somewhat greater than they are between *Psittacotherium* and *Hemiganus*, are yet comparatively insignificant, and are just such further modifications in a given direction as one would reasonably look for in a later genus, more especially when it is remembered that these modifications were already clearly foreshadowed in *Psittacotherium* in its advance over *Hemiganus*. There cannot, therefore, be the slightest doubt that *Calamodon* is the direct descendant of *Psittacotherium*, from which it is separated in time by a deposit representing two hundred feet or more of vertical thickness.

Stylinodon cylindrifer *Cope.*

The next form in this family to be considered is the Wind River representative, *S. cylindrifer*. This species is known from only a single molar tooth, presumably of the upper jaw, together with a few fragments of a canine and some inconsiderable pieces of the skull. The molar tooth (Fig. 25) is remarkable for its long cylindriform pattern and the narrow vertical bands of enamel which have an external and an internal position with reference to the crown. The tooth differs from any known teeth of *Calamodon* in that it grew from a persistent pulp, and in having the vertical bands of enamel much narrower. The canine is represented by only a few fragments, but enough is preserved to determine the fact that it also grew from a persistent pulp, and had a thick anterior facing of enamel.

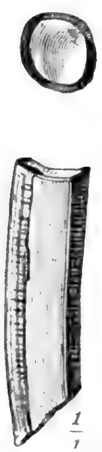

Fig. 25. Side and crown views of molar tooth of *Stylinodon cylindrifer*.

It is more than probable that when this species is more completely known it will be found to occupy an intermediate position between *Calamodon* and the Bridger *Stylinodon*, and will doubtless require the making of a new generic name. At present we can only provisionally refer it to the genus *Stylinodon*, with which it best agrees.

Stylinodon mirus *Marsh.*

While this paper was in course of preparation Prof. Marsh has published[1] a full account of the beautifully preserved remains of this species in his collection. The type consists of a fragment of the lower jaw, with three or four of the molar teeth in place, and indications of the alveoli of two more. The second specimen consists of all the cervical and first dorsal vertebræ, together with the first pair of ribs and sternum in position ; with these are associated a nearly complete fore limb, parts of the skull, jaw, and other fragments.

Fig. 26. Side view of lower jaw fragment (type) of *Stylinodon mirus.* (After Marsh.)

The type (Fig. 26) shows that the teeth were much elongated, rootless, of persistent growth, and provided with narrow vertical bands of enamel, which had an external and an internal position upon the molars and premolars, very similar to the single tooth of *S. cylindrifer* already described. Fragments of the large scalpriform canine indicate that it was faced with enamel, that it was of persistent growth, and was implanted in the jaw in the same manner as the corresponding tooth in *Calamodon* and *Psittacotherium.*

In the second specimen enough of the jaw is preserved to determine more fully its character. According to Prof. Marsh

[1] Am. Jour. Sci. (4), Vol. III, Feb., 1897, pp. 137–146

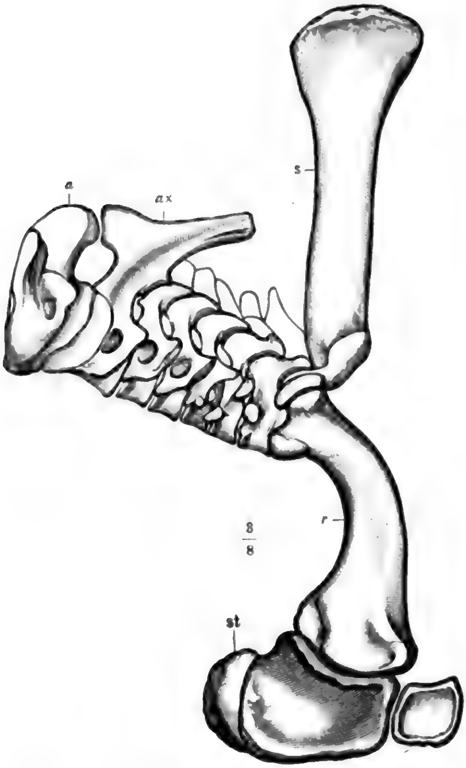

Fig. 27. Side view of cervical and first dorsal vertebræ, together with first rib and sturnum of *Stylinodon mirus*: *a.*, atlas; *ax.*, axis; *s.*, spine of first dorsal; *r.*, first rib; *st.*, sturnum. (After Marsh.)

there are seven teeth behind the large scalpriform canine, whose root is extended backward as far as the base of the penultimate molar. The condyle of the jaw is transverse, and its motion was not limited behind by a postglenoid process. The body of the jaw is remarkably short and deep, as is also the *symphysis mandibuli*. The skull is short and massive, without prominent sagittal crest, and having the arrangement of the occipital plane similar to some of the later Edentates. The occipital condyles are small, and there are no distinct paroccipital processes.

In the cervical vertebræ (Figs. 27 and 28) the centra are short, with nearly flat articular faces. The axis has a long neural spine directed backward. The neural spine of the first dorsal is elongated, as are those of the succeeding anterior dorsals. None of the cervicals show a double interlocking, such as is seen in many of the later Edentates.

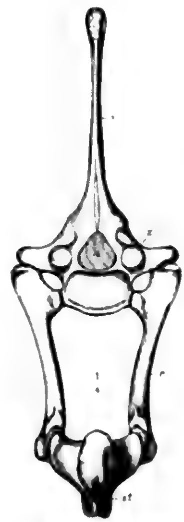

Fig. 28. Cross section of thorax, front view, of *Stylinodon mirus.* Lettering as in last figure. (After Marsh.)

In the shoulder girdle the scapula is relatively long and narrow, with prominent acromion, which supported a well-developed clavicle. The coracoid is small. The humerus (Fig. 29) is short and stout; the head displays the pyriform pattern so highly characteristic of the Edentata; the deltoid crest is powerful, and there is a distinct entepicondylar foramen. The ulna and radius (Fig. 30) are almost identical in all their features with these bones in *Hemiganus*, *Psittacotherium* and *Calamodon.* The manus, moreover, shows all the characters above described in *Psittacotherium.* No terminal phalanges are known, but the similarity of the rest of the foot with that of *Psittacotherium* is so striking that there can be no doubt of the fact that *Stylinodon* possessed large, powerful claws.

Family CONORYCTIDÆ.

In this family I arrange two genera, *viz.: Conoryctes* and *Onychodectes.* The family distinctions between them and the Stylinodontidæ are not great, more particularly when compared with the earliest representative of this family, *Hemiganus.* The following important differences, however, may be noted: In the Stylinodontidæ the long axis of the second and third premolars in the lower jaw is placed transversely to the long axis of the jaw, and, as already described, these teeth develop two cusps which stand in this position. The fourth lower premolar, on the other hand,

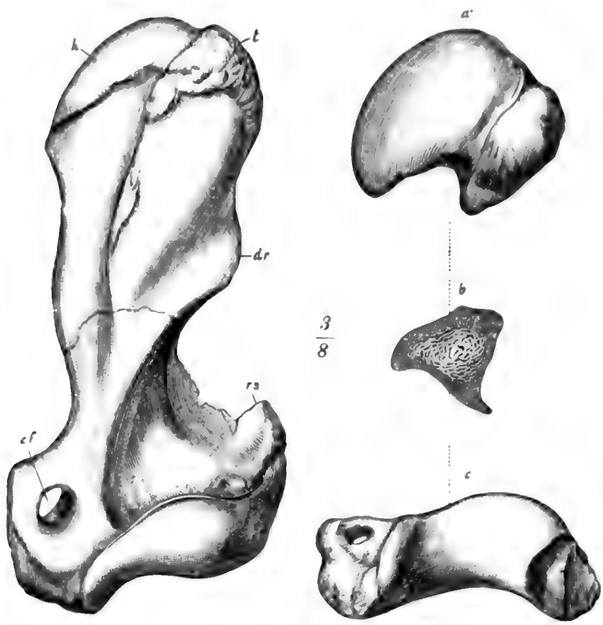

Fig. 29. Front, proximal, distal and sectional views of humerus of *Stylinodon mirus*: *h.*, head; *t.*, tuberosity; *dr.*, deltoid ridge; *ef.*, entepicondylar foramen; *rs.*, supinator ridge. (After Marsh.)

developed a posterior heel and became submolariform, quite in the ordinary way. In the Conoryctidæ the second and third lower premolars show no disposition to develop this peculiar bilobed condition, but the long axis of the tooth agrees with that of the jaw. These differences are no doubt dependent upon the length of the jaws in the respective groups, which, together with their concomitant modifications, may be taken to define the families. We thus note that the lower jaw in the Conoryctidæ is comparatively long and slender, lacking the deep, massive appearance of the Stylinodontidæ; the coronoid is not so much enlarged, and the posterior temination of the tooth line does not pass behind the anterior border of the coronoid. The condyle, moreover, is placed more nearly on a level with the tooth line. The propriety of associating the two groups in one suborder is apparent when the identity of the pattern of the molar crowns is considered, and what is yet probably more significant, the loss of incisors and the weak development of the enamel upon all the teeth.

Onychodectes[1] *Cope.*

So far this genus has been found in the lower beds of the Puerco only. It is represented by two species, *S. tissonensis* Cope, and *O. rarus* Osborn & Earle. The first of these species is not uncommon in the collection of the Museum, and is represented by nearly every part of the skeleton, while the second is known from a single fragment of a lower jaw.

In *O. tissonensis* the skull is long and narrow (Fig. 31), with a weak development of the sagittal crest. There is no indication of postorbital processes on the frontals. The muzzle is unusually long and slender, being well roofed by the nasals, which extend forwards in such a manner as to cover in the premaxillæ almost completely above. The premaxillaries are of considerable size, and extend well back between the nasals and the maxillaries above. The palate is long and narrow, and there is no evidence that it was very much prolonged behind the termination of the molar tooth line. The foramina of the skull cannot be determined, on account of the intensely hard matrix in which it is imbedded.

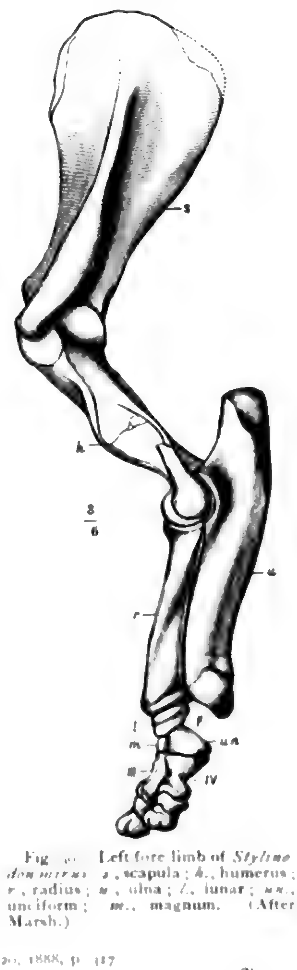

Fig. [illegible] Left fore limb of *Stylinodon mirus*. *s.*, scapula; *h.*, humerus; *r.*, radius; *u.*, ulna; *l.*, lunar; *un.*, unciform; *m.*, magnum. (After Marsh.)

The lower jaw (Fig. 32) is long and comparatively slender; the coronoid is high and falcate, the condyle is placed just above the level of the

[1] Proc. Amer. Philos. Soc., July 20, 1888, p. 317.

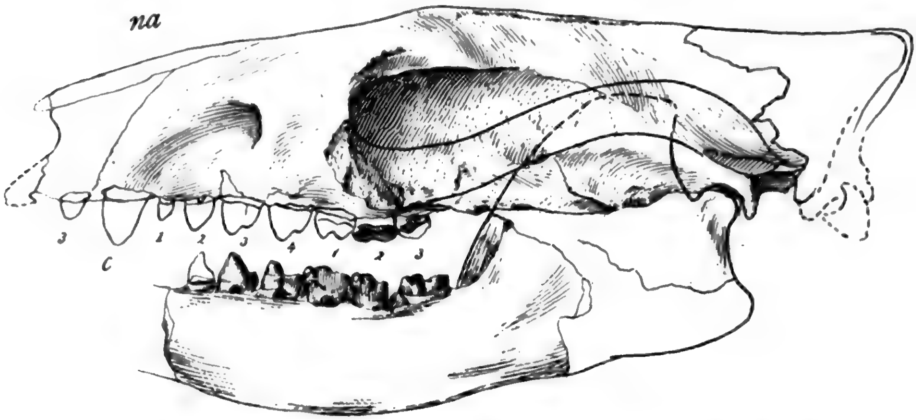

Fig. 31. Side view of skull of *Onychodectes tissonensis*. Natural size. (After Osborn and Earle.)

tooth line, and the teeth do not pass behind the anterior border of the coronoid. It is not clear whether the angle is well developed, but it is more than probable that it is.

The dental formula is somewhat in doubt, owing to our lack of knowledge of the incisors; that there was one pair at least in the upper jaw is certain, and I think it more than likely that there were two. The same uncertainty prevails with reference to the lower jaw. It may be provisionally written I.$\frac{2}{2}$(?), C.$\frac{1}{1}$, Pm.$\frac{4}{4}$, M.$\frac{3}{3}$.

The structure of the teeth (Fig. 33) has been well described by Cope, and I will mention here only their more salient characters. The superior premolars are all simple, with the exception of the fourth, which has a strong external and internal cusp. The unworn crowns of the upper molars show three principal cusps, with a weak external cingulum. The two outer cusps, paracone and metacone are subequal, and their summits are slightly inclined inwards, giving to them a somewhat claw-like appearance: hence the name *Onychodectes* (claw biter). The internal cusp or protocone is large and lunate, having upon the limbs of the crescent faint intermediate cusps. The inner face of the crown is remarkably deep, and the enamel has unusual vertical extent.

Fig. 32.

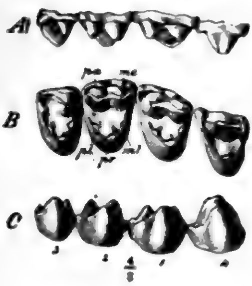

Fig. 33.

Fig. 35.

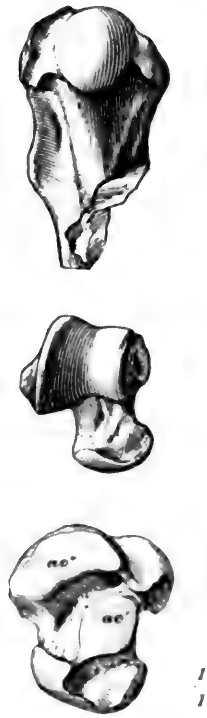

Fig. 34.

Fig. 32. Side view of lower jaw of *Onychodectes tissonensis.* (From Osborn and Scott's forthcoming book.)

Fig. 33. Crown (*B*), outside (*A*), and inside (*C*) views of upper molars and fourth premolar of *Onychodectes tissonensis*: *pa*, paracone; *me*, metacone; *ml*, metaconule, *pr.*, protocone; *pl.*, protoconule. (From Osborn and Scott's forthcoming book.)

Fig. 34. Posterior view of head of humerus, and dorsal and plantar views of astragalus of *Onychodectes tissonensis.*

Fig. 35. Posterior view of the head of the humerus of a modern Armadillo (*Tatusia*).

The premolars of the inferior series are simple, laterally compressed cones, except the third, which has a faint posterior heel, and the fourth, which has a broader and better developed heel. The pattern of the molars are of the imperfect tuberculo-sectorial type, the anterior cusp of the trigon being poorly developed. The two principal cusps of the trigon are subequal, and are placed in such a manner as to occupy a transverse position. The

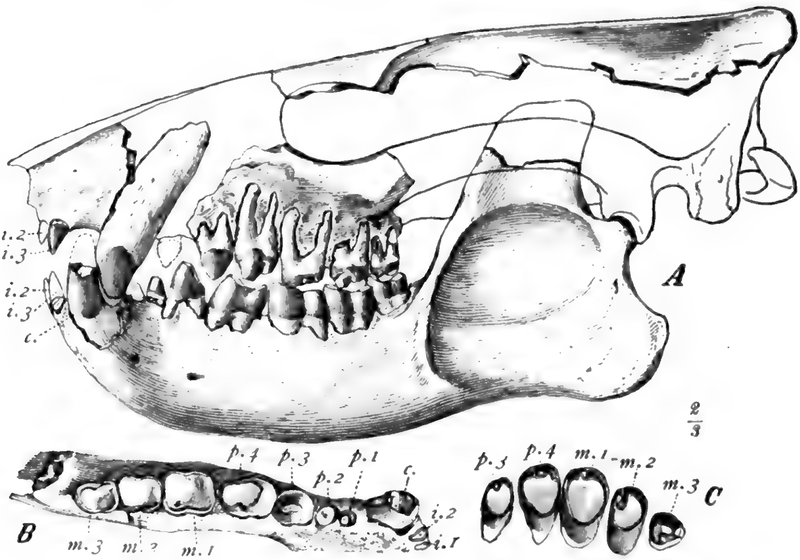

Fig. 36. Side view of skull (*A*), crown view of lower teeth (*B*), and crown view of upper teeth (*C*), of *Conoryctes comma*. (From Osborn and Scott's forthcoming book.)

heel is broad and lunate, and in the unworn condition carries three principal cusps and a small though distinct cusp at its anterior inner termination. The great development of this element in one specimen has led Osborn and Earle to establish a second species, *O. rarus.*

Numerous fragments of the skeleton are preserved, from which it is possible to obtain some idea of its structure. In one specimen (No. 3576*a*) there is a portion of a humerus (Fig. 34) with a complete proximal extremity. The head of the bone displays that characteristic pyriform articular surface so constant in all the Edentates; in the arrangements of the tuberosities and the deltoid crests it resembles the corresponding parts of the Armadillo (Fig. 35).

A number of metapodials of both the fore and hind feet show that these bones are moderately short and stout, while the phalanges are more elongated and slender than those of *Hemiganus*. The claw has essentially the same shape, but is relatively much smaller. The astragalus (Fig. 34) has a well-grooved trochlear surface, and can be readily distinguished from its cotemporaries by the absence of the astragalar foramen.

Conoryctes[1] *Cope*.

Remains of this genus are not uncommon in the upper horizon of the Puerco, in which it has been found exclusively so far. These remains are all referable to a single species, *C. comma*. Parts of the skull and jaws are known, together with a few fragments of limb bones, but further than this our knowledge of this form leaves much to be desired.

In the skull (Fig. 36) the facial portion is much shorter than in *Onychodectes*, and the sagittal crest is not conspicuous. The lower jaw is moderately short and stout, the coronoid is not especially enlarged, and the condyle, as in *Onychodectes*, is placed near the level of the tooth line. The lower molars do not pass behind the anterior border of the coronoid, and the angle is well developed.

The dental formula is I. $\frac{3}{3}$, C. $\frac{1}{1}$, Pm. $\frac{3}{3}$, M. $\frac{3}{3}$. The incisors are small and pointed, and are separated from the canines in the upper jaw by a considerable diastema. The canines are of good size and probably had completely enamel-covered crowns, although in all the specimens known the enamel is removed from certain areas of these teeth; whether this is the result of wear, or whether it is absent in these situations, is impossible to say: at all events the enamel covering of these teeth, as in all the others of this species, is conspicuous for its general thinness and weak development.

The first (second) superior premolar is simple, and follows the canine with but comparatively little interval; the second (third)

[1] Proc. Amer. Philos. Soc., 1881, p. 486.

premolar is trilobed, having a large external conical cusp, and a small somewhat lunate inner with a small anterior basal cusp. The fourth premolar is tritubercular, and is almost, if not quite, molariform in structure. In nearly all the specimens the crowns of the molars are so much worn as to obscure greatly, if not to destroy completely, the crown pattern ; this, moreover, occurred early in the life of the individual, and in some instances, before all the teeth were fully erupted. In some of the specimens the crown (Fig. 36) is sufficiently preserved to indicate that it was tritubercular, having two external and one internal cusp. All the molars show their tendency toward hypsodonty in the great vertical extent of the enamel upon their inner or lingual faces.

In the lower jaw all the premolars, with the exception of the fourth, are simple laterally compressed cones. This latter tooth has a principal anterior cusp, to which is added a prominent basin-shaped heel ; when the crown is reduced by wear it resembles a true molar closely, and is generally spoken of as molariform. The structure of the crowns of the inferior molars, while in no instance well preserved, yet indicate that the usual elements of the trigon are present ; the anterior element is, however, very small and insignificant, and can be said to be practically absent. The two posterior cusps of the trigon are subequal and placed in such a manner that upon wear they present the appearance of a transverse crest. The heel is large and prominent, and when little worn shows a distinct basin shape. In size the first molar is the largest and the last is the smallest.

Among the fragments of limb bones, a head of a humerus exhibits the same characteristic pattern already noted in the other members of the group.

Altogether this genus shows in some respects resemblances to *Hemiganus*, and in others is close to *Onychodectes*. The terminal phalanges, as well as the rest of the foot-structure, are entirely unknown.

Relationship to the Edentata.

Considering the Ganodonta as a whole, there can be but little doubt that they form a homogeneous group, characterized by certain features which became more and more marked as the respective phyla advanced into later time. These features relate to the loss of the incisors, the weak development and loss of enamel, and the development of hypsodonty with its dependent modification, growth from a persistent pulp. They are further united by the great similarity in pattern of the molar crowns, and the characteristic shape of the head of the humerus. All these characters go to indicate that, however widely they may have been separated at the beginning of the Puerco, they are, nevertheless, descended from a common ancestor in the earlier Mesozoic.

One phylum, *viz.:* the Stylinodontidæ, as I have attempted to show, began in the generalized type *Hemiganus*, and continued into the Bridger, terminating, so far at least as our positive knowledge now extends, in *Stylinodon*. This, it may be remarked, is as complete and perfect a phylum as has ever been deciphered within the whole range of palæontology. Whether or not *Conoryctes* or *Onychodectes* left modified descendants is uncertain, but it is not impossible that some of the later Edentata may yet be traced to them.

Regarding the Edentate affinities of at least one of these groups, the evidence, in my judgment, is so overwhelmingly conclusive, that a mere statement of the points of likeness will suffice: I refer particularly to the Stylinodont phylum in its relations to the great Ground Sloths or Gravigrada. These characters are as follows: (1) In the skull there is great similarity in form; the muzzle is short, the sagittal crest is low, and the occipital plane slopes forwards as in *Mylodon*, *Megatherium* and *Megalonyx*. (2) The lower jaw is short, deep and robust, with a greatly enlarged coronoid, a prominent angle, and a position of the condyle high above the tooth line. (3) The incisors are reduced to a single pair in the lower jaw of *Calamodon*, and are probably completely absent in *Stylinodon*. (4) The posterior portion of the tooth line below passes well behind the anterior border of the coronoid. (5) The canines in all are enlarged, and in *Calamodon* and *Stylinodon* grew from persistent pulps, as in *Megalonyx*. (6) All the molars and premolars in *Stylinodon* are greatly elongated, of persistent growth, and the enamel is confined to narrow vertical bands. (7) There is a thick deposit of cementum on the dentine in those situations in which the enamel disappears. (8) The cervical vertebræ strongly resemble those of the Gravigrada. (9) There were well-developed clavicles present. (10) The humerus bears a striking resemblance in all of its essential features to those of *Mylodon*, *Megalonyx* and *Megatherium*. (11) The ulna and radius are also similar. (12) The manus is almost identical with that of the Ground Sloths. (13) The humerus and ulna and radius have no medullary cavities; and (14) the femur has all the characteristic features of the Gravigrada. (15) The lumbar vertebral formula was the same as in the Edentata. (16) The pelvis is decidedly Edentate; and (17) the caudals bear a striking resemblance to those of the Ground Sloths.

If this astonishing array of similarities is accidental and does not indicate genetic affinity, then all that can be said is that palæontological evidence is worthless in the determination of the various successive steps in the descent of a group or species. I hold that, in view of all the evidence above set forth, the proposition that the one has descended from the other may now be regarded as a positively demonstrated fact.

If this proposition be true, then it follows that all the South American Edentates must have been derived from the North American Ganodonta, since their earliest appearance in South America does not antedate the Santa Cruz epoch. In this formation they appear suddenly in great numbers and variety without apparently any previous announcement in the older Pyrotherium deposits. This fact in itself would seem to indicate that they were migrants from another region, and while we are as yet unable to place these deposits in the time scale with accuracy, it is yet highly probable that the Santa Cruz Beds are not older than our North American Oligocene. In North America, as I have just shown, the Ganodonta appear in the very earliest Puerco deposits, and continue without interruption into the Bridger, where they disappear. No evidences of them have up to date been detected in the Uinta or White River Beds.

Now it is currently believed by geologists that no land connections existed between North and South America from the close of the Cretaceous to the close of the Miocene, when an extensive land bridge was formed. I am not familiar with the geological evidence upon which this conclusion rests, but if one is permitted to judge from the subjoined statement of Mr. F. C. Nicholas,[1] it is at the very least open to question. It is of course possible that the Ganodonta may have reached South America by way of Europe, Africa and Antartica, but on the whole it seems infinitely more probable that there was a land bridge of short duration during Eocene time between North and South America, and that they reached their destination in this way, than by the questionable and circuitous route just mentioned. If they gained entrance into South America by the European-African route, it seems indeed strange that they should have left no remains in the later Tertiaries of Europe. With the exception of a single specimen of *Calamodan europæus*, from deposits corresponding with the Wasatch in age, all traces of the American Edentata are absent in Europe, Asia and Africa.

Origin of the Edentata.

In my first paper[2] I endeavored to establish the fact that there is a group of forms occurring in our Eocene deposits which show a remarkable resemblance to the Edentata, and which, accord-

[1] In a letter to me under date of Feb. 12, 1897, Mr. Nicholas writes as follows:

"While traveling through Central America I have noticed that certain parts of it appear to be of rather the older than the more recent geological periods. On the coast of Spanish Honduras I found float material containing *Spirifer*, apparently *S. mucronatus*.

"In the same country I found residual clays where the surface erosions indicate an old formation. Along the coast there are immense alluvial deposits that must have taken a long time to accumulate. In the interior I find sedimentary formations and intrusive plagioclase rocks.

"Along the Pacific the country is of volcanic formation. On the Isthmus of Panama there are sedimentary rocks and cemented gravels resembling somewhat the terrace formation of the Atlantic.

"In the central parts of the Isthmus there are plagioclase rocks and crystalline types.

"To the south, below the Gulf of Darien, there are low sediments which, except for a short divide, are continuous from the Atlantic to the Pacific. The divide has evidently been intruded through the sediments, because they are found irregularly over it.

"The continents must have been separated at this point, the geological age being undetermined, but judging from the erosions and by comparisons of various intrusions in the district, I should say it was of early Tertiary formation.

"I feel certain that parts of Central America belong to the Devonian Period, that before Cretaceous times these parts of the country were ancient islands In Cretaceous and early Tertiary times seismic disturbances must have been very great, and subsidences separating the two continents for irregular periods would be probable; but the older, that is, the least central parts of Central America, were comparatively undisturbed. Here animals forced south by adverse conditions further north would have found a resting place, and the Sloths, Armadillos, Anteaters, and similar types, are very abundant

"These secure parts of the country were very near the Isthmus, and when the changing conditions were favorable, animals could have easily made their way to South America and then overrun the country, developing most abundantly in the lower latitudes, where conditions were most favorable to them"

[2] Bull. Amer. Mus. Nat. Hist., Vol. VIII, p. 259-262, Nov. 30, 1896; Science, Dec. 11, 1896, p. 865.

ing to our present knowledge, must be regarded as their ancestors. This group I have defined and named the Ganodonta, and referred it, as a suborder, to the Edentata, enumerating at the same time the genera, so far known, of which it is composed, as well as their distinctions. In this I have clearly been the first, since no previous effort of the kind had ever before been made. It is true that both Marsh and Cope have *suggested* the possibility of its truth, but it is equally true that their knowledge of the composition, limitation and affinities of the group have, previous to the appearance of my paper, been indeed vague. Marsh, in his Nashville address, speaking of the Tillodontia, said: "and possibly we may here yet find the key to the Edentate genealogy." He does not say that it *has* been found, or that it *has* been demonstrated, or that any one has even *attempted* to demonstrate such a proposition; he merely contents himself with the statement of the possibility that it *may yet be* found here. From this I conclude that the origin of the Edentata was unknown to him at that time. He also failed to recognize the distinctions between the Ganodonta and the Tillodontia.

Cope at one time held that his group Tæniodonta exhibits affinities with the Edentata, but this he subsequently abandoned, and he, too, utterly failed to grasp the fundamental facts of the problem. This is amply attested by his classification of *Hemiganus*, *Onychodectes* and *Conoryctes* in the Creodonta, by his placing *Psittacotherium* in the Tillodontia, and by his failure to recognize the intimate relationship between *Calamodon* and *Stylinodon*.

I hold that a proposition is not demonstrated until the facts are adduced necessary for its proof, and a mere suggestion falls a long way short of this.

As regards the name of the suborder, it is necessary to add a few words. Cope employed the name Tæniodonta to designate a supposed suborder of his group Bunotheria, in which he placed[1] the Creodonta, Mesodonta, Insectivora, Tillodontia and Tæniodonta. In the Tæniodonta he classified two genera, *viz.*, *Calamodon* and *Ectoganus*; he defined the suborder as follows: "Incisors much enlarged, growing from persistent pulps, the superior with enamel in anterior and posterior bands, and hence truncate."

[1] Tertiary Vertebrata, p. 185.

Now I do not know of any specimens in any collection which can be determined with certainty as being either canines or incisors of the superior dentition of either of these genera. I judge from Prof. Cope's figures[1] that the tooth which he took for a superior incisor is an unworn second lower premolar. I know the superior incisors and canines of *Psittacotherium*, and in this genus the enamel does *not* occur in anterior and posterior bands; if one can judge by the near relationship existing between *Psittacotherium* and *Calamodon*, it is almost, if not quite, certain that this latter genus had the enamel of these teeth distributed in the same manner. It will thus be seen that this definition is conceived in error, and does not define any known group. The name cannot, therefore, be used.

Since the appearance of my first paper, Prof. Marsh in his description of *Stylinodon mirus*, has substituted the name Stylinodontia for Ganodonta, on the ground that the name Ganodonta is preoccupied. The name *Ganodus* was used by Egerton in 1843 for a genus of fishes. Now if a generic name can preoccupy an ordinal or subordinal name, then Prof. Marsh's name Stylinodontia is open to the same objection, since it is preoccupied by the generic name *Stylinodon*, and the ordinal term Dinocerata is preoccupied by *Dinoceras*, etc. As a matter of fact, according to the best authorities on zoölogical nomenclature, the use of a name in a generic sense does not preclude its use in a family, subordinal or ordinal sense; the termination is different in each case, and there is not the slightest difficulty or question as to what is meant. I therefore contend that the name Ganodonta is a valid one; that it is the first that was ever employed to designate the group of animals to which it was applied, and that according to all usages and customs of naturalists in the employment of names it must stand.

In the present imperfect state of our knowledge it is quite impossible to frame a comprehensive definition of the order Edentata, if it is admitted that they are descended from the Ganodonta, and are genetically related to them. In the order Edentata I include only the American forms, since it is probable that the Old World Edentates have had a different origin,

[1] U. S. Geol. Surv. W. 100th M., Pl. XLI.

although it is not impossible that they may have originated from a common source. The definition of the more modern forms has always rested upon the loss of the enamel of the teeth and the complication of the vertebral articulations. As already seen, the Ganodonta violate both these characters, but they are none the less members of the same group, if it can once be established that they are related by ties of consanguinity. It is idle to speak of "essential" and "adaptive characters." If evolution be a fact, then *all* characters which distinguish one group of animals from another must ultimately disappear as we approach the point of their common origin. This is strikingly illustrated in this same group Ganodonta, the earlier members of which are separated by a comparatively small interval from the contemporaneous Creodonta, Condylarthra and other groups. If our definitions mean anything, and are to be of any real service, they can only record the characters which the various phyla have acquired in point of modification, and express the tendencies whither these modifications, however small and inconspicuous they may be in their beginning, ultimately lead. The single character, therefore, which is common to all the forms of this group, thus comprehensively included, is an early disposition to the loss of the enamel from the crowns of the teeth, as well as the loss of incisors from both jaws. This I take it, in the absence of more exact knowledge, is the real definition of Edentata.

Order EDENTATA.

I have defined the Ganodonta as follows: "Primitive Edentates, characterized in the earlier forms by rooted teeth with divided fangs, with their crowns having a more or less complete enamel investment, in the later forms by the teeth becoming hypsodont, rootless, of persistent growth, and by limitation of the enamel to vertical bands in progressive decrease. They are further characterized by the presence of incisors in both jaws, by a typical molar and premolar dentition, by a trituberculate molar crown, which disappears early in life through wear, leaving the dentine exposed."

I further add that the vertebral articulations are not complex and hence nomarthrous.

If we limit the order Edentata to the American forms alone, then it is divisible into two suborders, viz.: Ganodonta and Xenarthra, but if we include the Old World forms, another suborder, Nomarthra, must be added.

The definitions of these three suborders would be as follows:

Teeth more or less covered with enamel; one or two pairs of incisors present; vertebral articulations not complex . . . . GANODONTA Wortman.

Teeth without enamel investment; incisors rarely present; vertebral articulations complex . . . . XENARTHRA Gill.

Teeth without enamel investment; incisors absent; vertebral articulations not complex . . . . NOMARTHRA Gill.

The two known families of the Ganodonta may be defined thus:

Long axis of the second and third lower premolars longitudinal. . . . . .
CONORYCTIDÆ.

Long axis of the second and third premolars transverse . . . . STYLINODONTIDÆ.

The two genera of the Conoryctidæ are distinguished as follows:

Premolars $\frac{3}{3}$ . . . . *Conoryctes.*
Premolars $\frac{4}{4}$ . . . . *Onychodectes.*

The genera of the Stylinodontidæ are:

Crowns of upper canines encased in enamel; canines not growing from persistent pulps; lower incisors faced with enamel; lower molars and premolars rooted, with divided fangs, and enamel-covered crown . . . . *Hemiganus* Cope. Lower Puerco.

Crowns of upper canines with enamel confined to anterior face; canines not growing from persistent pulps; lower incisors surrounded with enamel; lower molars and premolars rooted, with fangs connate, and enamel-covered crowns . . . .
Psittacotherium Cope. Upper Puerco.

Crowns of superior canines with enamel confined to anterior face; canines growing from persistent pulps; lower incisors without enamel; lower molars and premolars with connate fangs; enamel confined to vertical bands on inferior premolars. ....

Calamodon Cope. Wasatch.

Crowns of canines unknown, growing from persistent pulps; all lower teeth rootless, growing from persistent pulps; enamel of all lower molars and premolars confined to vertical narrow bands.........

Stylinodon Marsh. Bridger and Wind River.

Article VII.—PRELIMINARY DESCRIPTION OF A NEW MOUNTAIN SHEEP FROM THE BRITISH NORTHWEST TERRITORY.

By J. A. Allen.

Plates II and III.

Through the kindness of Mr. A. J. Stone, of Missoula, Montana, the Museum has received three mounted specimens of a Mountain Sheep or Bighorn quite unlike any heretofore described. They were collected by Mr. Stone on the headwaters of the Stickeen River, British Northwest Territory, near the Alaskan boundary, at an altitude of about 6500 feet. The species may be described as follows:

Ovis stonei, sp. nov.

Male Adult.—Above gray, formed by an intimate mixture of whitish and blackish brown; face, ears and sides of neck lighter and more whitish, being much less varied with blackish brown; whole posterior area and lower parts from hinder part of back downward and forward, covering the posterior aspect of thighs, and the abdomen, white, the white area narrowing anteriorly and terminating in a V-shaped point on the middle of the chest; also a broad sharply-defined band of white on the posterior surface of both fore and hind limbs, extending from the body to the hoofs, and proximally including also the inner surface; front of neck, from base of lower jaw posteriorly to the white of the ventral surface, including the breast and greater part of the chest, and thence along the sides to the thighs, nearly black; the lateral extension along the flanks becomes narrower posteriorly, and the neck is somewhat grizzled with white (see Pl. II); outer surface of both fore and hind limbs blackish brown, either uniform or in some specimens varied with a slight mixture of whitish; back of head with a broad area of black, narrowing posteriorly and continuing to the tail as a well-defined blackish dorsal stripe; tail wholly deep black, except a few white hairs on the middle of its lower surface; a narrow blackish chin bar, varying in breadth and distinctness in different individuals; hoofs black; horns light brown.

Measurements (of type, ♂ ad.).—(Measurements from mounted specimens, taken with a tapeline and following the curvatures of the parts measured.)

Tip of nose to base of tail, 1676 mm.; tail vertebræ, 89; tail to end of hairs, 121; tip of nose to eye, 197; tip of nose to base of ear, 305; length of horn (over convexity), 762; distance between points of horns, 552; circumference of horn at base, 324; circumference of horn at middle, 216; circumference of front hoof at base, 190.

This species is based on three males, of the ages respectively of 2, 5 and 6 years. The older specimen is taken as the type. On this the dark areas are blacker, and on some parts less varied with whitish tipped hairs than in the others, especially the two-year-old.

This species differs from *Ovis dalli* in the prevailing coloration being either dark gray or blackish brown, according to the area in question (see Pl. II), instead of being "a nearly uniform dirty-white color." In *O. stonei* the white is restricted to definite, sharply defined areas, in strong contrast with the adjoining parts. *O. stonei* and *O. dalli* apparently agree in size and in the character of the horns.

O. stonei agrees in a general way in pattern of coloration with *O. cervina* (Desm.), but the 'umber brown' or 'wood-brown' of the latter is everywhere replaced in *O. stonei* with blackish brown or black. It is also a much smaller animal, and the horns are slenderer and have a more outward curvature at the tips.

The following table gives comparative measurements of two specimens of *O. dalli* (from True, in Nelson's 'Report upon Nat. Hist. Coll. made in Alaska,' 1887, p. 283), of two specimens of *O. stonei* and of two specimens of *O. cervina* from Montana, all from mounted adult male specimens, and therefore comparable.

	O. CERVINA.[1]	O. CERVINA.[2]	O. STONEI.[2]	O. STONEI.[2]	O. DALLI.[1]	O. DALLI.[1]
Tip of nose to base of tail........	1854	1854	1676	1626	1626	
Tip of nose to eye..............	229	228	197	194	178	
Tip of nose to base of ear........	330	340	305	318	292	
Length of horn over convexity....	775	867	762	837	838	648
Circumference of horn at base....	444	400	324	330	293	312
Circumference of hoof at base....	267	205	190	190	211	

[1] From True, *l. c.*
[2] From specimens in Am. Mus. Nat. Hist.

Mr. Stone took measurements of the animals before skinning, but they are unfortunately not available at this writing. He also has separate skulls, which he will later forward for examination, when it will be possible to give some further particulars respecting this interesting species.

I am indebted to Mr. Stone, in whose honor the species is named, for the following observations.

"The three animals were killed in the Che-on-nee Mountains, British Northwest Territory. These mountains are a part of the interior of the Coast Range, drained by the headwaters of the Stickeen River, and not far from Alaska Territory.

"The timber line in this country extends only to a height of about 2500 feet, giving the mountain ranges the appearance of being quite high, but in reality there are no high mountains in this section of the Coast Range.

"The only specimens of this Sheep I had the opportunity of studying were the males, which I found during the months of August and September in the most rugged parts of the mountains, entirely above timber line. I often found them singly, and at no time did I discover more than five in one bunch, though one of my party reported having seen eleven together. I saw perhaps fifty head, and secured twelve specimens. I was very careful in my study of these interesting animals, and I found them to be very uniformly marked, both in color and general characteristics.

"The youngest of the three, now in the Museum, was secured Aug. 8, 1896, in a very deep and rocky cañon just at the base of one of the highest peaks in this part of the mountains. At the time I discovered him he was all alone carefully making his way down the cañon, and from what I afterwards learned I am very much inclined to believe he was then in quest of the ewes, lambs, and yearlings in the edge of the timber further down the mountain side, and it is quite likely that he had not yet regularly taken up the company of the older rams.

"The two older specimens were taken Aug. 10, about five miles distant from the first, and were the only ones in the bunch. I watched them an entire afternoon before killing them. They passed the time alternately nibbling at tiny bits of grass occasionally seen peeping from crevices in the rocks, and playing or lying down on patches of snow and ice. They were very fat.

"Specimens taken two months later possessed the same markings, but were somewhat darker."

Mr. Stone is familiar with *Ovis dalli*, which he reports as occurring some two hundred and fifty miles north of the locality where he obtained the present examples of *O. stonei.*

DESCRIPTION OF PLATES II AND III.

PLATE II.—*Ovis stonei*, ♂ ad.

PLATE III.—Fig. 1, head of *Ovis stonei*, ♂ ad. (same specimen as figured in Pl. II).

Fig. 2.—Head of *Ovis cervina*, ♂ ad., from Montana, for comparison with Fig. 1. The Montana specimen is probably somewhat older than the specimen of *Ovis stonei* shown in Fig. 1, but probably the difference in age is not great.

Both heads are photographed to the same scale.

OVIS STONEI, sp. nov.

Fig. 1.

Fig. 2.

Fig. 1. OVIS STONEI, sp. nov.
Fig. 2. OVIS CERVINA (Desm.)

Both figures photographed to same scale

Article VIII.—ON A SMALL COLLECTION OF MAMMALS FROM PERU, WITH DESCRIPTIONS OF NEW SPECIES.

By J. A. Allen.

A small collection (28 specimens) of mammals collected for this Museum by Mr. O. T. Baron, the well-known ornithological collector, contains 12 species, several of which are apparently new, while others are of interest from the localities represented. The collection was made in northwestern Peru, mostly not far from Cajabamba, at altitudes varying from 4000 to 10,500 feet.

1. Vespertilio oxyotus *Peters.*—One specimen, ♂ ad., Santiago, alt. 10,500 feet, April 9, 1895.

2. Molossus nasutus *Spix.*—Four specimens, all adult females, Guayabamba, alt. 6000 feet, Sept. 24, 1894.

3. Vampyrops lineatus (*Geoffr.*).—Five specimens, two males and three females, all adults, Guayabamba, alt. 6000 feet, Sept. 20–27, 1894. The males are slightly larger than the females.

4. Sciurus (Microsciurus) peruanus, sp. nov.

Ears small; tail narrow; premolars $\frac{1}{1}$.

Above, in general effect, dusky olivaceous, the hairs being blackish brown, minutely tipped with olivaceous, and on the head with yellowish rufous; sides of nose and chin buffy gray; throat gray, passing into yellowish rufous on the breast and abdomen; inside of limbs rusty gray; limbs externally, including feet, dark brown, punctated with rusty; ears within and on the anterior border brown tinged with rusty, the extreme tip posteriorly yellowish, passing into whitish on the back of the ear towards the base, with a prominent postauricular spot of fluffy white hair; tail above dark reddish brown centrally, the hairs broadly tipped with yellowish white and subapically broadly ringed with black; below the tail is, superficially, blackish, washed with whitish.

Total length (from skin), 280; head and body, 130; tail vertebræ, 110; tail to end of hairs, 150; ear from notch, 11; hind foot, 38. Collector's measurements: Head and body, 130; tail (vertebræ?), 130; hind foot, 40.

Skull.— Total length, 36; basal length, 29.5; greatest zygomatic breadth, 21.3; least interorbital breadth, 13; length of nasals, 9.

Type, and only specimen, No. $\frac{11816}{10108}$, ♀ ad., Guayabamba, alt. 4000 feet, Sept. 8, 1894; O. T. Baron.

This species belongs to the *Microsciurus* group, characterized by small size and very convex skull. It differs from my *S.* (*M.*) *alfari*, from Costa Rica, in its much more olivaceous coloration, shorter and broader nasals, longer anterior palatine foramina, and much larger audital bullæ. It is of course related to *S. chrysuros* Puch.,[1] from Santa Fé de Bogota, and to *S. pusillus* Desm., from Cayenne, from which, however, it is apparently separable.

5. Ichthyomys stolzmanni *Thomas.*—One specimen, ♂ ad., Cajabamba, alt. 9000 feet, Jan. 17, 1895.

The type locality of *I. stolzmanni* is Chanchamayo, near Tarma, Peru, at an altitude of about 3000 feet, about 250 miles southeast of Cajabamba, and at an elevation some 6000 feet lower. The present specimen, however, appears to agree in all respects with Mr. Thomas's description of *I. stolzmanni*.

6. Mus musculus *Linn.*—Nine specimens—5 from Cajabamba and 4 from Cajamarica. The Cajabamba specimens are all strongly tinged with rusty buff; the others are more like ordinary house mice. The fulvous Cajabamba specimens may be referable to the fulvous form of the House Mouse common in southern Europe and northern Africa, first described by Waterhouse (P. Z. S., 1837, p. 19), as *Mus brevirostris* (from Maldonado, Uruguay), and later (1872) by Fischer as *Mus musculus* var. *flavescens*—the name *flavescens*, however, being preoccupied. (*Cf.* Barret-Hamilton, Zoölgist, May, 1896, pp. 178–181.)

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[1] Pucheran described (Rev. de Zool., VIII, 1845, pp. 336, 337) two species from Bogota, Colombia, one of which (*S. rufoniger*) is said to be of the size of the Guerlinguet, or *S. æstuans*, and the other (*S. chrysuros*) as being much smaller. There is no doubt of the latter being referable to *Microsciurus;* the former is possibly referable to the *S. æstuans* group, although Dr. Trouessart treats them as synonymous, adopting the name *chrysuros* for the species, although occurring one page later than *rufoniger*, in consequence of the name *rufoniger* being preoccupied by a *Sciurus rufonigra* of Gray (Ann & Mag. Nat. Hist., X, 1842, p. 263), given three years earlier to an Indian species. According to the measurements given by Alston (P. Z. S., 1878, p. 954), on the authority of Prof. A. Milne-Edwards, the *S. rufoniger* of Pucheran seems likely to prove a member of the *S. æstuans* group, and as such probably separable, at least subspecifically, from true *S. æstuans*, the type locality of which is Surinam. An examination of the skull would quickly determine the point, *Microsciurus* having the premolars $\frac{2}{1}$ and *S. æstuans* having them $\frac{1}{1}$.

7. Akodon olivaceus (*Waterh.*).—One specimen, ♀ ad., Guayabamba, alt. 5500 feet, Aug. 30, 1894.

8. Oryzomys stolzmanni *Thomas*.—One specimen, ♂ ad., Guayabamba, alt. 5000 feet, Aug. 8, 1894.

9. Oryzomys, sp. nov.—One specimen, ♀ juv., Limabamba, alt. 8000 feet, Dec. 24, 1894.

This specimen I have no doubt represents an undescribed species, but it is too immature to be taken as a type, the last molar just appearing in sight. Externally, with its silver white feet and hairy sharply bicolor tail, it has very much the appearance of a *Peromyscus*. The upper parts are dark grayish brown, slightly washed with pale yellowish; under surface clear grayish white, rather sharply separated on the sides from the color of the upper surface. Soles naked. The tail is decidedly longer than the head and body, the collector's measurements from the fresh specimen being, head and body, 65 mm.; tail, 80; hind foot, 22. The skull (imperfect) and dentition show it to be an aberrant species of *Oryzomys*, perhaps of the *Thomasomys* group.

10. Oryzomys baroni, sp. nov.

Above yellowish brown, mixed with many blackish tipped hairs; sides paler and more grayish; below clear whitish gray, the hairs plumbeous at base, the basal portion slightly tinging the surface; fore limbs grayish brown to the base of the toes, which are lighter; lower portion of tarsus dusky, metapodials and toes dull soiled whitish; ears rather large, clothed thinly on both surfaces with short fine hairs, brown externally, slightly rufous internally; tail brown, nearly concolor, being barely lighter below, clothed with fine short hairs, too sparse to conceal the annulations. Mammæ, 1 pectoral, 1 abdominal = 4; only 3 functionally developed in the present specimen.

Length of type (♀ ad.), measured by the collector in the flesh: Total length, 290; head and body, 130; tail, 160; hind foot, 30 mm. Ear from notch, 18 (from dry skin).

Skull.—Cranial portion rather flat; facial portion broad, with very broad nasals; supraorbital and cranial ridges well developed, forming raised beads; palatal floor extending but slightly behind the last molar, but in other respects the skull and dentition are nearly as in typical *Oryzomys*, including tooth pattern. Total length, 35; basal length, 30; zygomatic breadth, 17.5; interorbital breadth, 11 ; length of nasals, 13.5 ; width of nasals at middle, 5.5 ; interparietal, 10 x 3 ; length of interpterygoid fossa, 10.3 ; palatine length, 15 ; length of the anterior palatine foramina, 7 ; upper molar series, 5.3 ; diastema, 9 ; length of lower jaw (from inner base of incisors to posterior border of condyle), 19 ; from tip of incisor to condyle, 22.3 ; height of lower jaw at condyle, 8.6 ; height of ramus at m_1, 5.

Type, No. $\frac{11880}{10112}$, ♀ ad., Malca Cajabamba, alt. 8000 feet, April 27, 1894 ; collected by Mr. O. T. Baron, for whom the species is named.

This species is based on two specimens—the type, a very old female, with the teeth much worn, and a female 'young adult,' with the teeth wholly unworn. This differs from the type only in being somewhat smaller, and is obviously not quite fully grown. Both are from the same locality.

This species is nearly related to *Oryzomys xanthæolus* Thomas, from Tumbez, North Peru, from which it differs in being much larger, and in being less yellow.

11. **Sigmodon peruanus**, sp. nov.

Above pale ashy gray, grizzled with darker ; middle of lower back slightly brownish ; sides of head (cheeks) pale buffy, forming a well-marked area ; fore limbs like the cheeks ; hind limbs pale buffy gray, like adjoining parts of body ; lower parts pale yellowish gray, basal two-thirds of hairs plumbeous ; fore and hind feet yellowish gray ; ears large, hairy, in color like surrounding pelage ; tail unicolor, pale yellowish gray-brown, quite hairy, the hairs concealing the annulations.

Total length, 245 mm.; head and body, 150 ; tail, 95 ; hind foot, 31 (collector's measurements, taken in the flesh). Ear from notch, 18 (from dry skin).

Skull massive, very heavy in all parts, short and broad ; zygomatic arches very stout and greatly expanded ; nasals short and broad ; anterior palatine foramina very short. (Bullæ, basioccipital and pterygoid plates broken away.) Total length, 36 ; basal length, ? ; zygomatic breadth, 23 ; interorbital breadth, 6.3 ; width of brain-case, 15.5 ; length of nasals, 12.5 ; palatal length, 16.5 ; anterior palatine foramina, 7.4 ; upper tooth row, 6.5.

Type (and only specimen), No. $\frac{11818}{10110}$, ♀ ad., Trujillo, Peru, May 25, 1895 ; Mr. O. T. Baron.

The single specimen on which this species is based is an old female, with the teeth much worn, taken at Trujillo, Peru, at an elevation of 200 feet, "in brush, near water." The teeth are too much worn to show distinctly the enamel pattern.

This species is widely distinct from any other known form of *Sigmodon*, especially in the character of the skull, which is broad and short, and very massive, with the zygomata very heavy and widely spreading. In skull characters it is nearest to *S. fulviventer* Allen, but the peculiar cranial features shown in this species—a short, broad, heavily-ossified skull—are all greatly emphasized in *S. peruanus*. It has also an exceptionally short tail, and is peculiar in the pale gray tint of the general coloration above.

The species is of further special interest on account of its extending the known range of the genus so far down into South America. Trujillo is on the coast, in about S. lat. 8°.

12. **Metachirus nudicaudatus** (*E. Geoffr.*).—One specimen, ♀ ad., Guayabamba, alt. 5500 ft., Aug. 30, 1894.

Article IX.—DESCRIPTION OF A NEW SPECIES OF SIGMODON, FROM BOGOTA, COLOMBIA.

By J. A. Allen.

For the opportunity of examining the material on which this species is based I am indebted to the kindness of Mr. Oldfield Thomas, Curator of Mammals in the British Museum, who has not only placed it at my disposal for study, but has also presented several of the duplicates to this Museum.

Sigmodon bogotensis, sp. nov.

Similar in coloration to *S. borucæ*, but it is darker and larger, and differs notably in cranial characters.

Above yellowish brown strongly grizzled with blackish, the hairs being blackish plumbeous basally and tipped with yellowish brown, the tipping short over the middle region, much longer on the sides, which are lighter and more strongly yellowish brown than the back; below pale buffy gray, the hairs darker beneath the surface; ears dark brown, thickly clothed with short hairs on the inner margin, nearly naked externally; tail dark brown, a little lighter on lower surface, hairy, but the hairs so thinly scattered as not to conceal the annulations; feet buffy gray, the dusky basal portion of the hairs often showing at the surface.

Measurements (approximate, from skins).—Total length, 273; head and body, 173; tail, 100; hind foot, 33; ear from notch, 16.5.

Skull.—Total length, 36; basal length, 32; palatal length, 17.0; length of nasals, 14; length of anterior palatine foramina, 8; width of nasals anteriorly, 4, posteriorly, 2.5; zygomatic width, 21; width of brain-case, 15; least interorbital width, 6.1; length of upper tooth row, 6.1.

Type, "G. D. C. 265," ♂ ad., British Museum; Plains of Bogota, Colombia, Dec. 6, 1895; G. D. Child.

This species is based on a series of 11 specimens, collected on the plains east of Bogota, by Mr. G. D. Child. Seven are sexed by the collector as males and three as females, and the sex of one is not indicated; all but one are adults. They were collected at various localities on the east bank of the Magdalena River, opposite Bogota, in October, December, January and April, 1895–'96. The series is very uniform in coloration.

Sigmodon bogotensis finds its nearest known relative in my *S. borucæ*, from Costa Rica, from which it differs in being much larger, considerably darker in coloration, and with a much more hairy tail. As regards the skull, the nasals are broader and less produced and more depressed at the anterior border ; the anterior palatine foramina are shorter, terminating anteriorly farther from the incisors, while their posterior extension is the same in both species ; the outer and inner pterygoid plates are more abruptly divergent, and the interparietal is much narrower antero-posteriorly ; the interorbital region is also broader.

This species is of especial interest as demonstrating the existence of a typical species of *Sigmodon* as far south at least in the elevated interior of northern South America as the plains of Bogota, in Colombia. On the west coast of South America the genus is found to range as far south as northern Peru (see *anteà*, p. 118).

Article X.—THE DECORATIVE ART OF THE INDIANS OF THE NORTH PACIFIC COAST.

By Franz Boas.

It has been shown that the motives of the decorative art of many peoples developed largely from representations of animals. In course of time, forms that were originally realistic became more and more sketchy, and more and more distorted. Details, even large portions, of the subject so represented, were omitted, until finally the design attained a purely geometric character.

The decorative art of the Indians of the North Pacific Coast agrees with this oft-observed phenomenon in that its subjects are almost exclusively animals. It differs from other arts in that the process of conventionalizing has not led to the development of geometric designs, but that the parts of the animal body may still be recognized as such. The body of the animal, however, undergoes very fundamental changes in the arrangement and size of its parts. In the following paper I shall describe the characteristics of these changes, and discuss the mental attitude of the artist which led to their development.

In treating this subject, we must bear in mind that almost all the plastic art of the Indians of the North Pacific Coast is decorative art. While some primitive people—for instance, the Eskimo—produce carvings which serve no practical ends, but are purely works of art, all the works of the Indian artists of the region which we are considering serve at the same time a useful end; that is to say, the form of the object is given, and the subject to be represented is more or less subordinate to the object on which it is shown. Only in the cases of single totemic figures is the artist free to mould his subject without regard to such considerations; but, owing to the large size of such figures, he is limited by the cylindrical form of the trunk of the tree from which he carves his figures. We may therefore say that the native artist is in almost all his works limited by the shape of the object on which he represents his subject.

The plastic arts of the Indians are carving and painting, in which latter we may include tattooing and weaving. Carving is done mostly in wood, but also in stone and horn. It is either in the round, in bas-relief, or, although more rarely, in high relief. There is no art of pottery.

The artists have acquired a high technique, which proves that realistic representations of animals are not beyond their powers. The following are a few exquisite examples of realistic carvings. The helmet (Fig. 1) is decorated with the head of an old man affected with partial paralysis. Undoubtedly this specimen must be considered a portrait head. Nose, eyes, mouth, and the general expression, are highly characteristic. The mask (Fig. 2) represents a dying warrior. The artist has represented faithfully the wide lower jaw, the pentagonal face, and the strong nose of the Indian. The relaxing muscles of the mouth and tongue, the drooping eyelids, and the motionless eyeballs, mark the agonies of death. The conception is so realistic that the mask creates a ghastly impression. Fig. 3 represents a dancing hat decorated with the design of a seal. Fig. 4 is a small float representing a swimming puffin. Fig. 5 is a rattle in the form of a swimming goose. The characteristic bend of its neck and the characteristic color of head and neck are very true to nature.

In these cases the artist has rendered the form of his model faithfully. The object on which the representation of his model was placed allowed him the use of the figure without any alteration. This is not often the case. Generally the object to be decorated has a certain given form to which the decoration must be subordinated, and the artist is confronted with the problem of how to adjust his subject to the form of the object to be decorated.

Before attempting an explanation of the method adopted by the artist in the solution of this problem, we must treat another aspect of our subject. We must premise that in consequence of the adaptation of the form to the decorative field, the native artist cannot attempt a realistic representation of his subject, but is often compelled to indicate only its main characteristics. In consequence of the distortion of the animal body, due to its adaptation to various surfaces, it would be all but impossible to

Fig. 1.

Fig. 2.

Fig. 3.

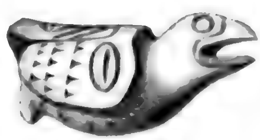


Fig. 4

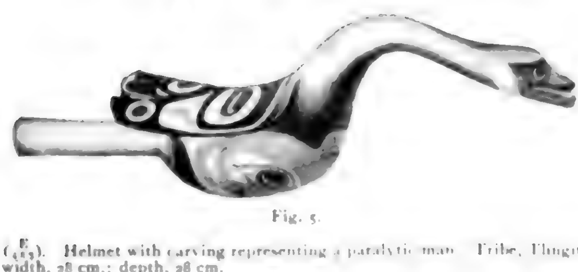


Fig. 5.

Fig. 1 ($\frac{E}{413}$). Helmet with carving representing a paralytic man. Tribe, Tlingit. Height, 21.5 cm.; width, 28 cm.; depth, 28 cm.

Fig. 2 ($\frac{E}{3881}$). Mask representing a dying warrior. Tribe, Tlingit. Height, 24 cm.; width, 19 cm.; depth, 11 cm.

Fig. 3 ($\frac{E}{434}$). Dancing hat representing a seal. Tribe, Tlingit. Height, 21 cm.; width, 24 cm.; depth, 23 cm.

Fig. 4 ($\frac{E}{[illegible]}$). Small float representing a swimming puffin. Tribe, Tlingit. Length, [illegible] cm.

Fig. 5 ([illegible]). Rattle representing a goose. Tribe, Haida. Length, 30 cm.

recognize what animal is meant, if the artist did not emphasize what he considers the characteristic features of animals. These are so essential to his mind that he considers no representation adequate in which they are missing. In many cases they become the symbols of the animal. We find, therefore, that each animal is characterized by certain symbols, and great latitude is allowed in the treatment of all features other than symbols.

I will illustrate this feature of the art of the Indians of the North Pacific Coast by means of a number of characteristic examples.

Fig. 6 is a figure from a totem pole, which represents the beaver. It will be noticed that the face is treated somewhat like a human face, particularly the region around eyes and nose. The position of the ears, however, indicates that the artist intended to represent an animal head, not a human head. While the human ear is represented, in its characteristic form, on a level with the eye (Figs. 26 and 28), animal ears are indicated over the forehead ; that is to say, approximately in the position in which they appear in a front view of the animal. Their characteristic shape may be seen in Figs. 6 and 7, and in many others. While the ears characterize the head as that of an animal, the two large incisors serve to identify the rodent *par excellence*,—the beaver. The tail of the animal is turned up in front of its body. It is ornamented by cross-hatching, which is intended to represent the scales on the beaver's tail. In its fore paws it holds a stick. The large incisors, the tail with cross-hatching, and the stick, are symbols of the beaver, and each of these is a sufficient characteristic of the animal.

Fig. 7 is another representation of a beaver from a totem pole. It resembles Fig. 6 in all details, except that the stick is missing. The beaver is simply holding its fore paws raised nearly to its chin. There are other carvings in which the beaver is shown with four or five toes, but the symbols described here never vary.

In Fig. 8, which is the handle of a spoon, we find only the first of the symbols of the beaver represented, namely, its incisors. Only the head and the fore paws of the animal are shown; and in its mouth are indicated an upper and a lower pair of incisors, all the other teeth being omitted. There is nothing except the teeth to indicate that the artist intended to represent the beaver.

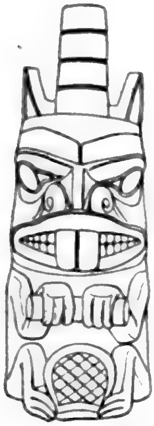


Fig. 6.

Fig. 7.

Fig. 8.

Fig. 6 (1/1). Lowest figure from model of a totem pole, carved in slate, representing a beaver. Tribe, Haida. Height, 22.5 cm.

Fig. 7 (1/1). Lowest figure from model of a totem pole, carved in slate, representing a beaver. Tribe, Haida. Height, 19 cm.

Fig. 8 (1/1). Handle of a spoon made of mountain-goat horn, design representing a beaver. Tribe, Tlingit. Length of handle, 8 cm.

Fig. 9 is the front of a dancing head-dress, which is attached to a framework made of whalebone, and set on top with bristles of the sea-lion. To the back is attached a long train of ermine skins. The outer side of the carved front is set with abalone shells. The squatting figure which occupies the centre of the front represents the beaver. The same symbols which were mentioned before will be recognized here. The face is human ; but the ears, which rise over the eyebrows, indicate that an animal is meant. Two large pairs of incisors occupy the centre of the open mouth. The tail is turned up in front of the body, and appears between the two hind legs, indicated by cross-hatching. The fore paws are raised to the height of the mouth, but they do not hold a stick. It will be noticed that on the chest of the beaver another head is represented, over which a number of small rings stretch towards the chin of the beaver. Two feet, which belong to this animal, extend from the corners of its mouth towards the haunches of the beaver. This animal represents the dragon-fly, which is symbolized by a large head and a slender segmented body. In many representations of the dragon-fly there are two pairs of wings attached to the head. The face of this animal resembles also a human face ; but the two ears, which rise over the eyebrows, indicate that an animal is meant. Combinations of two animals of this sort are found very frequently, a smaller figure of one animal being represented on the chest of a larger carving. Examples of this kind will be seen in Figs. 13 and 17.

Fig. 10 is a halibut-hook, the point of which is carved with a design of the sculpin. The symbols of the fish are fins and tail. Those of this species of fish are two spines rising over its mouth, and joined dorsal fins. In this figure the sculpin is represented swallowing a fish, the tail of which protrudes from its mouth. The two spines appear immediately over the lips, their points being between the two eyes, which are represented by two circles with small projections. The two pectoral fins are indicated in bas-relief over the eyes. The joined dorsal fins extend from the eyes upward toward the narrowest part of the body. The tail of the animal extends toward the place where point and shank of the hook are bound together by means of a strip of spruce root.

The same animal is represented in a slightly different way in Fig. 11, which represents the lower portion of a totem pole. The lowest figure is probably the sun, or perhaps a starfish. Its arms extend upward, and are being bitten by a sculpin, which latter is shown with its head downward, its back forward, and its tail extending upward. The head will be easily recognized. Two crescent-shaped ornaments above the corners of the mouth represent the gills of the fish. Above these are seen the pectoral fins. On the level of the pectoral fins toward the middle appear the symbols of the sculpin, namely, the two spines, the lower portions of which are decorated with small human faces. The eye is represented under the spine. The dorsal fin commences at the height of the eyes, and finally merges into the tail. The tail end of the fish is clasped by a human figure, which appears cut in two by the fish tail. This carving is also characterized by two symbols,—the two spines and the joined dorsal fins.

Fig. 9.

Fig. 10.

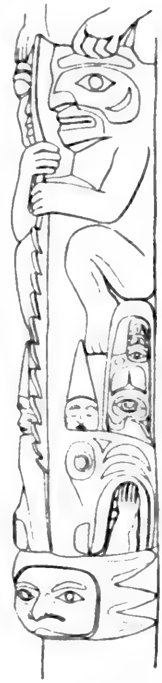


Fig. 11.

Fig. 9 (16/[illegible]). Head-dress representing a beaver. The dragon-fly is shown on the chest of the beaver. Tribe, Haida. Height 18 cm.

Fig. 10 (E/1181). Halibut-hook with design representing a sculpin swallowing a fish. Tribe, Tlingit. Length of point, 26.5 cm.

Fig. 11 (16/[illegible]). Part of a totem pole with design representing a sculpin. Tribe, Tsimshian. Height from base to tip of tail, 220 cm.

Fig. 12 represents a legging made of blue cloth with a red cloth appliqué of the figure of a sculpin. The sides of the legging are trimmed with leather fringes. The general shape of the fish will be easily recognized. Its teeth are represented by buttons of abalone shells, which are sewed on the cloth. The eyes and the dorsal fin are indicated in the same manner. Two small triangles cut out to the right and left of the mouth represent the gills. Immediately over the eyes, and extending toward the middle of the back, we find the two spines, indicated by two slender triangular pieces of red cloth cut out in their middle part. The pectoral fins are indicated by two broader pieces of red cloth extending from the eyes outward and upward toward

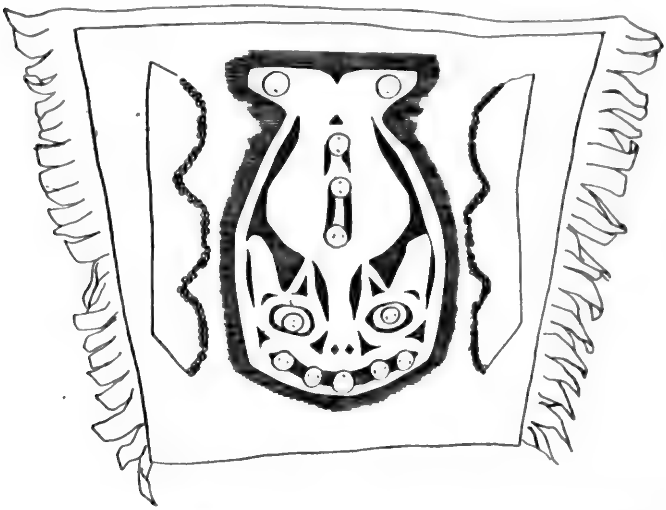


Fig. 12 ($\frac{16}{328}$). Woollen legging with an appliqué design representing a sculpin. Tribe, Haida. Length, 28.5 cm.; greatest width, 31 cm., 38 cm. with fringes.

the margin of the body of the fish. The dorsal fin is indicated by the long slits along the back of the animal. In this case the species is best characterized by the two spines which appear over the eyes.

In Figs. 13–16 I give a selection of carvings representing the hawk. The hawk is symbolized by an enormous hooked beak, which is curved backward so that its slender point touches the chin. In many cases the face of the bird is represented as that of a human being. In this case the nose is given the shape of the symbol of the hawk. It is extended in the form of a beak, and drawn back into the mouth, or merged into the face below the lower lip.

Fig. 13 is the front of a head-dress, which is used like the one described before (Fig. 9). The upper, larger face is that of the hawk. The face is human; but the ears, which rise over the eyebrows, indicate that an animal is meant. The body of the animal is exceedingly small, and is hidden behind the smaller, lower face. Its outlines are seen under this face, in the middle of the lower edge of the carving. It is not quite certain whether the two

Fig. 13.

Fig. 14.

Fig. 15.

Fig. 16.

Fig. 13 ($\frac{16}{[illegible]}$). Head-dress representing a hawk. Tribe, Tsimshian. Height, 20.5 cm.; width, 18.5 cm.

Fig 14 ($\frac{16}{[illegible]}$). Handle of a spoon made of mountain-goat horn: lowest figure representing a hawk; upper figure representing a man holding a dragon-fly. Tribe, probably Tsimshian. Length of carved part of handle, 10 cm.

Fig. 15 ($\frac{E}{1371}$). Rattle with design of a hawk. Tribe, Tlingit. Height without handle, 17 cm.

Fig. 16 ($\frac{16}{[illegible]}$). Dish made of mountain-sheep horn Tribe, Tlingit. Greatest length, 26 cm.

wings, which are grasped by the arms, are those of the hawk, or whether they belong to the face which is carved on the body of the bird. It will be noticed that over the arm, which is grasping the wing, another wing is carved. Possibly this carving is intended to represent the wing of the hawk, while the central raised wing is that of the being holding the two central wings.

Fig. 17 ($\frac{16}{240}$). Head-dress representing an eagle bearing a frog on its chest. Tribe, Tsimshian. Height, 19 cm.; width, 15 cm.

Fig. 14 is the handle of a spoon, on which is represented the head of a hawk, symbolized by its beak. The top of the spoon represents a man who is holding a small animal with a segmented body, which may represent the dragon-fly, although the head seems rather smaller than we are accustomed to see in representations of the dragon-fly.

In Figs. 15 and 16 the same symbols of the hawk will be recognized.

Fig. 17, the front of a head-dress representing the eagle, is very similar to the preceding series; but it differs from these carvings in that the beak of the bird is not turned back so as to touch the face, but ends in a sharp point extending downward. The wings of the eagle are shown extending from the margin of its body inward. The feet are seen at the sides of the lower margin of the carving, under the wings. On the body of the eagle a rather realistic carving of a frog is shown. The characteristic difference between the eagle and the hawk will also be noticed in the painting on a drum (Fig. 63), in which also the beak ends in a sharp point directed downward, and not turned back toward the face.

Figs. 18 and 19 are representations of the killer-whale. In the rattle (Fig. 18) the form of the whale will be easily recognized. Its tail is bent downward. The large head, one of the characteristic features of the whale, is much more pronounced in this than in the next figure. The eye appears on the front part of the rattle. Under the eye we see the large mouth, which is set with a number of curved spines. They are intended to represent the teeth.

Immediately behind the mouth, on the lower part of the carving, we find the flippers. The painted ornament, which has the form of a small face, in front of the huge dorsal fin, is intended to represent the blow-hole. We find in this specimen a fuller series of the symbols of the whale (namely, a large head, a mouth set with teeth, the blow-hole, and a dorsal fin) than in the next specimen (Fig. 19).

In Fig. 19 the whale is painted on a mask so that the head is placed on the left cheek of the face. The back extends over the

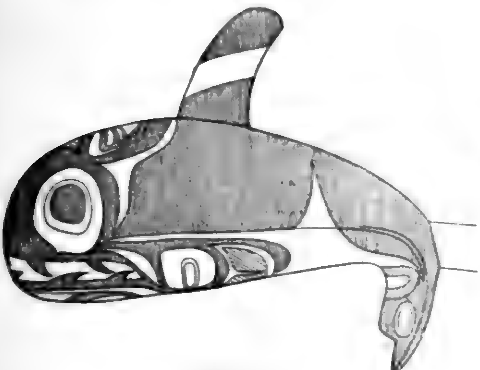


Fig. 18.

Fig. 19.

Fig. 18 ([illegible]). Rattle representing a killer-whale. Tribe, Haida or Tsimshian. Length, 25 cm.

Fig. 19 ([illegible]). Mask with painting representing a killer-whale Tribe, Bella Coola. Height, 28 cm.; width, 20 cm ; depth, 15 cm.

forehead, and the tail is on the right cheek. The whole animal is given the form of a fish whose tail and pectoral fin, or rather flipper, are essential characteristics. The specific characteristic, or the symbol, of the killer-whale, is its large dorsal fin, which rises over the eyebrows. The eye of the animal is indicated by a white spot. Its mouth is open, and is also left uncolored.

The following series (Figs. 20–23) are representations of the shark. Whenever the whole body of this animal is represented, it is characterized by a heterocerc tail, a large mouth, the corners of which are drawn downward, a series of curved lines on each cheek which represent the gills, and a high tapering forehead, which is often decorated with two circles and a series of curved lines similar to those found on the cheeks.

In Fig. 20 we see the upper part of a totem pole, on which a shark is represented devouring a halibut. The head has the characteristic symbols, to which are added here the numerous sharp teeth which are found often, but not regularly, as symbols of the shark. The greater part of the body has been omitted by the artist, since the animal is sufficiently identified by the symbols found on the head ; but under the chin will be noticed the two pectoral fins which identify it as a fish.

Fig. 21 is the handle of a copper dagger on which the mouth with depressed corners, the curved lines on the cheeks, and the ornament rising over the forehead, characterize the shark.

Fig. 22 is a small pipe on which the entire shark is represented. The square end at the right-hand side is the face of the animal, which is shown in front view in the smaller figure. Eyes and mouth are inlaid with abalone shell. On account of the narrowness of the face, the three curved lines generally found on the cheeks are placed under the mouth. The forehead has the characteristic height and tapering shape described before. The opposite end of the pipe shows the heterocerc tail turned upward. On the sides are carved the pectoral fins, which extend over about one-half of the whole length of the sides of the pipe.

Fig. 23 is a copy of a tattooing on the back of a Haida woman. Here we have only the outline of the head of a shark, again characterized by a peculiarly high forehead, the depressed corners of the mouth, and curved lines on each cheek.

Fig. 24 represents a fabulous sea-monster with the head and fore legs of a bear and the body of a killer-whale, but with two or three dorsal fins. Flippers are attached to the fore legs. The head of the specimen shows one of the most characteristic symbols of the bear, namely, the wide mouth set with teeth, the tongue protruding. The large paws are a second symbol of the bear. The sea-monster is also symbolized by the three crescents which are shown behind the corner of the mouth. These are intended to represent gills. We shall find a series of representations of this fabulous monster later on (Figs. 73, 75, 76, and 77).

Fig. 20.

Fig. 21.

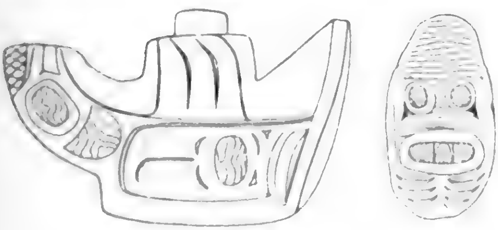


Fig. 22.

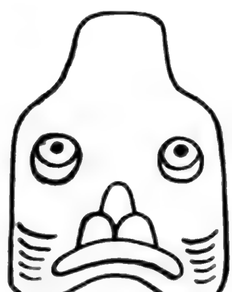


Fig. 23.

Fig. 20 ([illegible]). Part of model of a totem pole carved in slate with design representing a shark surmounted by an eagle. Tribe, Haida. Length of shark figure, 13.5 cm.; width, 6.5 cm.

Fig. 21 ($\frac{E}{2037}$). Handle of a dagger representing the head of a shark. Tribe, Tlingit. Length of handle, 15 cm.; width, 7.5 cm.

Fig. 22 ([illegible]). Wooden pipe, representing a shark. Tribe, Tlingit. Length, 10 cm.; height, 6 cm.; depth, 3 cm.

Fig. 23. Tattooing representing a shark. Tribe, Haida. (From a photograph.)

Let us briefly recapitulate what we have thus far tried to show. Animals are characterized by their symbols, and the following series of symbols has been described in the preceding remarks:

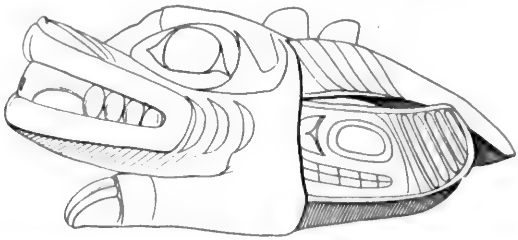


Fig. 24 ($\frac{16}{377}$). Wood carving representing a fabulous monster with a bear's head and paws, and the body of a killer-whale. Tribe, Tlingit. Length, 33.5 cm.; width, 23.5 cm.; height, 13 cm.

1. Of the *beaver:* large incisors, scaly tail, and a stick held in the fore paws.

2. Of the *sculpin:* two spines rising over the mouth, and a continuous dorsal fin.

3. Of the *hawk:* large curved beak, the point of which is turned backward so that it touches the face.

4. Of the *eagle:* large curved beak, the point of which is turned downward.

5. Of the *killer-whale:* large head, large mouth set with teeth, blow-hole, and large dorsal fin.

6. Of the *shark:* an elongated rounded cone rising over the forehead, mouth with depressed corners, a series of curved lines on the cheeks, two circles and curved lines on the ornament rising over the forehead, round eyes, numerous sharp teeth, and heterocerc tail.

7. Of the *bear:* large paws, and large mouth set with teeth, with protruding tongue.

8. Of the *sea-monster:* bear's head, bear's paws with flippers attached, and gills and body of the killer-whale, with several dorsal fins.

9. Of the *dragon-fly:* large head, segmented, slender body, and wings.

So far I have considered the symbols only in connection with their use in representing various animals. It now becomes necessary to inquire in what manner they are used to identify the animals. We have seen that in a number of the preceding cases entire animals were represented, and that they were identified by means of these symbols. When we investigate this subject more closely, we find that the artist is allowed wide latitude in the selection of the form of the animal. Whatever the form may be, as long as the recognized symbols are present, the identity of the animal is established. We have mentioned before that the symbols are often applied to human faces, while the body of the figure has the characteristics of the animal.

Fig. 25 (16/8). Model of a totem pole with three figures representing, from below upward, a sculpin, dog-fish, and sea-monster. Tribe, Haida. Height, 47.5 cm.

We find this principle applied in Fig. 25, which represents a totem pole. Three animals are shown in this carving. Each of these has a human face, to which are added the symbols that characterize the animal. In the top figure the ears indicate that the head represents that of an animal; while the arms, to which the flippers are attached, indicate that the sea-monster (see Fig. 24) is meant. The next figure below represents the shark. It has a human face, and it seems that originally a large lip with a labret was attached to it, which, however, was lost before the specimen came into possession of the Museum. This would indicate that a female shark is represented. Its symbols in this case are the peculiar high ornament which rises over its forehead, and the fins, which are placed under the chin. The face of the lowest figure resembles the faces of the two upper figures very closely. Its body, which is shown under the face, makes it clear that the artist intended to represent a fish; and the two large spines which rise over the eyebrows specify that the figure represents a sculpin.

While in these cases the entire animals have been represented, in others only parts of animals are shown in conventional forms which combine elements of the human form with those of the animal. In other cases the symbols are applied to a purely human face.

Fig. 26 is a human face with human ears. Only the nose indicates that the mask is not intended to represent a human being.

Fig. 26.

Fig. 27.

Fig. 26 ($\frac{E}{1891}$). Mask representing a hawk. Tribe, Tlingit. Height, 21.5 cm.; width, 17.5 cm.; depth, 10 cm.

Fig. 27 ($\frac{E}{337}$). Mask with painting symbolizing the red-winged flicker. Tribe, Tlingit. Height (excluding ears), 25 cm.; width, 20 cm.; depth, 11 cm.

It is strongly curved, and drawn back into the mouth, thus symbolizing that the mask is intended to represent the hawk.

In Fig. 27 we see the face of a woman with a moderately large labret. The ears, as explained before, are those of an animal. The nose, which has been lost, had undoubtedly the form of a bird's beak. Thus the face was characterized as that of a bird. It was specified partly by the form of the beak, but principally by the ornaments painted in red and black on cheeks and fore-head. These represent the feathers of the red-winged flicker.

Fig. 28 is a small carved mask which was worn in front of a headband of swan's down. It represents a human face. In place of the eyebrows we find two rows of circles, which represent the sucking-cups of the squid. By means of this symbol the face is recognized as that of the squid.

Fig 28.

Fig. 29.

Fig. 28 ($\frac{16}{650}$). Small mask with eyebrows, symbolizing the squid. Tribe, Tlingit. Height (excluding hair), 11 cm.; width, 9.5 cm.; depth, [illegible] cm.

Fig. 29 ($\frac{E}{1878}$). Mask with painting symbolizing the killer-whale. Tribe, Tlingit. Height, 18 cm.; width, 15 cm.; depth, 8 cm.

In the same manner the mask (Fig. 29) is identified as the killer-whale by the two black ornaments painted on the left cheek and extending down to the chin. They represent the dorsal fin of the killer-whale.

These symbols are also used as facial paintings by dancers, who are thus recognized as personifying the animal in question, or as belonging to the social group presided over by the animal. At social or religious festivals ceremonies are performed which are in most cases dramatizations of myths, in which the dancer represents either the animal, or the spirit that appeared to his ancestor. In many of the composite masks used on such occasions, the ancestor himself is represented by a small figure placed on the mask, thus indicating that he was carried away by the animal which the dancer personifies. In other festivals, legends are dramatized which refer to the events that took place "before the animals took off their blankets;" that is, at the time when there was no clear distinction between men and animals. In these ceremonies the dancers appear with paintings or other decoration symbolizing the animals. To this class belongs the ornament (Fig. 30), which represents the dorsal fin of a killer-whale, and which is worn attached to the back part of the blanket. These ornaments and paintings are found most extensively among the Kwakiutl tribes.

It appears, therefore, that as, first of all, the artist tried to characterize the animals he intended to represent by emphasizing their most prominent characteristics, these gradually became symbols which were recognized even when not attached to the animal form, and which took the place of representations of the entire animal.

Having thus become acquainted with a few of the symbols of animals, we will next investigate in what manner the native artist adapted the animal form to the object he intended to decorate. First of all, we will direct our attention to a series of specimens which show that the native artist endeavors, whenever possible, to represent the whole animal on the object that he desires to decorate.

Fig. 31 is a club used for killing seals and halibut before they are landed in the canoe. The carving represents the killer-whale. If the principal symbol of the killer-whale, its dorsal fin, were placed in an upright position on the club, the implement would assume an exceedingly awkward shape. On the other hand, the artist could not omit the dorsal fin, since it is the most important symbol of the animal. Therefore he has bent it downward along the side of the body, so that it covers the flipper. The tail of the whale would have interfered with the handle, and for this reason it has been turned forward over the back of the whale, so as to be in close contact with the body.

The distortion of the body has been carried still further in Fig. 32, which is the handle of a spoon, and represents the same

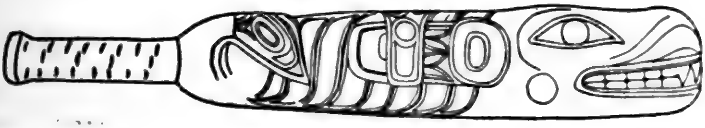


Fig. 31.

Fig. 30.

Fig. 32.

Fig. 30 ($\frac{E}{273}$). **Wood carving representing the dorsal fin of the killer-whale. Tribe, Tlingit. Height, 25 cm.; thickness, 3 cm.**

Fig. 31 ($\frac{E}{242}$). **Fish-club carved to represent the killer-whale. Tribe, Tlingit. Total length, 49 cm.; height, 8 cm.; thickness, 5 cm.**

Fig. 32 ($\frac{16}{1173}$). **Handle of horn spoon with design representing a killer-whale. Tribe, probably Tsimshian. Length of handle, 15 cm.**

animal. The large head of the whale, to which the flippers are attached, will be easily recognized near the bowl of the spoon. The body has been twisted backward so that the tail almost touches the mouth. The carving is only on the back of the spoon, and the two projections just below the mouth will be recognized as the two tips of the whale's tail, which has been split along its lower side and then distended along the back of the spoon. The dorsal fin has thus been brought into a position so as to extend along the handle of the spoon. It is seen projecting upward from the head of the whale, between the legs of the man who forms the tip of the handle.

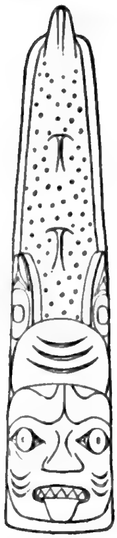


Fig. 33 ($\frac{16}{1187}$). Model of a totem pole representing a shark. Tribe, Haida. Height, 27 cm.; width, 5 cm; depth, 4 cm.

Fig. 33 is a small totem pole representing the shark. The tip of its tail forms the top of the pole, while the face is placed at its lower end. Since most of the symbols of the shark are found on its face, it was necessary to bring the face into such a position as to be seen in front view, but the artist also desired to show the back of the fish. For this reason the head has been twisted around entirely, so that it appears in front view over the back of the fish. In order that the flippers, an important symbol of the fish, might be made visible, they have been pushed backward far beyond the place to which they properly belong.

The speaker's staff (Fig. 34), which also represents the shark, has been distorted in the same manner; but here the head has been turned round entirely, so that it faces the back of the fish. The pectoral fins are shown below the chin.

In Fig. 35, which is a berry-spoon representing a shark, the lower jaw of the animal has been entirely omitted. The flat bowl of the spoon is formed by the palate of the fish, while its back is the lower side of the spoon.

The changes of position and of the relative sizes of parts of the body, which result from such adaptations to the form of the object to be decorated, are still more far-reaching in the following specimens.

Fig. 36 is a shark represented on the top of a totem pole. The head of the animal is shown in the form of a human face with the characteristic symbols. Under the chin are two flippers. The body must be considered turned upward; but it has been shortened so much that only the tail remains, which rises immediately above the face.

In Fig. 37 (a wooden dancing hat) the symbols of the killer-whale are attached to its head. Since the whole body was omitted in this case, it was necessary to remove the symbols from the back to the head. We see the dorsal fin rising over the eyes, and the flippers attached to the head behind the eyebrows.

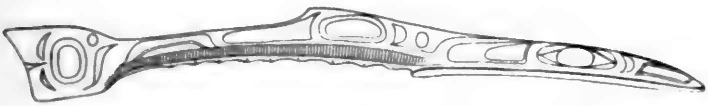


Fig. 35.

Fig. 36.

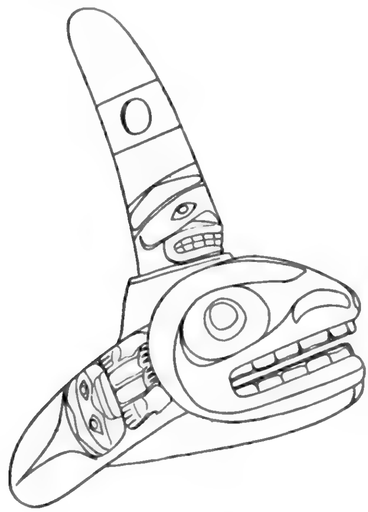


Fig. 37.

Fig. 38.

Fig. 34 ([illegible]). Speaker's staff representing a shark. Tribe, Tlingit. Length, 184 cm

Fig. 35 ([illegible]). Berry-spoon representing a shark. Tribe, Tsimshian. Length, 36 cm.; width, 4.5 cm.

Fig. 36 ([illegible]). Part of a totem pole representing a shark. Tribe, Haida. Height of shark carving, 20 cm ; width, 8.5 cm ; depth, 7.5 cm

Fig. 37 ([illegible]). Dancing hat representing a killer-whale. Tribe, Tsimshian. Total height, 50 cm.; width, 28 cm.; depth, 30.5 cm.

Fig. 38 ([illegible]). Halibut-hook with design representing a beaver. Tribe, Tlingit. Length of point, 32.5 cm.

Fig. 34.

In Fig. 38, which represents a halibut-hook carved with a design of the beaver, we find that the two incisors, the symbols of the beaver, have been moved over to the right side of the animal which is represented on the point of the hook. While in reality only one of the incisors would be visible in this view, the artist, in order to be certain that his idea would be understood, moved the two incisors so as to make both visible. We find that in all these cases the artist has taken great liberty with the form of the animal body, and has treated it so that the symbols become clearly visible. On the whole, we may say that the artist endeavors to represent the whole animal. When this is not possible, all its essential parts are shown. The insignificant ones are often omitted.

We have now to treat a series of peculiar phenomena which result from the endeavor on the part of the artist to adjust the animal that he desires to represent to the decorative field in such a manner as to preserve as far as possible the whole animal, and bring out its symbols most clearly.

Fig. 39 is the top view of a wooden hat on which is carved the figure of a sculpin. The animal is shown in top view, as though it were lying with its lower side on the hat. The dancing hats of these Indians have the forms of truncated cones. To the top are attached a series of rings, mostly made of basketry, which indicate the social rank of the owner, each ring symbolizing a step in the social ladder. The top of the hat, therefore, does not belong to the decorative field, which is confined to the surface of the cone. The artist found it necessary, therefore, to open the back of the sculpin far enough to make room for the gap in the decorative field. He has done so by representing the animal as seen from the top, but split and distended in the middle, so that the top of the hat is located in the opening thus secured.

Fig. 40 represents a dish in the shape of a seal. The whole dish is carved in the form of the animal; but the bottom, which corresponds to the belly, is flattened, and the back is hollowed out so as to form the bowl of the dish. In order to gain a wider rim the whole back has been distended so that the animal becomes inordinately wide as compared to its length. The flippers are carved in their proper positions at the sides of the dish. The hind flippers are turned back, and closely join the tail. A similar method of representation is used in decorating small boxes. The whole box is considered as representing an animal. The front of its body is painted or carved on the box front; its sides, on the sides of the box; the hind side of its body, on the back of the box. The bottom of the box is the animal's stomach; the top, or the open upper side, its back. These boxes, therefore, are decorated only on the sides, which are bent of a single piece of

Fig. 39.

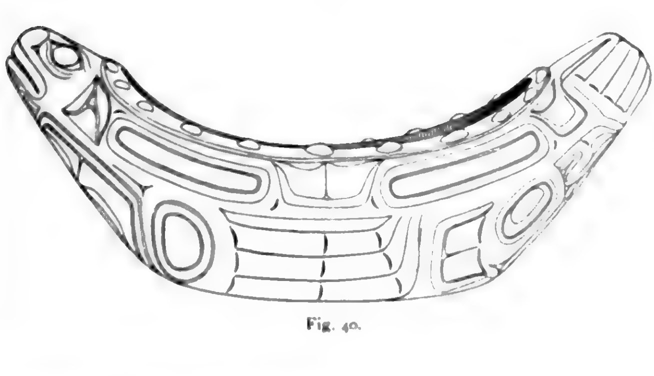


Fig. 40.

Fig. 39 ($\frac{16}{763}$). Dancing hat with design representing a sculpin. Tribe, Haida or Tsimshian. Height, 14 cm; width, 36 cm.; depth, 40 cm.

Fig. 40 ($\frac{E}{1381}$). Grease dish in the shape of a seal. Tribe, Tlingit. Length, 41.5 cm.; width, 21 cm.; depth in centre, 9.5 cm.

wood (Fig. 41). When we unbend the sides we find the decoration extended on a long band, which we may consider as consisting of two symmetrical halves. The centre is occupied by the front view of the animal, the sides by a side view, and the ends by one-half of the hind view at each end of the board. An actual unbending of the sides of the box would not give a symmetrical form; but, since the ends are necessarily sewed at the corner, the hind view of the body will occupy one end.

In the decoration of silver bracelets a similar principle is followed, but the problem differs somewhat from that offered in the decoration of square boxes. While in the latter case the four edges make a natural division between the four views of the animal,—front and right profile, back and left profile,—there is no such sharp line of division in the round bracelet, and there would be great difficulty in joining the four aspects artistically, while two profiles offer no such difficulty. When the tail end of each profile is placed where the ends of the bracelet join, then there is only one point of junction; namely, in the median line of the head. This is the method of representation that the native artists have adopted (Figs. 42, 72, 73, 74). The animal is cut in two from head to tail, so that the two halves cohere only at the tip of the nose and at the tip of the tail. The hand is put through this hole, and the animal now surrounds the wrist. In this position it is represented on the bracelet. The method adopted is therefore identical with the one applied in the hat (Fig. 39), except that the central opening is much larger, and that the animal has been represented on a cylindrical surface, not on a conical one.

An examination of the head of the bear shown on the bracelet (Fig. 42), makes it clear that this idea has been carried out rigidly. It will be noticed that there is a deep depression between the eyes, extending down to the nose. This shows that the head itself must not be considered a front view, but as consisting of two profiles which adjoin at mouth and nose, while they are not in contact with each other on a level with the eyes and forehead. The peculiar ornament rising over the nose of the bear, decorated with three rings, represents a hat with three rings (see p. 144), which designate the rank of the bearer.

We have thus recognized that the representations of animals on dishes and bracelets (and we may include the design on the hat, Fig. 39) must not be considered as perspective views of animals, but as representing complete animals more or less distorted and split.

The transition from the bracelet to the painting or carving of animals on a flat surface is not a difficult one. The same principle

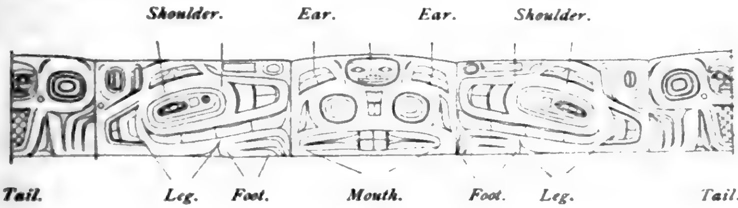


Fig. 41.

Fig. 42.

Fig. 41 ($\frac{16}{883}$). Carving on the sides of a dish representing a beaver. The sides of the dish are bent of a single piece of wood, and are shown here flattened out. Tribe, Tlingit. Length of short sides, 29 cm.; length of long sides, 31.5 cm ; greatest height of sides, 16 cm.

Fig. 42 ($\frac{E}{2372}$). Design on a bracelet representing a bear. Tribe, Nass River Indians. Height, 3.5 cm.

is adhered to ; and either the animals are represented as split in two so that the profiles are joined in the middle, or a front view of the head is shown with two adjoining profiles of the body. In the cases considered heretofore the animal was cut through and through from the mouth to the tip of the tail. These points were allowed to cohere, and the animal was stretched over a ring, a cone, or the sides of a prism. If we imagine the bracelet opened, and flattened in the manner in which it is shown in Fig. 42, we have a section of the animal from mouth to tail, cohering only at the mouth, and the two halves spread over a flat surface. This is the natural development of the method here described when applied to the decoration of flat surfaces.

It is clear that on flat surfaces this method allows of modifications by changing the method of cutting. When the body of a long animal, such as that of a fish or of a standing quadruped, is cut in this manner, a design results which forms a long narrow strip. This mode of cutting is therefore mostly applied in the decoration of long bands. When the field that is to be decorated is more nearly square, this form is not favorable. In such cases

Fig. 43. Painting representing a bear. Tribe, Haida.

a square design is obtained by cutting quadrupeds sitting on their haunches in the same manner as before, and unfolding the animal so that the two halves remain in contact at the nose and mouth, while the median line at the back is to the extreme right and to the extreme left.

Fig. 43 (a Haida painting) shows a design which has been obtained in this manner. It represents a bear. The enormous breadth of mouth observed in these cases is brought about by the junction of the two profiles of which the head consists.

This cutting of the head is brought out most clearly in the painting (Fig. 44), which also represents the bear. It is the painting on the front of a Tsimshian house, the circular hole in the middle of the design being the door of the house. The animal is cut from back to front, so that only the front part of the head coheres. The two halves of the lower jaw do not touch each

Fig. 44.

Fig. 45.

Fig. 4[illegible]

Fig. 44. Painting from a house front representing a bear. Tribe, Tsimshian.

Fig. 45 ([illegible]). Wooden hat painted with the design of a sculpin. Tribe, Haida. Height 17 cm.; width, 41 cm.; depth, 42.5 cm.

Fig. 46 ([illegible]). Hat made of spruce roots painted with the design of a beaver. Tribe, Haida or Tsimshian. Height, 16 cm.; diameter, 36.5 cm.

other. The back is represented by the black outline on which the hair is indicated by fine lines.

In a number of cases the designs painted on hats must also be explained as formed by the junction of two profiles. This is the case in the painted wooden hat (Fig. 45), on which the design of a sculpin is shown. It will be noticed that only the mouth of the animal coheres, while the eyes are widely separated. The spines rise immediately over the mouth. The flippers are attached to the corners of the face, while the dorsal fin is split into halves, each half being joined to an eye.

The beaver (Fig. 46) has been treated in the same manner. The head is split down to the mouth, over which rises the hat with four rings. The split has been carried back to the tail, which, however, is left intact, and turned up towards the centre of the hat. The importance of the symbols becomes very clear in this specimen. If the two large black teeth which are seen under the four rings, and the tail with the cross-hatchings, were omitted, the figure would represent the frog.

In other designs the cut is made in the opposite direction from the one described heretofore. It passes from the chest to the back, and the animal is unfolded so that the two halves cohere along the middle line of the back. This has been done in the Haida tattooings (Figs. 47 and 48), the former representing the raven, the latter the duck. In both the tail is left intact. The duck has been split along the back so that the two halves of the body do not cohere except in their lowest portion, while the two halves of the raven are left in contact up to the head.

Fig. 49 is a dancing apron woven from mountain-goat wool, and fastened to a large piece of leather, the fringes of which are set with puffin beaks. The woven design represents the beaver. Its symbols, the two pairs of incisors and the scaly tail, are clearly represented. While in most carvings and paintings the tail is turned upward in front of the body, it is hanging down here between the two feet. The meaning of the ornaments in the upper part of the apron to the right and to the left of the head are not quite clear to me, but I believe they must be considered as the back of the body split and folded along the upper margin of the blanket. If this explanation is correct, we have to con-

Fig. 47.

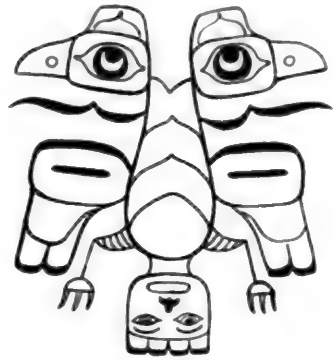


Fig. 48.

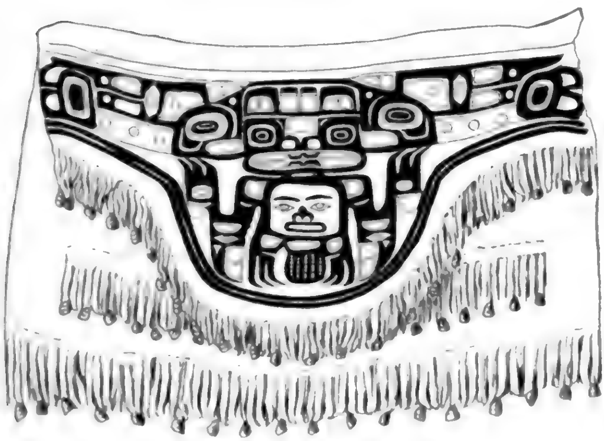


Fig. 49.

Fig 47. Tattooing representing a duck. Tribe, Haida.

Fig. 48. Tattooing representing a raven. Tribe, Haida.

Fig. 49 ([illegible]). Dancing apron woven of mountain-goat wool, design representing a beaver. Tribe, Tsimshian. Height of design, 38 cm.; width, 91 cm.

sider the animal cut into three pieces, one cut running along the sides of the body, the other one along the back.

Fig. 50 is one of a pair of leggings embroidered with quills on a piece of leather. The design, which represents the sea-monster described in Fig. 24, must also be explained as a representation of the animal split along its lower side, and flattened. In the lower portion of the legging the two profiles are seen, which are joined on a level with the eyes, while the two mouths are separated. The nostrils are shown in the small triangle below the line connecting the two eyes. Owing to the shape of the legging, the arms are not attached to the body, but to the upper part of the head. They appear at the right and left margins of the legging,

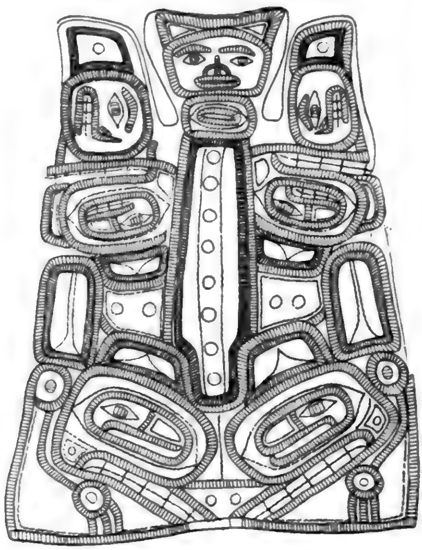


Fig. 50 ($\frac{16}{534}$). Embroidered legging representing a sea-monster with a bear's head and body of the killer-whale. Tribe, Haida. Height, 37.5 cm.; greatest width, 31 cm.

and are turned inward along the lower jaws, the three-toed paws touching the lower margin. The fins, which are supposed to grow out of the upper part of the arms, adjoin the elbows, and are turned upward. Another pair of fins, which do not appear in most representations of this monster, are attached to the upper part of the back, and form the two flaps to the right and left of the upper margin. On the back we see a series of circles, which probably represent the dorsal fins. The tail occupies the centre of the upper margin. The smaller ornaments in the outside corners of the head, adjoining the mouth, probably represent the gills.

Fig. 51 represents a leather legging painted with the design of a beaver squatting on a human head. In this specimen we observe that the proportions of the body have been much distorted owing to the greater width of the legging at its upper part. The head has been much enlarged in order to fill the wider portion of the decorative field.

The gambling leather (Fig. 52) is treated in a similar manner. It represents the beaver, and must probably be explained as the

Fig. 51.

Fig. 52.

Fig. 51 ([illegible]). Painted legging with design representing a beaver sitting on a man's head. Tribe, Haida. Height, 22 cm; greatest width, 19 cm.

Fig. 52 ([illegible]). Gambling leather with engraved design representing a beaver. Tribe, Tlingit. Height, 18.5 cm.; width, 17 cm.

animal cut in two. The symbols—the large incisors and a scaly tail—appear here as in all other representations of the beaver, but the lower extremities have been omitted. It might seem that this design could be explained as well as a front view of the animal, but the deep depression between the two eyes is not in favor of this assumption. The head consists undoubtedly of two profiles, which join at the nose and mouth; but the cut has not been continued to the tail, which remains intact.

In the following figures we find a new cut applied. Figs. 53 and 54 represent the shark. I explained, when discussing the symbols of the shark, that in the front view of the animal the symbols are shown to best advantage. For this reason side views of the face of the shark are avoided, and in representing the whole animal a cut is made from the back to the lower side, and the two sides are unfolded, leaving the head in front view.

The painting (Fig. 53) has been made in this manner, the two halves of the body being entirely separated from each other, and

Fig. 53. Painting representing a shark. Tribe, Haida.

folded to the right and to the left. The heterocerc tail is cut in halves, and is shown at each end turned downward. The pectoral fins are shown unduly enlarged, in order to fill the vacant space under the head.

The shark which is shown in Fig. 54 is treated in a slightly different manner. Again the head is left intact. The cut is made from back to chest, but the two halves of the animal are not separated. They cohere at the chest, and are unfolded in this manner, so that the pectoral fins and dorsal fins appear to the right and left of the body. The heterocerc tail is not clearly indicated in this specimen.

The method of section applied in Fig. 55 is still different. The figure represents a painting on the margin of a large leather blanket. The animal here represented is the killer-whale. The upper painting clearly represents the profile of the animal. The lower painting represents the other profile, so that both the right and the left halves of the animal are shown. Since there was no room for showing the dorsal fin on the lower painting, it is indicated by a curved line on one of the series of wider fringes at the lower margin of the blanket. It is remarkable that the tails in the two halves of the animal are not drawn symmetrically; but it is possible that this is due to a mistake on the part of the painter, because the design is repeated on the opposite margin of the blanket in the same manner, but with symmetrical tails. The two halves of the body differ in details, but their main features are

Fig. 54.

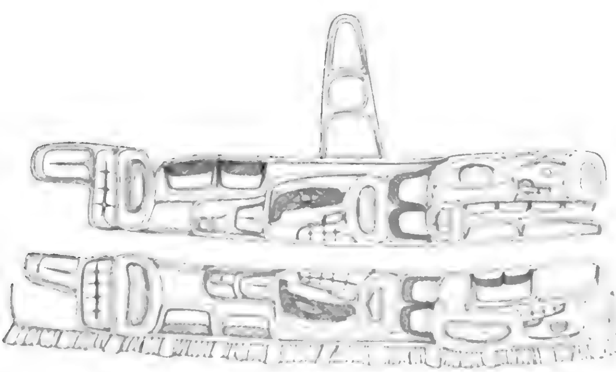


Fig. 55.

Fig. 54 ($\frac{16}{603}$). Slate dish with carved design representing a shark. Tribe, Haida. Diameter, 27.5 cm.; depth, 3.5 cm.

Fig. 55 ($\frac{K}{1807}$). Painting on edge of a blanket representing a killer-whale. Tribe, Tlingit. Length, 124 cm.

identical. The flipper is shown on a very large scale. It is attached immediately behind the head, and extends to a point near the tail. Its principal part is occupied by a face, in front of which an eye is shown.

Animals are represented by means of sections not only on flat surfaces, but also in round carvings in which one side cannot be shown. This is the case on all totem poles, the hind part of which is not carved. Whenever all the symbols of the animal can be shown on the front of the totem pole, the animals are apparently represented in their natural position. But representations of animals, the symbols of which would be placed on the rear side of the totem pole, make it clear that the artist actually splits the animals along the rear of the totem pole, and extends this cut in such a way that the animal is spread along the curved front of the pole. This will become clear by a consideration of the following figures.

Fig. 56 represents a sea-monster with a whale's body and bear's paws. It differs from the monster discussed before in that it has a whale's head, and no fins attached to the fore paws. It has, however, one large dorsal fin. The blow-hole of the whale is shown over its eyebrows. The tail is turned up in front of the body, and the paws are raised in front of the chest. The dorsal fin will be recognized in the narrow strip, ornamented with a small ring, which slants downward from the elbow towards the tail. An ornament of this sort is shown on both sides of the carving. We see, therefore, that the dorsal fin has been split, and is turned down along each side of the body. This shows that the right and left margins of the carved portion of the totem pole must be considered as the medial line of the back, which has been split and pulled apart.

The sculpin shown on the totem pole (Fig. 57) is treated in the same manner, but in this case the cut is made along the lower side of the animal. The head is turned upward, so that the front view of the face is seen when looking down upon the back of the fish. The spines rise over nose and eyebrows. The pectoral fins are shown over the eyebrows on the edge of the carved portion of the pole, while the hind portion of the lower part of the body occupies the upper part of the margin of the pole.

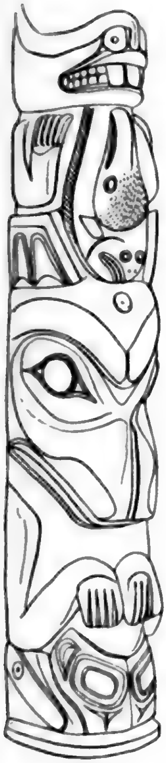


Fig. 56.

Fig. 57.

Fig. 58.

Fig. 56 ($\frac{16}{[illegible]}$). Part of model of a totem pole with design representing a sea-monster. Tribe, Haida. Height of figure, 23 cm.; width, 7.5 cm.; depth, 6 cm.

Fig. 57 ($\frac{16}{[illegible]}$). Part of model of a totem pole with design representing a sculpin. Tribe, Haida. Height of figure, 15 cm.; width, 5.5 cm.; depth, 5.5 cm.

Fig. 58. Part of a totem pole with design representing a sea-monster devouring a fish. Tribe, Haida. Height of figure (excluding ears), 13 cm.; width, 5.5 cm.; depth, 5 cm. *a*, dorsal fin; *b*, fin of forearm; *c*, tail of monster; *d*, paws of monster; *e*, wing of bird.

The exceedingly intricate central figure on the pole shown in Fig. 58 must be explained in the same manner as Fig. 56. We see here the sea-monster described before in Fig. 24. It has a bear's head. In each ear is placed a small human figure the hands of which grasp the eyelid of the monster, which they are lifting. The tail is turned upward in front of the body, immediately over a beaver's head, which is the next lower figure on the column. The dorsal fin has been split, and one-half of it is seen under the mouth of the bear, indicated by a projection which is decorated with a double circle. The fore paws of the animal are raised in front of its chest, and appear under the mouth. The fins which are attached to them are shown to the right and to the left of the tail. The animal is swallowing another being, but it is not clear what animal is meant. A fish-tail and a hand are seen protruding from the mouth. The space between the fore paws and the tail of the sea-monster is occupied by an inverted bird, which will be seen clearly when the figure is reversed. Its head is shown with beak resting between the feet. The two wings are extended, and reach from the fins of the fore arm of the monster to its dorsal fin. The particular point brought out by this figure is the same as that which I tried to make clear in considering Fig. 56; namely, that the two edges of the carved pole must be considered as the extended medial line of the back of the animal that is represented on the pole.

These carvings make it clear that in paintings on hats, such as shown in Figs. 39, 45, and 46, and in flat figures, such as Fig. 12, we must consider the outer rim of the figure as the distended sides of a cut made along the lower side of the animal. All these distortions and sections of animals may be explained by the necessity the artist felt of showing all the symbols of the animal in his works.

In most cases the symbols appear clearly in profiles of animals. For this reason the artist, when representing profiles, has not endeavored to show both sides of the body. I will give here a series of figures illustrating this point.

Fig. 59 represents the top of a box on which is carved the sea-monster Wasku. It has a wolf's head and body, and a large dorsal fin. It is able to hunt in the sea as well as on land. The artist has shown a profile of the animal with one fore leg and one hind leg, the tail curled up over the back. The dorsal fin, which in most representations of this animal stands out vertically from the body, has been laid down along the back in order to fit it into the decorative field.

Fig. 60 is a tattooing representing the sea-monster Tsem'aks, which has a raven's body with a whale's body attached to its head, and a fin attached to the raven's back. It is shown in profile with one leg, the dorsal fin, and the tails of raven and whale twisted around so as to be seen from the side.

Fig. 61 is a tattooing representing the moon. In its lower portion the crescent will be seen. In the dark portion of the moon

Fig. 59.

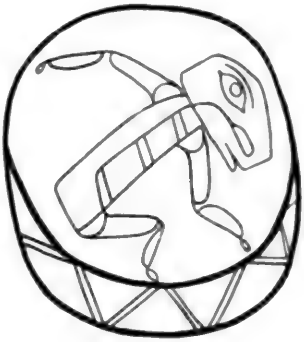


Fig. 61.

Fig. 60.

Fig. 59 ($\frac{1}{6}$). Slate carving representing the sea-monster Wasku. Tribe, Haida. Size, 29.5 x 19.5 cm.

Fig. 60. Tattooing representing the fabulous sea-monster Tsem'aks. Tribe, Haida.

Fig. 61. Tattooing representing the moon. Tribe, Haida.

a semi-human figure is shown in profile, with one leg. One arm is extended downward, and one backward, as though he were lifting a heavy weight.

In Fig. 62, which represents the design on a circular slate dish, we see a good case of the adaptation of a profile to the decorative field. The design represents a killer-whale with two dorsal

Fig. 62 ($\frac{16}{608}$). Slate dish with design representing a killer-whale. Tribe, Haida. Diameter, 41.5 cm.; depth, 6.5 cm.

fins. The animal is bent around the rim of a dish so that the head touches the tail. The two dorsal fins are laid flat along the back, while the large flipper occupies the centre of the dish.

Fig. 63, which is the painting on the head of a drum, is a combination of front and side views. It is a system of representation with which we are familiar in the art of ancient Egypt. Here the head is turned sideways, while the body, the outstretched wings, and the feet are shown in front view. It is found very rarely in the art of the Indians of the North Pacific coast, and, so far as I am aware, almost exclusively in representations of the eagle. The painting on the outer ring of the drum-head is difficult to explain. It will be noticed that the tail of the eagle

Fig. 63.

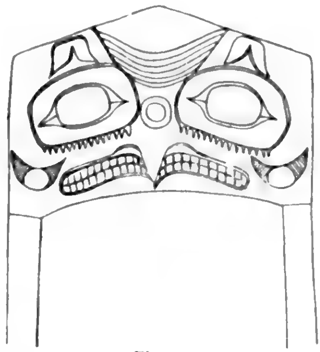


Fig. 64.

Fig. 63 ([illegible]). Drum painted with design of an eagle. Tribe, Tsimshian. Diameter, 58 cm.

Fig. 64 ([illegible]). Carving on the end of a food tray representing a hawk. Tribe, Tlingit. Width, 20 cm.

occupies the lower centre of the ring. On top we see the front view of a human figure, the arms of which are placed near the lower corners of the face, and are of diminutive size, while the hands are of very large size. The two sitting figures below the two hands probably represent the back of the man who is shown on top, but their connection with the peculiar fin-like figures on the lower portion of the painting is not clear.

There are very few designs which can possibly be interpreted as full-face views of animals. I explained before that the face of the shark is always shown in this manner, because its symbols appear best in this position. The only other animal which is painted or carved on flat surfaces in full front view is the hawk or thunder-bird, whose symbol is the long beak which descends to the chin. A number of carvings representing the thunder-bird were given in Figs. 13–16.

We find full-face representations of the thunder-bird very frequently used on dishes, on which the beak is indicated by a long wedge which separates the mouth into two halves. It is, however, not certain whether the artists consider this face always as a full front view, because we often find (Fig. 64) a depression between the two eyes, corresponding to the depression which I described before when referring to the joining of the profiles of animals. It may be that the long central wedge must be considered as the two halves of the long descending beak, which join in the middle.

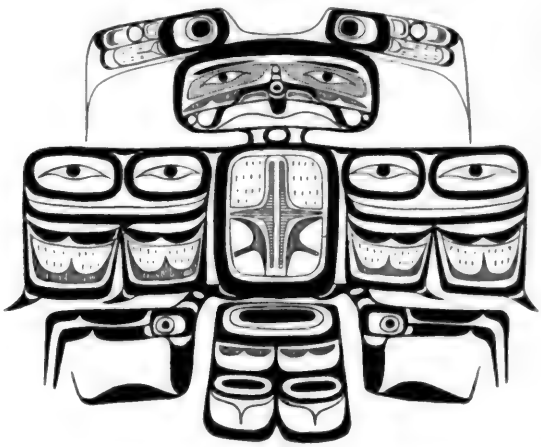


Fig. 65. Painting from front of a house representing a thunder-bird. Tribe, Kwakiutl.

It might be expected, however, that in this case the beak would, at least sometimes, be carried on outward to the right and to the left below the chin, corresponding to one-half of the beak seen in Fig. 13. I have not observed a single specimen in which this is the case, and therefore I am rather inclined to consider the carvings of thunder-birds on dishes as full front views.

This ornament may have originated in the following manner: Many grease and food dishes have the form of canoes. The canoe symbolizes that a canoe-load of food is presented to the guests; and that this view is probably correct is indicated by the fact that the host in his speeches often refers to the canoe filled with food which he gives to his guests. The canoe form is often modified, and a whole series of types can be established forming the transition between canoe dishes and ordinary trays. Dishes of this sort always bear a conventionalized face at each short end, while the middle part is not decorated. This is analogous to the style of the decoration of the canoe. On the whole the decoration of the canoe is totemistic. It may be that it is only the peculiar manner in which the beak of the hawk is represented which has given rise to the prevalence of this decoration. The upper jaw of the hawk is always shown so that its point reaches the lower jaw and turns back into the mouth. When painted or carved in front view the beak is indicated by a narrow wedge-shaped strip in the middle of the face, the point of which touches the lower margin of the chin. The sharp bow and stern of a canoe with a profile of a face on each side, when represented on a level or slightly rounded surface, would assume the same shape. Therefore it may be that originally the middle line was not the beak of the hawk, but the foreshortened bow or stern of the canoe. This decoration is so uniform that the explanation given here seems to me very probable.

In Fig. 65 we see a painting representing a full front view of the thunder-bird. Its principal symbol is the long beak, which in front view appears like a long line descending from the nose over the mouth. It is doubtful if in this case the body may be considered as being split along the back. On account of the fact that the face is certainly represented as a full-face view, it seems to me more likely that the animal is represented with spread wings, similar to the eagle in Fig. 63.

I have described a number of sections applied in representing various animals. Heretofore we have had cases only in which the sections were rather simple. In many cases in which the adaptation of the animal form to the decorative field is more difficult, the sections and distortions are much more numerous and far-reaching than those described before.

The cut that has been applied in the totem pole (Fig. 66) is also much more intricate than the preceding ones. The upper figure represents a bird which is shown in the form of a human being, to the arms of which wings are attached. Under this figure we find a representation of the killer-whale. The hind part of its body is more easily recognized than the head. A small human figure is seen riding on the dorsal fin. The tail, which appears at the lower margin of the figure, is turned backward over the back of the animal. We must therefore imagine that the head has been turned downward behind the human figure riding on the dorsal fin. We must remember that the part of the animal which is turned downward will be placed in the back of the totem pole, which is not carved, and that consequently, according to what was stated before, the artist will split it and distend it so that the middle line will appear at each edge of the carved portion of the pole. Thus the right half of the head will be brought into view on the right side of the totem pole, the left half on the left. This is the explanation of the whale's head with its teeth, which is seen in our figure next to the tail, the lower jaw being omitted. The flipper, which adjoins the head, is laid over the back of the whale, immediately under the feet of the human being riding on the dorsal fin of the whale. The figure must therefore be explained in such a way that the animal is twisted twice, the tail being turned up over the back, and the head being turned down under the stomach, the head being then split and extended outward.

Fig. 67 is a copy of a painting on the front of a box. It represents a frog. By far the greater portion of the box-front is occupied by the head of the animal, which, according to what was said before, must be considered as consisting of two adjoining profiles. The symbol of the frog's head is its toothless mouth. The two black portions extending downward from the lower corners of the face are two halves of the body. To these are joined the fore paws, which occupy the space below the mouth; the upper arm and fore arm being turned inward, the fore feet being turned outward under the arm. The hind legs occupy the lateral field on both sides of the head. They are not connected in any way with the body of the animal.

In Fig. 68 we find a novel representation of the killer-whale, which is copied from the painting on a house of the Kwakiutl Indians. The sections that have been used here are very complicated. First of all, the animal has been split along its whole back towards the front. The two profiles of the head have been joined, as described before. The painting on each side of the mouth represents gills, thus indicating that a water-animal is meant. The dorsal fin, which according to the methods described heretofore would appear on both sides of the body, has been cut off from the back before the animal was split, and appears now placed over the junction of the two profiles of the head. The flippers are laid along the two sides of the body, with which they cohere only at one point each. The two halves of the tail have

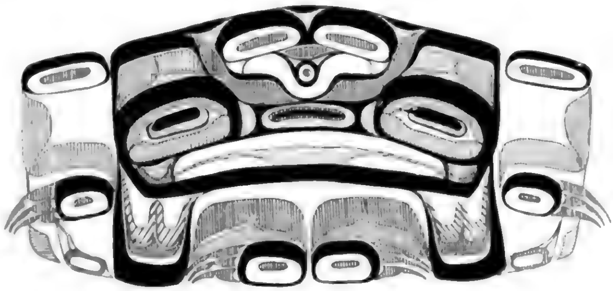


Fig. 67.

Fig. 66.

Fig. 68.

Fig. 66 ([illegible]). Part of model of a totem pole with design representing a killer-whale. Tribe, Haida. Height from whale upward, 35 cm ; width, 8 cm.; depth, 6 5 cm.

Fig. 67. Painting from a box front, design representing a frog. Tribe, Haida.

Fig. 68. Painting from a house front with design representing a killer-whale. Tribe, Kwakiutl.

been twisted outward so that the lower part of the figure forms a straight line. This is done in order to fit it over the square door of the house.

In Fig. 69 the same animal has been treated in still a different manner. The figure is also the painting from a house-front of the Kwakiutl Indians. The central parts of the painting are the two

Fig. 69. Painting from a house-front, design representing a killer-whale. Tribe, Kwakiutl.

profiles of the head of the killer-whale. The notch in the lower jaw indicates that it also has been cut, and joined in its central part. The cut on the upper part of the face has been carried down to the upper lip. The body has disappeared entirely. The cut of the head has, however, been carried along backward the whole length of the body as far as the root of the tail, which latter has been cut off, and appears over the junction of the two profiles of the head. The dorsal fin has been split, and the two halves are joined to the upper part of the head, from which they extend upward and outward. Immediately below them the two halves of the blow-hole are indicated by two small faces, the upper parts of which bear a semicircle each. The flippers are attached to the lower corners of the face. The painting on the face next to the mouth represents the gills.

Fig. 70 is another house-painting of the Kwakiutl, representing the raven. The same principle has been adhered to by the artist who made this painting. The central portion of the figure is occupied by the head of the raven split from its lower side upward so that the two halves cohere along the upper edge of the beak. Then the two halves of the head have been folded

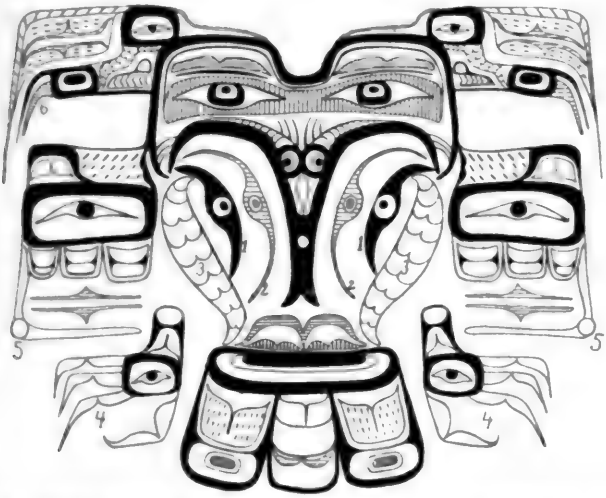


Fig. 70. Painting from a house-front representing a raven Tribe, Kwakiutl. (1) Lower jaw; (2) tongue; (3) chest; (4) feet; (5) legs; (6) wings.

upward, so that the two halves of the tongues and the two lower jaws appear on each side of the central line. The two halves of the lower side of the body are shown extending in a curved line from the corners of the mouth towards the tail, which latter has not been cut. The wings have been considerably reduced in size, and pulled upward so that they appear over each upper corner of the head. The legs occupy the right and left lower parts of the painting, the feet being disconnected from the thin legs.

In Fig. 71, which is a painting on the margin of a blanket, the sea-monster described in Fig. 24 is represented. The animal is shown here as split in two along its back; but all its parts, except the head, the paws, and the tail, are much reduced in size. The two enormous eyes, and between them the nose, will readily be recognized. The teeth are indicated by a series of slanting lines under each eye, but the lower jaws of both halves have been omitted. The whole body is represented by the thin line extending from the lower outer corner of the eyes upward, then along the upper margin of the painting, and downward again. The three dorsal fins are shown over this line,—one-half of each on each side of the back. The arms are indicated by two curves under the line indicating the back. The fin of the arm is shown

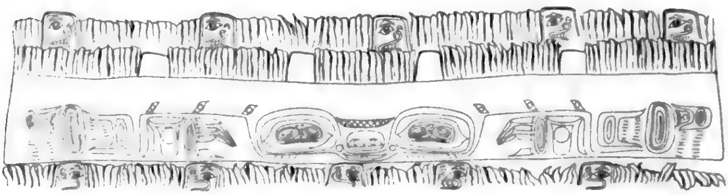


Fig. 71 ($\frac{16}{385}$). Painting from the edge of a blanket representing a sea-monster. Northern British Columbia. Length, 139 cm.

under the fore arm. While all these are of small size, the paw which adjoins the fore arm is shown on a very large scale, the claws turned towards the face. The line representing the body runs towards both ends of the painting along the lower margin until it is merged into the tail, one-half of which is shown on each side. In this specimen the proportions of the body are much more distorted than in any previous case.

The following series of figures are designs found on a number of silver bracelets. The animals represented on these are also shown very fragmentarily.

In Fig. 72 we see the beaver cut in two along its back. The face does not need any further explanation. The fore legs adjoin it on each side, the toes being turned inward; but the whole rest of the body has been omitted, except the two halves of the tail, which the artist was compelled to show, because they are symbols of the animal.

In Fig. 73 we recognize the sea-monster, with a bear's head and a whale's body. Here also by far the greater portion of the etching represents the head and fore arms of the monster. The fins, that are attached to the upper arms near the elbow, are shown on a rather small scale. The whole rest of the body is of very small size, the two halves of the body, with the adjoining half of the tail, occupying only the outer upper margin of the bracelet. I am not quite clear whether the artist intended to

Fig. 72.

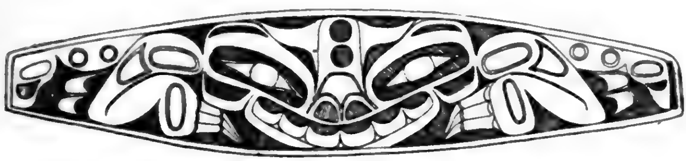


Fig. 73.

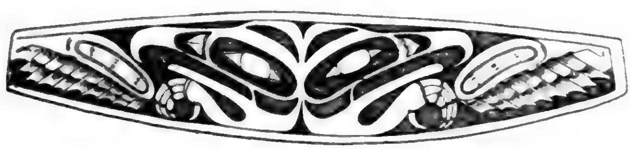


Fig. 74.

Fig. 72 (E/[illegible]). Design on a silver bracelet representing a beaver. Tribe, Haida. Height, 3.5 cm.

Fig. 73 (E/[illegible]). Design on a silver bracelet representing a sea-monster. Tribe, Haida. Height, 3.5 cm.

Fig. 74 (E/[illegible]). Design on a silver bracelet representing a hawk. Tribe, Haida. Height, 3.5 cm.

represent the two halves of the dorsal fin by the curved ornament adjoining the hat which rises over the nose of the monster.

The hawk which is shown in Fig. 74 has been cut in a different manner, namely, from the beak backward, the two halves being then turned outward. The centre of the design is occupied by the two halves of the head, and the two talons which adjoin it. The wings are cut off from the body, and occupy the outer corners of the design.

The designs on the following series of carvings are no less conventionalized. Fig. 75 is a sea-monster adjusted to a circular slate dish. The carving is perfectly symmetrical ; but, owing to an accident, the drawing appears asymmetrical because it has been taken from an eccentric point of view. Here also the centre is occupied by the head of the animal. The tail is seen under the lowest part of the mouth, turned upward in front of the body. The arms are shortened considerably. They are attached to the lower corners of the mouth, the paws touching the chin.

Fig. 75 ($\frac{16}{611}$). Slate dish with design representing a sea-monster. Tribe, Haida. Diameter, 36.5 cm.; depth, 7.5 cm.

The fins are joined to the upper part of the arms, and are turned upward so that they lie close to the sides of the face and about on a level with the ears.

In Fig. 76, which represents the front of a small box carved in slate, the same sea-monster is shown. Again we see the animal cut in two, the section separating the eyes and the ears, the mouth, however, being left intact. Here the whole body has been omitted, with the exception of the paws, to which the fins are attached. The paws will be recognized turned inward under the mouth, while the fins extend upward along the outer margins of the slab. The dorsal fin has been bisected, and one-half is shown in each upper corner. The ornament in the centre of the upper margin probably represents the tail turned upward over the back so that it almost touches the head.

Fig. 77 represents the carving on a slate slab. We have here a different representation of the sea-monster, which is also, as we might say, very much abbreviated. The head occupies by far the larger portion of the carving. The body, which is seen underneath

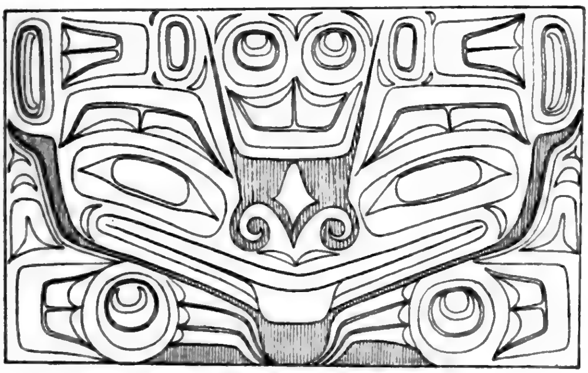


Fig. 76.

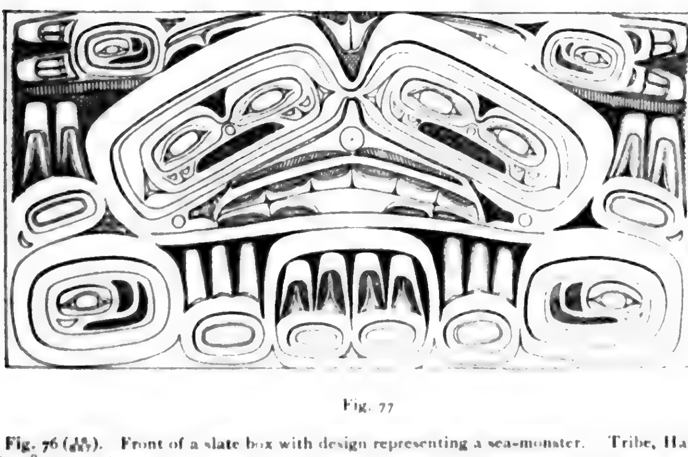


Fig. 77

Fig. 76 ([illegible]). Front of a slate box with design representing a sea-monster. Tribe, Haida. Size, 18.5 x 30 cm.

Fig. 77 ([illegible]). Slate slab with design representing a sea monster. Tribe, Haida. Size, 14 x 26.5 cm.

the head, occupying the centre of the slab, is indicated by a comparatively small square with rounded edges, which is decorated with two fins. The rest of the decoration on the lower edge of the slab must be interpreted as the arms of the monster, the large face on each corner representing an elbow. The whole arm, extending from the elbow to the hand, is omitted. The latter is indicated by an oval the centre of which is occupied by an eye. From it rise the three fingers or claws. The important symbols of the monster, the fins, which are attached to the fore arm, are shown adjoining the elbow, and rise along the sides of the slab, outside of the eyes. The two ornaments occupying the upper corners of the slab are undoubtedly the tail of the monster.

The shark which is shown in Fig. 78 is found on one end of a small food tray. I do not need to repeat the description of the shark's face, on which the characteristic symbols will be recognized. I have introduced this figure here in order to show that the whole body of the animal has been omitted with the sole exception of its pectoral fins, which are carved on the rim of the tray on both sides of the forehead. Their position is somewhat analogous to the one found on the totem pole (Fig. 33).

In Figs. 79 and 80 we find the representations of the sculpin distorted and dissected in the same manner as the sea-monster on the preceding figures.

In Fig. 79 the sculpin has been adapted to a circular slate dish. The centre of the design is occupied by a rosette, which has undoubtedly been copied from European designs. In the drawing the outlines of the various parts of the body have been strengthened in order to make their relations somewhat clearer. It will be noticed that the head is split in two, cohering only at the nose and the upper jaw. The two spines rise immediately from the nose. The two halves of the body extend from the corners of the face upward along the rim of the dish. There they grow thinner, indicating the thin portion of the fish body near the tail. The tail has not been split, and is turned upward and backward so that it touches the central rosette. A comparison between this design and the design at the centre of the upper margin in Fig. 76 will show a great similarity between the two, thus making it probable, that, as stated before, the latter design is intended to

Fig. 78.

Fig. 79.

Fig. 78 ($\frac{1}{487}$). Design from the end of a food tray representing a shark. Tribe, Tlingit. Central length of design, 12.5 cm.

Fig. 79 ($\frac{16}{283}$). Slate dish with design representing a sculpin. Tribe, Haida. Diameter, 34 cm.; depth, 6.5 cm.

represent the tail of the monster. The pectoral fins of the sculpin are shown in a rather abnormal position. They are turned forward from the body so that they adjoin the lower jaw. They will be recognized between the jaws and the rim of the dish. The dorsal fin is indicated by the long pointed ornaments extending from the eye towards the tail.

In the design Fig. 80 the sculpin has been dissected in a somewhat different manner. The head occupies the upper margin of the slab. It has a remarkably triangular shape. The body has been bisected from head to tail, and turned and twisted in such a manner that each half extends in a curve downward from the corners of the face to the middle of the lower margin of the slab. The pectoral fins have been left in contact with the corners of the mouth, and are placed in the same position as in the preceding figure, namely, adjoining the lower jaw. They meet just below the chin of the animal. I believe the ornaments which are stretched along the right and left margins of the slab represent the dorsal fins of the sculpin.

Our last figure (Fig. 81) shows the design of a beautiful Chilcat blanket. In this specimen the distortion and dissection of the animal have been carried further than in any of the preceding specimens. On the design are shown the two profiles of the head, the dorsal fin, the tail, the flippers, and the chest of the killer-whale. In order to understand the design, we must imagine the

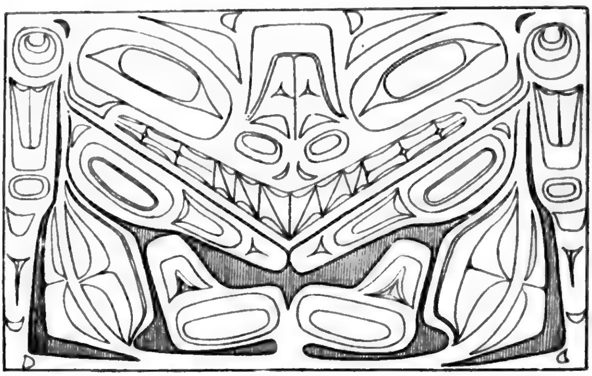


Fig. 80 ($\frac{16}{667}$). Front of a slate box with design representing a sculpin. Tribe, Haida. Size, 18.5 x 30 cm.

whale placed head downward, the chest towards the observer. The design on the chest is the large face which occupies the centre of the upper margin of the blanket. Then we must imagine that the head has been cut off, and split and twisted in such a way that the two halves of the mouth are turned outward. Next we must imagine the body of the animal cut through just above the chest, and turned backward so that the tail is placed behind the head. Then the two halves of the head have been moved to the right and to the left in order to allow the tail to appear between the two halves. In this position the dorsal fin would be hidden behind the chest of the animal. In order to make it visible it has been cut off from the back and moved towards the tail until it appears just above the tail; it has been split and flattened so that both halves, the left and the right, are seen under the chest.

Finally the two flippers have been considerably enlarged and twisted in such a way that they occupy the two upper corners of the blanket.

I will add a remark in regard to the frequent occurrence of the eye ornament on all these designs. An examination of our figures will show that in most cases it is used to indicate a joint.

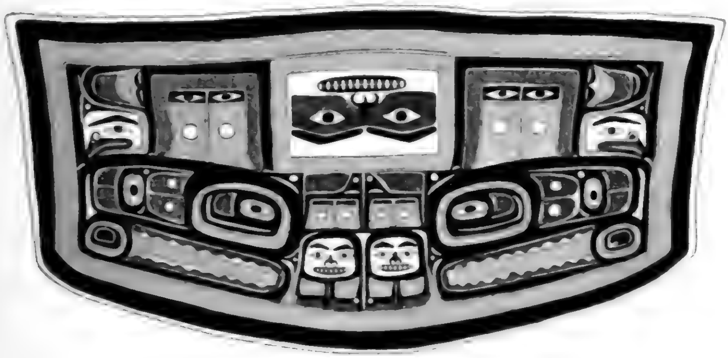


Fig. 81 ($\frac{E}{337}$). Chilkat blanket representing a killer-whale. Tribe, Tlingit. Width, 156 cm.; height, 77 cm.

Shoulder, elbow, hand, hips, knees, feet, the points of attachment of fins, tails, and so forth, are always indicated by eyes, which, I believe, may best be interpreted as representations of the surfaces of ball-and-socket joints.

We can now sum up the results of our considerations. In the first part of this paper I described the symbols of a number of animals, and pointed out that in many cases there is a tendency to substitute the symbol for the whole animal. The works of art which I described in the second part of my paper may be said to illustrate a principle which is apparently diametrically opposed to the former. While the symbolism developed a tendency to suppress parts of the animal, we find in the efforts of the artist to adapt the form of the animal to the decorative field a far-reaching desire to preserve, so far as feasible, the whole animal ; and, with the exception of a few profiles, we do not find a single instance which can be interpreted as an endeavor to give a perspective and therefore realistic view of an animal. We have found a variety of methods applied which tend to bring the greatest possible part of the animal form into the decorative field. I conclude from this that it is the ideal of the native artist to show the whole animal, and that the idea of perspective representation is entirely foreign to his mind. His representations are combinations of symbols of the various parts of the body of the animal, arranged in such a way that if possible the whole animal is brought into view. The arrangement, however, is so that the natural relation of the parts is preserved, being changed only by means of sections and distortions, but so that the natural contiguity of the parts is preserved.

The success of the artist depends upon his cleverness in designing lines of dissection and methods of distortion. When he finds it impossible to represent the whole animal, he confines himself to rearranging its most characteristic parts, always of course including its symbols. There is a tendency to exaggerate the size of the symbols at the expense of other parts of the subject. I presume this is the line in which the two principles of the decorative art of the Indians of the North Pacific Coast of America merge into each other. The gradual emphasizing of the symbol at the expense of other parts of the body leads in many cases to their entire suppression, and to designs in which the animal is indicated only by its symbols.

Article XI.—DESCRIPTIONS OF NEW SPECIES OF SILURIAN FOSSILS FROM NEAR FORT CASSIN AND ELSEWHERE ON LAKE CHAMPLAIN.

By R. P. Whitfield.

Plates IV and V.

The following new forms of fossils, with others, have been collected and sent to me for determination by Profs. H. M. Seely and G. H. Perkins, in connection with the Geological Survey of Lake Champlain, made under the direction of the Faculties of Middlebury College and the State University. They are, with two or three exceptions, from the horizon of the Fort Cassin Beds, and indicate that the fauna of that period is not yet fully known, as there are several species of which no examples have been obtained sufficiently perfect for description and illustration.

Rhinopora prima, n. sp.

Plate IV, Figs. 5 and 6.

Bryozoum forming a thin cup-shaped or open funnel-formed body, composed of a thin expansion of film of not more than half and mostly less than half a millimeter in thickness ; on the outer surface this film is closely covered with small mammiform elevations or tubercles arranged in curving lines, or quincunx order. These tubercles are about .5 mm. in diameter or sometimes slightly more, so that they measure two to the millimeter or three and a half tubercles in 3 mm. Each tubercle when examined under a lens is seen to have a small round pore in its summit, which opens into a larger cavity below. The cup formed by the bryozoum has been nearly an inch in diameter, but is open on one side.

The specimen was supposed to belong to the genus *Calathium* (a sponge), but I think there is no question that it properly belongs to the Bryozoa, and is very closely related to if not exactly identical generically with *Rhinopora verrucosa* Hall, from the Clinton Group.

Formation and locality.—In the limestones at Fort Cassin, Vt.

Protorthis cassinensis, n. sp.

PLATE IV, FIGS. 1 AND 2.

Protorthis sp.? HALL, Pal. N. Y. Vol. VIII, Pt. ii, Plate lxxxiv, Figs. 1 and 2.

Shell small, seldom attaining to more than 10 mm. in its extreme width, and the distance from beak to base about two-thirds that of the width. Valves nearly equally convex and moderately arcuate, with a proportionally long hinge-line; cardinal angles rounded; beaks small and incurved; dorsal valve with a perceptible mesial sinus. Surface marked by extremely fine hair-like radiating striæ, difficult to perceive except under a fairly strong magnifying power. Shell substance distinctly fibrous without any appearance of punctæ even under strong magnification; but the fibers are quite crystalline, and the punctæ, if any have existed, may have been destroyed by this change.

In the interior, as shown by Prof. Hall in the work cited above, there appears to be a triangular cavity formed by the dental lamellæ of the ventral valve, and also proportionally strong muscular markings.

Formation and locality.—In the limestones at Fort Cassin, Vt. Not very common.

Protorthis minima, n. sp.

PLATE IV, FIGS. 3 AND 4.

Shell small, almost minute, varying in size from 1 mm. to 4 mm. in transverse diameter, and on the ventral valve the length from beak to base is about equal to the transverse diameter, but on the dorsal side almost one-third less. Valves subquadrangular in outline, with broadly rounded front and lateral angles. Ventral valve the most ventricose, in fact quite prominently so, with a rather large beak and a fairly well-marked mesial sinus along the middle. Dorsal valve more regularly and less prominently ventricose. Surface marked by radiating lines, so fine in their texture as to represent only the fibers of the shell structure.

This differs from *P. cassinensis* in the very quadrangular outline and in its greater convexity.

Formation and locality.—Abundant in some layers of the Fort Cassin limestones at Fort Cassin, Vt.

This and the preceding species are certainly congeneric. Prof. Hall has figured the first species in the work cited at the head of that description to illustrate his genus *Protorthis*, founded on *Orthis billingsi* Hartt, from the St. John's group, which is pre-Potsdam, while this is from a very much higher position, even if we admit that it may be Calciferous, which is by no means certain. So far as I can see, the two forms, *Orthis billingsi* and the present two species, are entirely unlike each other, and represent two very distinct groups of the Orthidæ. I should be much more inclined to refer the two species here described to the group of *Orthis*, typified by *O. elegantula*, *O. subcarinata*, and others of similar character; while *O. billingsi* is much more nearly related to such forms as *O. fasciata* of the Niagara group and *O. strophomenoides* of the Lower Helderberg, called by Hall *Orthostrophia*. I do not think, however, that they are worthy of a distinct generic name, or it would be the easiest way to dispose of them.

Murchisonia cassina, n. sp.

PLATE IV, FIG. 7.

Shell below a medium size, slender and with a rapidly ascending spire, consisting of seven or more volutions, which are strongly rounded between sutures, and but little more than half as high as their transverse diameter; last two or three volutions subangular in the middle and showing evidence of having possessed a well-marked band just below the middle of the height. Surface of the shell not visible, but as seen through its substance, where preserved in the matrix, it would seem to have been rather smooth.

In its slender spire, strongly rounded volutions with deep, sharp sutures, this species differs from any other species known in these beds. It somewhat resembles *M. gracilis* of the Trenton and Hudson River formations, but is less oblique and more slender.

Formation and locality.—In the limestone beds at Fort Cassin, Lake Champlain.

Straparollina minima, n. sp.

PLATE IV, FIGS. 10–12.

Shell minute, its greatest diameter being only 6 mm., the height about 4 mm., and consisting of three volutions. Apical angle about 105°; volutions only slightly convex between sutures and rather rapidly expanding, the last one distinctly angular on the periphery, but hardly carinate. On the underside the last volution is nearly as convex as on the upper surface, and presents a rather broad umbilical opening with subangular margin. Aperture a little transverse, subangular at the outer margin, the lip somewhat receding below and outward from the suture. Surface of the shell too much weathered to show growth-lines.

Two examples of this shell have been found at Colchester, Vt., on Lake Champlain, by Prof. G. H. Perkins, and are probably near the horizon of the Beekmantown Calciferous.

Maclurea affinis *Bill.*

Plate IV, Figs. 8 and 9.

Maclurea affinis Bill. Pal. Foss. Vol. I, p. 238, Fig. 224.

Some examples of this species have been obtained preserving the external shell, which has not hitherto been described. The shell substance is of moderate thickness and marked on the exterior by a series of comparatively regular varices, which are more or less distant on the inner coils with projecting lamellar edges and with concave interspaces. On the outer volution they become more rounded and take on the form of undulations of the surface, and finally near the aperture of adult specimens are quite irregular, presenting the appearance of old age characters. On the inner whorls these varices sometimes look like the septa of a Nautiloid shell, and would be very readily mistaken for such, but on closer examination they are seen to be surface-markings only.

The examples have been furnished by Profs. G. H. Perkins and H. M. Seely, and were collected from the Fort Cassin Beds at the mouth of Otter Creek, Vt.

Ecculiomphalus compressus, n. sp.

Plate IV, Fig. 13.

Shell of medium size, consisting of a little more than one volution, volutions quite rapidly expanding, the inner half very slender and thin, while the last third is more rapidly expanded and the outer portion straightened. Section of the volution ovate, acutely rounded on the dorsal edge and more broadly rounded on the inner side. Surface of the shell marked by very strong growth-lines, irregular and curving strongly backward toward the outer edge of the volution, indicating a strong, deep notch in the outer margin of the aperture.

The nearest allied form is found in *Ecculiomphalus canadensis* Bill., from the Calciferous rocks at Phillipsburg, Canada, from which it differs in its more rapidly expanding shell and in the compressed ovate section and obtusely angular back, whereas that one is nearly circular in section.

Formation and locality.—In the Calciferous sandrock at Colchester, Vt. Received from Prof. G. H. Perkins.

Bucania champlainensis, n. sp.

PLATE IV, FIGS. 14-16.

Shell of medium size for the genus, with the outer volution broadly expanded and much thickened, being somewhat heart-shaped on the margin of the lip. Inner volutions rounded and involved within the lip of the outer one to the extent of nearly or quite one-third of its diameter, but showing deep umbilical cavities on the sides. Number of volutions, three or four. Surface of the shell, so far as can be determined, smooth.

The specimens representing this species, although numerous, are all sections in the limestone, and none of them show the entire form. The most of them have been imbedded and worn away so as to show the expanded aperture on the surface of the rock, with a section of the inner volutions more or less on one side of the center; and many show the lip open in front, indicating probably a broad notch in the front margin. The substance of the lip, as seen in section on the surface of the rock, is often 6.5 mm. (¼ inch) in thickness.

The species differs from *B. rotundata* Hall in its rounded volutions and very small umbilicus; and from *B. expansa* Hall in the small umbilicus and want of angular carina of the dorsum, as well as in the more compactly coiled volution.

Formation and locality.—In the Upper Chazy (Chazy "C" of Brainerd and Seely's section at Valcour Island and at Chazy, N. Y.), Lake Champlain.

Nautilus perkinsi, n. sp.

Plate V, Figs. 1 and 2.

Shell of moderate size, consisting of seven or more closely-coiled volutions, the outer ones slightly embracing the inner to about or less than one-quarter of the diameter, and very greatly increasing in their diameter with additional growth ; very slightly flattened on the back and marked by strong, very oblique folds on the sides, which pass backward from the suture across the volution and become obsolete on the dorsum. These folds cross some five or six septa in their extent between the ventral and dorsal faces, are rounded on their surface and strongest on the middle of the sides. Surface marked by lines of growth, which have a broad sinus on the dorsal portion of the shell, and follow nearly the direction of the oblique folds on the sides. Septa rather deeply concave, arranged so as to include about five chambers in the space of an inch, measured on the dorsal surface of the outer volution. Siphon of moderate size, subcentral, nearest to the dorsal surface.

This species is somewhat closely related to *N. champlainensis* from the same beds, but differs principally in the presence of the oblique undulations of the surface.

Formation and locality.—Fort Cassin Beds at Fort Cassin, Vt. Collected and presented by Prof. G. H. Perkins.

Harpes cassinensis, n. sp.

Plate V, Figs. 3 and 4.

Specimens consisting of the cephalic shield only, which is on the whole decidedly horseshoe-shaped, with the posterior extremities of the cheek spines somewhat incurved and reaching within the width of the glabellar elevation ; the anterior margin forward of the occipital furrow forms nearly a semicircle, while behind this point the curvature is less regular, and would, if continued, form the narrower portion of an ovate outline. Surface of the border concave between the dorsal furrow and the outer edge, the posterior limbs being pointed and incurved. Middle of the cephalic shield quite prominent, the glabellar lobe forming only about one-fifth of the width, and the fixed cheeks each about two-fifths of the space. Glabella cylindrically conical, rounded in front, marked by a single furrow near its base, with a smooth triangular space on each side passing outward to beyond the middle of the width of the fixed cheek. Fixed cheeks large, very prominent ; ocular tubercles proportionally large, with a distinct ocular ridge uniting them with the glabella, and less distinct outside of the eye. Occipital furrow very narrow, and the occipital ring slight.

Surface of the head covered entirely by very fine punctæ, which on the fixed cheeks become confluent, forming ramifying lines like vascular markings. Extreme margin of the shield occupied by a very narrow elevated border.

This species is closely related to *H. ottawensis* Billings, from the Trenton limestones near Ottawa, Canada, differing principally in the more prominent central portion of the shield, more cylindrical and narrower glabella, and also in the proportions of the glabella as compared with the length of the entire head, it being in this case considerably less than half the length of the head, instead of five-ninths, as stated in the description of that species given in Pal. Foss., Canada, Vol. I, p. 182.

Formation and locality.—In the Fort Cassin Beds at Fort Cassin, Vt.

Bathyurus perkinsi, n. sp.

Plate V, Figs. 7 and 8.

Glabella and fixed cheeks quadrangular in outline, but considerably longer than wide, the glabella alone being slightly longer than wide, its surface nearly smooth, slightly angular along the center and very faintly marked, in the best specimen, by a single pair of furrows a little behind the middle of its length; anterior margin of the glabella roof-shaped, forming an angle of about one hundred and ten degrees. Frontal limb of moderate width, narrowest in the middle and convex on the surface, grooved in front with a distinctly elevated, narrow margin, which becomes obsolete at the dorsal sutures. Fixed cheeks quite narrow, in fact nearly obsolete at the angles of the palpebral lobes. Postero-lateral limbs short, narrowly triangular, and distinctly grooved by the occipital furrow. Occipital ring comparatively broad. Other parts of the organism unknown.

This species bears a general resemblance to *B. quadratus* Bill., Pal. Foss., Vol. I, p. 411, fig. 396; but differs in the broader frontal limb, roof-shaped front of the glabella, narrower fixed cheeks, and small lateral limbs.

Formation and locality.—In the Fort Cassin Beds at the mouth of Otter Creek, Vt. Collected by Prof. G. H. Perkins and Prof. H. M. Seely.

Nileus striatus, n. sp.

PLATE V, FIGS. 5 AND 6.

Species recognized by the glabella and fixed cheeks only. Length of the head, excluding the occipital ring, equal to 3.5 mm., and with the occipital ring about 4 mm. Width across the head from the limits of the palpebral lobes almost 5 mm. Width of the glabella, 3 mm. Head very prominent, the glabella nearly or quite destitute of lateral furrows and nearly quadrangular in outline, broadly rounded in front and very slightly thickened on the anterior border. Fixed cheeks not visible in front of the eye lobe, but the lobe having a width equal to slightly more than one-third of the width of the glabella, and equal to fully one-half the length of the glabella, regularly curved on the outer margin and convex on the surface. Lateral limbs narrow antero-posteriorly, and considerably longer laterally than the width of the palpebral lobe. Occipital ring prominent, rounded, and the furrow distinct.

Surface of the crust of the glabella marked by very fine, transverse, raised striæ, invisible to the naked eye, and rather broadly bent forward in the middle of their length.

The species differs entirely from any of the species described in Pal. Foss., Canada, in size and form.

Formation and locality.—In the limestones at Fort Cassin, Lake Champlain. From Prof. H. M. Seely.

EXPLANATION OF PLATE IV.

Protorthis cassinensis Whitf. Page 178.

Figs. 1 and 2.—Views of the ventral and dorsal valve, each enlarged two diameters.

Protorthis minima Whitf. Page 178.

Figs. 3 and 4.—Views of two valves having quite different outlines, each enlarged six times.

Rhinopora prima Whitf. Page 177.

Figs. 5 and 6.—View of the specimen natural size, and an enlargement showing character of pustules.

Murchisonia cassina Whitf. Page 179.

Fig. 7.—View of the specimen described.

Maclurea affinis Billings. Page 180.

Figs. 8 and 9.—View of edge showing surface of the shell, enlarged two diameters, and surface of another specimen two diameters, showing undulations of surface.

Straparollina minima Whitf. Page 179.

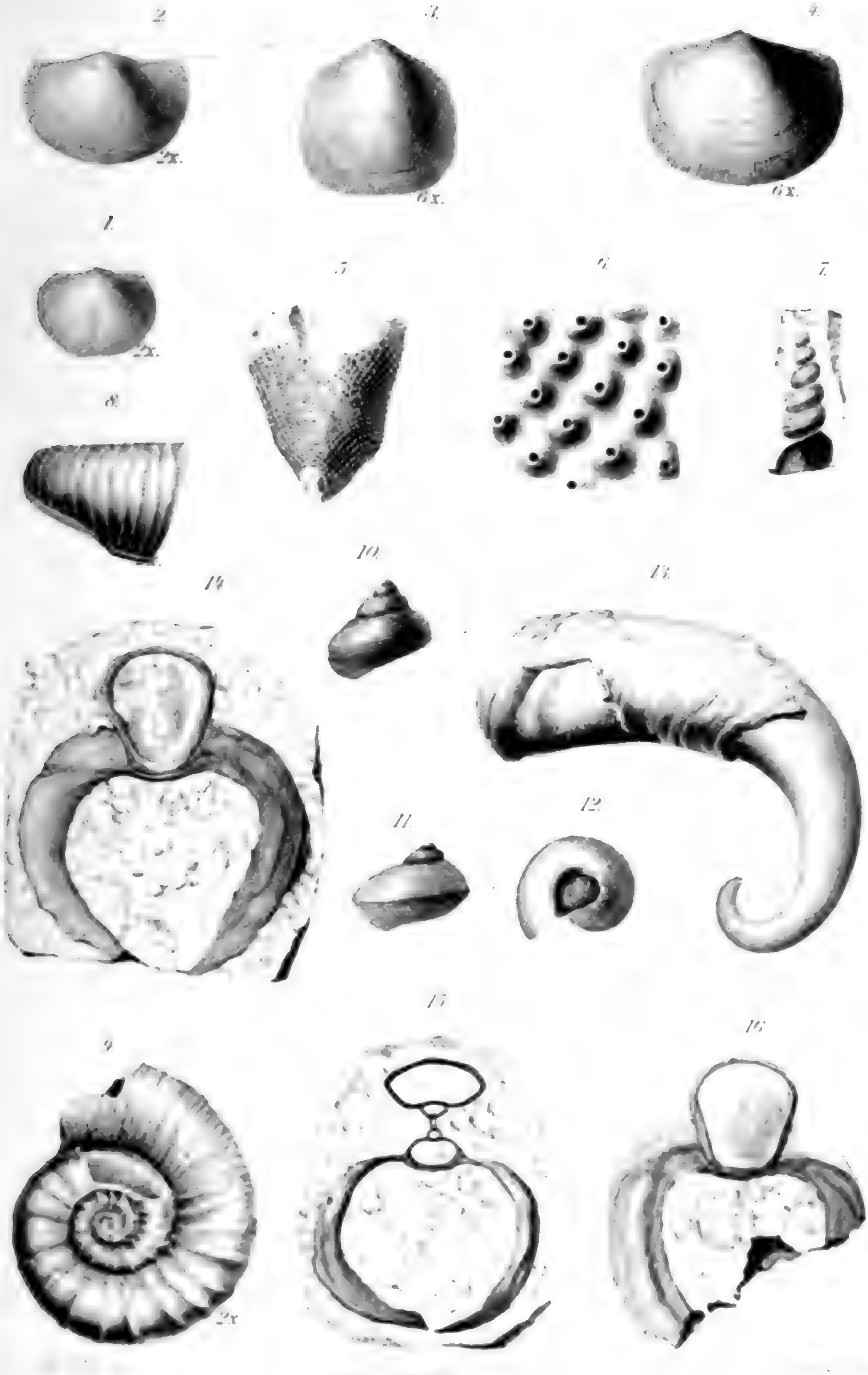
Fig. 10.—Side view of a small specimen.
Figs. 11 and 12.—Two views of a still smaller individual.

Ecculiomphalus compressus Whitf. Page 180.

Fig. 13.—View of the side of a specimen retaining part of the shell.

Bucania champlainensis Whitf. Page 181.

Figs. 14-16.—Views of three specimens, as they appear in the rock, showing aperture, etc.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EXPLANATION OF PLATE V.

Nautilus perkinsi Whitf. Page 182.

Fig. 1.—Side view of a very fine specimen.

Fig. 2.—View of a larger but imperfect specimen, showing the undulations of the surface more distinctly.

Harpes cassinensis Whitf. Page 182.

Figs. 3 and 4.—View of a nearly entire head, enlarged two diameters, and a profile of the same.

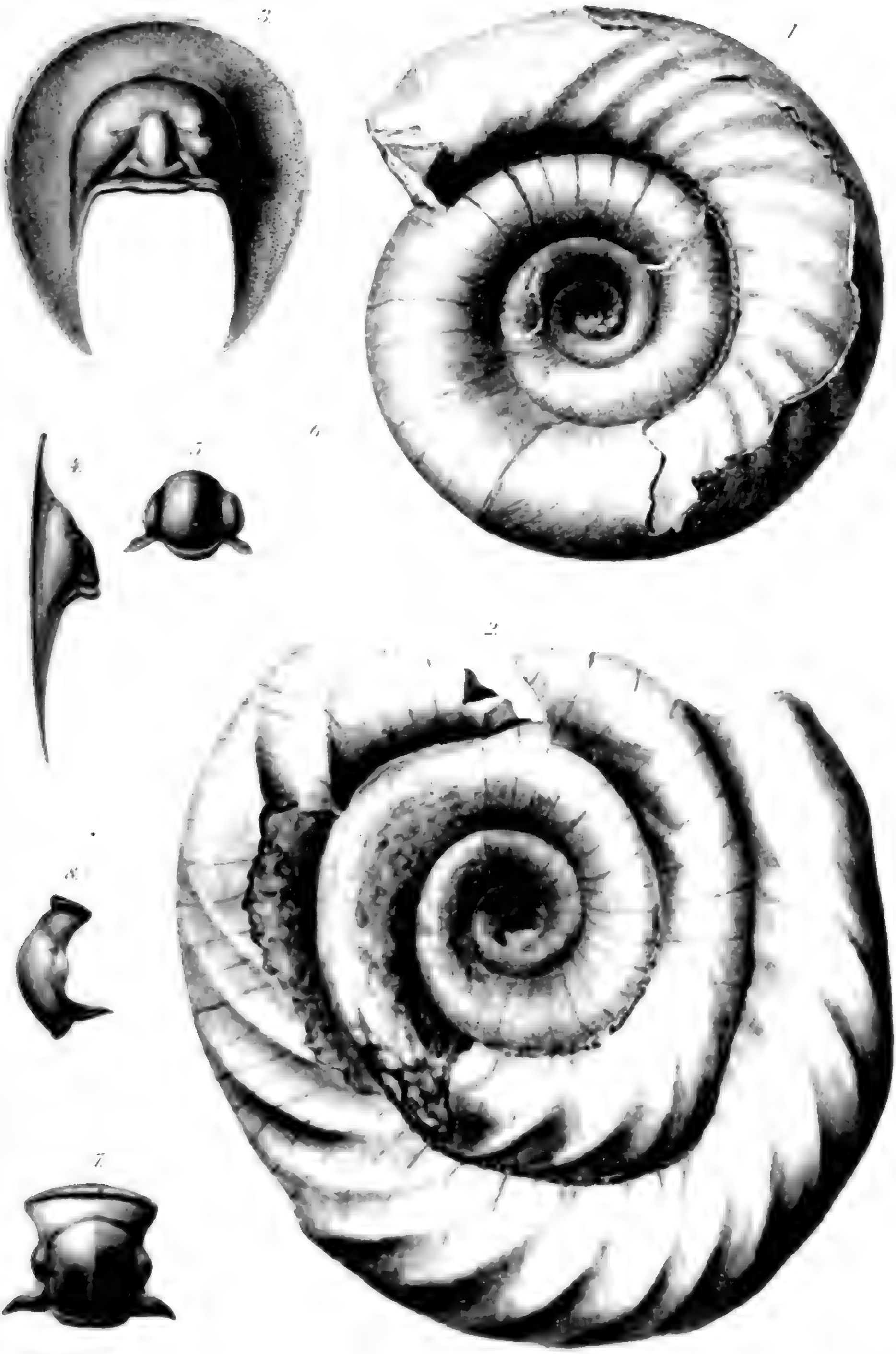
Nileus striatus Whitf. Page 184.

Fig. 5.—View of the head three times enlarged.

Fig. 6.—Profile, showing the rotundity.

Bathyurus perkinsi Whitf. Page 183.

Figs. 7 and 8.—View of the best glabella and fixed cheeks, twice enlarged, and a profile view of the same.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Article XII.—DESCRIPTIONS OF SPECIES OF RUDISTÆ FROM THE CRETACEOUS ROCKS OF JAMAICA, W. I., COLLECTED AND PRESENTED BY MR. F. C. NICHOLAS.

By R. P. Whitfield.

Plates VI–XXII.

The genus *Radiolites* Lamk. has long been known to occur in the Cretaceous rocks of Jamaica, W. I., but so far as I can ascertain none of the species found in the island have ever been described. They are particularly mentioned in the Geological Report of J. G. Sawkins, published in London in 1869; and in Appendix V to that report, Dr. Etheridge frequently refers to the forms of the Rudistidæ in the Cretaceous rocks in Jamaica, mentioning the different genera which occur, among which he places *Radiolites*, but gives no specific names, although several species occur. In the body of Prof. Sawkin's report *Radiolites* is frequently mentioned, as, for instance, on page 26, he says: "large radiolites very firmly imbedded, some indicating a length of seven feet." In almost every reference to the Cretaceous limestones of the island, the Hippuritidæ are mentioned, of which *Radiolites* appears to be the principal form, so far as can be ascertained from recent collections made there. Among the larger forms of *Radiolites*, and in fact the only very large one which I have seen, is that described below as *Radiolites nicholasi*, but I do not think it is a form that ever occurs of so great a length as six or seven feet, but is rather short and broad. Still it is the largest of any of the true Rudistidæ that I have seen from Jamaica. There is another form, *Barrettia*, described by S. P. Woodward, of London, as a form of Rudistidæ which may have reached a length of seven feet. But there is much doubt as to its true relations with the Rudistæ. In another paper, already prepared, I have discussed these relations, and illustrated several features of the genus not observed by Mr. Woodward.

Radiolites (Lapeirousia[1]) nicholasi, n. sp.

PLATES VI–IX, ALL FIGURES.

Shell large and ponderous when fully grown, in some cases attaining a diameter of fifteen by eighteen inches, with a length probably somewhat greater. Lower valve rapidly and broadly spreading upward from a basal or apical attachment, becoming deeply lobed on the back or cardinal (?) side, so that the top presents a somewhat reniform outline. On the back, or unsymmetrical side, there is a broad band, resembling the ligamental band of *Spondylus*, which in some of the smaller individuals is concave, but in the larger ones is convex, and separated from the other parts of the valve by a deep, sharp groove on each side, indicating the presence on the interior of the valve of a pair of crests or ridges, the feature upon which the genus *Lapeirousia* was established, but the evidences of the ridges are difficult to obtain. On one specimen, in which I have been enabled to take the upper valve out from its place in the lower valve, there occurs one narrow projecting ridge, while in place of what might represent the other, there appears a broad plate of a secondary deposit, on the inner face of the visceral cavity, that extends nearly or quite three inches around the inside of the cavity, deposited on the inside of the inner fibrous layer, and opposed to the denticulated horizontal process of the upper valve. The one narrow projecting ridge is simply a projection of this broad plate, and lies within the smaller cavity bordering the denticulated process. On the upper surface the broad spreading lamellæ are covered by the radiating vascular furrows, and the margin of the valve on the exterior is strongly and coarsely lamellar. Visceral cavity varying from one-fourth to two-fifths of the entire diameter of the valve, but situated quite near the cardinal band on the back; while the lateral lobes of the shell protrude, leaving the cardinal band deeply imbedded, resulting from the narrowing of the spreading lamellæ, as on this side their width is only an inch, or

[1] Bayle: Explication de le carte géol. de France, vol. IV, Atlas, pl. 110 et 111 (Zittel., Paléont., Vol. II, p. 87. French ed., 1887.)

sometimes two inches; while on the opposite side or front they may be six or ten inches in extent.

Upper valve convex, of but slightly greater diameter than the visceral cavity, so that it extends beyond its edge but little more than half an inch. On the inner face the upper valve is characterized by one deep, rather large, thickened process, projecting from the inside of the valve in front and along the left side for two-thirds of the length of the valve, as it is held with the cardinal band from one, and is divided into three tubercular prominences or ridges. On the back, toward the position of the cardinal band, a horizontal plate or process of a triangular form, connected with the body of the valve by a narrowed neck, spreads out to the broad vertical plate and cardinal ridge of the lower valve, which it reaches with the numerous denticulations which arm its end, or into which the process is divided. This form of the horizontal plate leaves a small cavity on the left side, and a much larger, deeper cavity on its right, which appear to unite between the process and the inner surface of the valve, above the process. Into the smaller cavity the projecting ridge of the lower valve enters, while the body of the plate of which it is a part extends around the back of the visceral cavity, and is apparently of a secondary deposit within the fibrous lining of the cavity, and occupies the position of the projecting process formed by the upholding of the mantle at the sides of the cardinal band.

Substance of the lower valve finely and distinctly lamellar, the lamellæ counting as many as twelve or fifteen in the space of 9 mm., and the surface of each lamella being very finely granular as well as being traversed by the vascular furrows common to this group. There is also the fine columnar or prismatic vertical structure, very distinctly seen, which pertains to this group of shells, and which presents on the surface of the lamellæ, under certain conditions, an extremely fine polygonal network of meshes.

The upper valve is circular or ovoid in outline, but somewhat truncate on the back, and in some cases shows evidence of having had low, shallow, radiating ribs. The substance is very thick and dense, the outer layer very finely laminated and thin in proportion to the inner layer, which is porcellanous.

Formations and localities.—In the Cretaceous limestone near Logie Green, Clarendon Parish, and at Green Island or Haughton Hall, Hanover Parish, Jamaica, W. I. The latter locality is that from which the peculiar form *Barrettia* is abundantly obtained, and at which the two forms are associated in the same beds. The locality from which Mr. Woodward's specimen of *Barrettia* was obtained by Mr. Lucus Barrett, F.G.S., and former Director of the Geological Survey of the British West Indies, was in Portland Parish, eastern Jamaica, at almost the other extreme of the island.

Radiolites adhærens, n. sp.

PLATES X, XI, XII.

Shell adherent, single or in clusters, closely appressed to foreign bodies and conforming to their shape in growth ; three to five inches long and two or more inches in transverse diameter. Externally marked by several broad longitudinal ribs or ridges on the lower valve, which are themselves usually marked by smaller ridges, the channels between the larger ones often moderately deep and of varying width ; ridges strongly rugose, from numerous transverse lines parallel to the upper margin of the valve. Upper valve extending to the margin of the lower and forming tongue-like projections at the ridges of the lower, more or less conical in shape with a nearly central apex, and also marked by numerous radiating ridges which are low and rounded. This is the feature of what is supposed to be a mature specimen ; while on some young specimens which form a group of fourteen individuals of various sizes, the upper valve is small and button-like, only extending to the edge of the visceral cavity, slightly convex on the surface with a subcentral apex and rather strong radiating ribs, which curve somewhat in their direction toward the margins. The apex is situated nearest to the cardinal or hinge margin, which is, in all cases, seen on the opposite side from that by which the valve is attached to any foreign substance.

The peculiar feature of this species lies in its attachment to foreign bodies, as it often spreads over a considerable area, throwing out the broad expansions over such bodies, coating them for considerable distance and filling up the irregularities of their surfaces with the spreading lamellæ of the lower valve; while on the opposite side of the shell it will be only of moderate thickness, often of not more than a fourth of an inch, and the exterior will give no indication of the lamellose structure, except the ordinary lines of growth. The lamellæ of the lower valve are very thin and the substance compact as compared with those of *R. nicholasi*, and the vertical lines which give the columnar structure are practically invisible except on very close inspection with a good glass. The upper valve structure is much more compact than that of the lower, and quite flaky.

This species bears considerable resemblance in its general appearance to *Radiolites squamosus* d'Orb., as figured in his Pal. Française, Cretaceous, pl. 561, only that it is so much more recumbent on the substance to which it is attached, and in the fewer and broader longitudinal ridges of the surface, which are also less rugose.

Formation and locality.—This species is from the Cretaceous at Logie Green, Jamaica, W. I.

Radiolites rudis, n. sp.

PLATE XI, FIG. 1.

Shell small, the only specimen present in the collection being about three inches high, and its greatest diameter less than two inches ; form irregular and very rugose, the lamellæ projecting in irregular folds which correspond to deep notches in the lip of the lower valve, the principal folds being to the right of what appears to be the hinge side of the shell, when that side is held towards one. The horizontal spreading lamellæ are very fine or thin, and vary much in their degree of extension, giving the rudely irregular outline to the lower valve. Vertical pillars of the lamellæ rather strong and distant. Upper valve as large as the border of the cup of the lower, highly round-conical in form, the margin fitting into the notches of the folds of the lower valve. The surface of the upper valve is obscured by adhering substances, but when visible is cancellated by two sets of lines, one concentric, the other radial.

This species presents somewhat the general appearance of *Radiolites* (*Sphærulites*) *leymeri* Bayle, as received in a collection from Prof. Zittel, but is somewhat more spreading, with larger vertical folds and proportionally larger upper valve.

Formation and locality.—In the Cretaceous Beds at Logie Green, Jamaica, W. I.

Radiolites cancellatus, n. sp.

PLATES XII AND XIII.

Shell rather small, the largest one referred to this species being about two and a half inches high, by two inches in its greatest transverse diameter, at the top. General form of the lower valve rather moderately spreading from the basal attachment, and slightly curved, flattened on the back or outer curvature, which apparently represents the cardinal bands of other species, and faintly marked by two indistinct longitudinal depressed lines ; lateral edges of the lower valve sharply rounded and the front broadly rounded ; marked by about five strong longitudinal plications. Upper valve extending to the margin of the lower, moderately convex with a nearly or quite marginal apex, low and inconspicuous ; also by low rounded plications corresponding to those of the lower valve but less distinctly marked. Surface of shell marked by strong lamellose ridges of growth, transverse to the plications and strongly undulating across them ; also by wire-like, raised, longitudinal lines which cancellate the entire shell except the flattened space on the outer curvature.

The flattened space on the outer side of the larger of the two specimens of this species occupies about two-thirds of the width of the lower valve, and gives it a somewhat *Calceola*-like aspect. It is very faintly marked by the two longitudinal lines which represent the "cardinal bands" of other species. On the smaller of the two the flattening is less marked, and one of the vertical lines is more strongly marked, while the curvature of the shell is not only greater than that of the larger one, but it is also twisted, and in its general form and appearance bears considerable resemblance to the figures of *Caprotina trilobata* d'Orb., Pal. Franç., Cretaceous, pl. 582. This appearance also appertains to the surface structure in its cancellations and in the appearance and form of the upper valve. I cannot, however, think that it is specifically distinct from the larger one, which is undoubtedly a true *Radiolites.*

Formation and locality.—In the Cretaceous limestone at Logie Green, Clarendon Parish, Jamaica, W. I.

Radiolites macroplicatus, n. sp.

PLATES XII AND XIII.

Shell attaining a considerable size, the largest one present in the collection having a length of a little more than six inches by a transverse diameter at the top of the cup of the lower valve of four and three-fourth inches, with the lower extremity imperfect. Form obconical, moderately spreading upward and slightly curved. Upper valve low, conical, extending to the entire size of the lower valve; apex subcentral or much nearer to one side than the other. On the larger one mentioned, the apex is nearly one-third of the width of the valve from the side forming the back or outside of the curvature of the lower valve. Entire surface of both valves marked by coarse, angular, and very rudely lamellose, radiating or vertical plications, fifteen in number on the largest specimen, and thirteen in a much smaller one. The lamellæ are very coarse and strongly undulated in crossing the vertical ridges, producing a distinctly zigzag marking on the ridges. The fine horizontal plates or lamellæ of the microscopic structure of the lower valve number from eight to ten in the space of 3 mm., and the columnar or vertical plates or cells will average nine in the same distance.

This species belongs to an entirely distinct group of *Radiolites* from those with broad spreading lamella, like *R. crateriformis* d'Orb. and *R. nicholasi* herein described, in which the upper valves are small in comparison to the diameter of the lower, and the lower valve shows no evidence of the cardinal plates on the irregular or unsymmetrical side as does *R. nicholasi.*

Formation and locality.—In the Cretaceous limestones at Logie Green, Clarendon Parish, Jamaica, W. I.

Radiolites annulosus, n. sp.

PLATE XIV, FIG. 3.

Shell of moderate size, narrowly turbinate in general form, with a moderately conical upper valve; extreme height of the shell about four and a half inches, and the greatest width less than two and a half inches. Lower valve marked with numerous regular, rather closely arranged, concentric, varix-like annulations, of which there are about seven or eight in the space of an inch; these are crossed by vertical lines which are formed by the lines constituting the columnar structure of the lower valve. Under a glass the vascular lamellæ are seen to be extremely fine and closely arranged, and when ground down the lamellæ are seen to be grouped into bands of finer and coarser sets to form the concentric varix-like annulations.

The surface of the only specimen of this species present in the collection is somewhat decomposed, especially that of the upper valve, so much so that the external features of this part are entirely destroyed, but not sufficient to give an entire mould of the interior, still too much to serve for a lucid description of its characters. On the back of the lower valve, by cutting away the clay from under the upper one, the single infolding of the shell of the lower valve at this point is clearly seen.

Formation and locality.—In the Cretaceous limestones near Christianna, Manchester Parish, Jamaica, W. I.

Caprina jamaicensis, n. sp.

PLATE XIII, FIGS. 1 & 2, AND PLATE XV.

Shell large and ponderous, having a diameter across the top of the lower valve of eight inches. Lower valve very oblique, broadly spreading and very much curved, shortest on the hinge side ; its substance quite thick and strongly marked by irregular concentric ridges or growth lines. Upper valve thin, smooth or with microscopic lines on the exterior ; beak large, incurved and overhanging the cardinal side of the lower valve. Within, the shell of this valve is marked by fine, thread-like grooves radiating from the apex.

The above description is of an adult specimen, badly crushed and distorted, and having the basal portion of the lower valve broken away, and one entire side crushed in so as to nearly destroy the original contour. A small shell, having its broadest diameter one and three-fourth inches, is oval in outline on the upper valve, with the apex of that valve only slightly enrolled ; but of this one the lower valve is crushed and compressed so as to obscure the original form. A second upper valve, of nearly the same size as the last, has the same general form and character, being thin and semitranslucent, with the radiating lines of the interior showing through its substance. But all the specimens, like all these large forms, are much crushed and broken, as if by some convulsive movement of the imbedding material, probably resulting from some of the earthquake movements common among the West India Islands.

Formation and locality.—In the Cretaceous limestone at Logie Green, Clarendon Parish, Jamaica, W. I.

EXPLANATION OF PLATE VI.

Radiolites nicholasi Whitf. **Page 186.**

Fig. 1.—View of the summit of a large individual retaining the upper valve in place. The specimen was cut through on the line shown to give the section on Plate VII, Fig. 1. Figure reduced to nearly one-third natural size.

Fig. 2.—View of the surface of a fragment, reduced to one-half natural size, showing the ramifications of the vascular lines, and a section of the visceral cavity.

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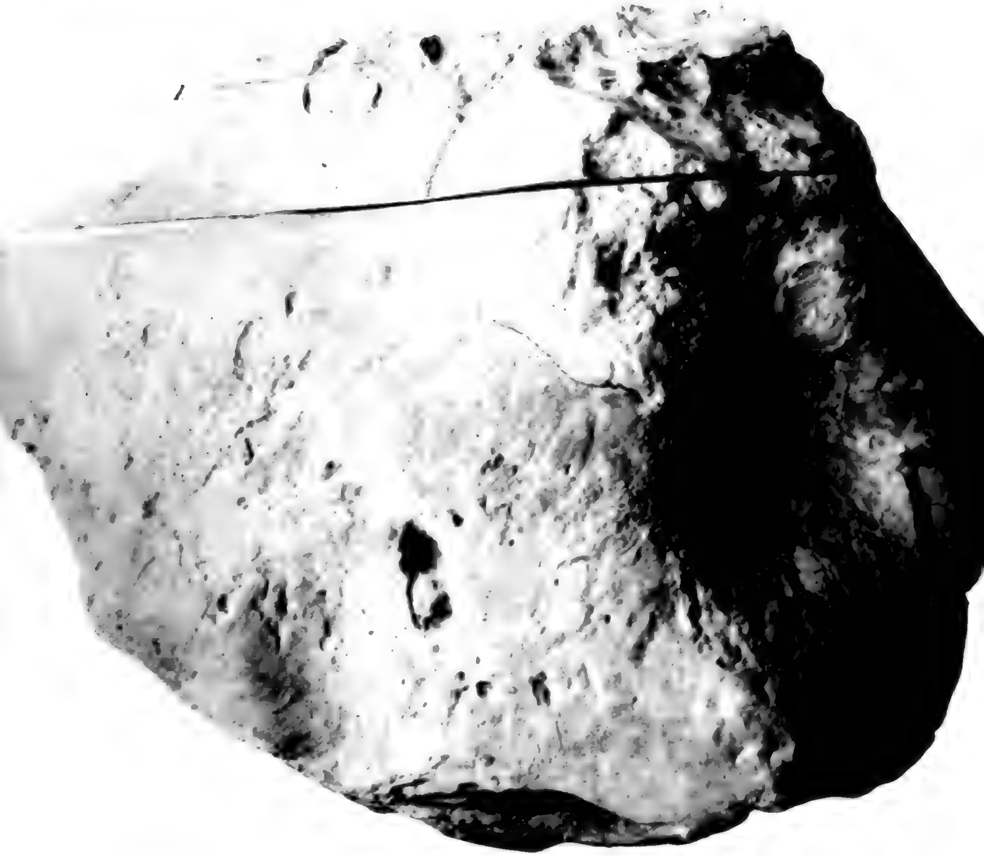

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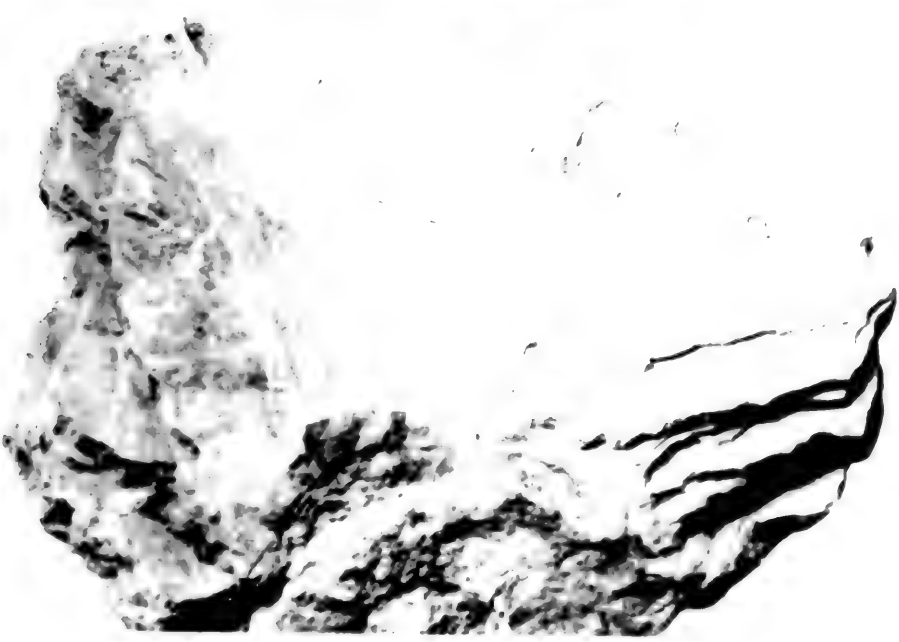
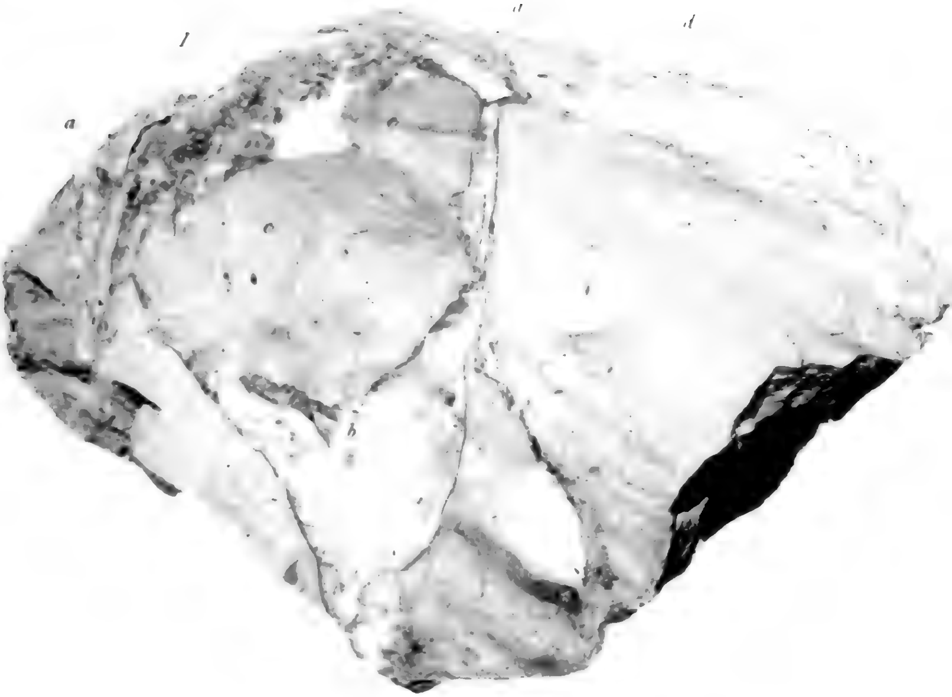


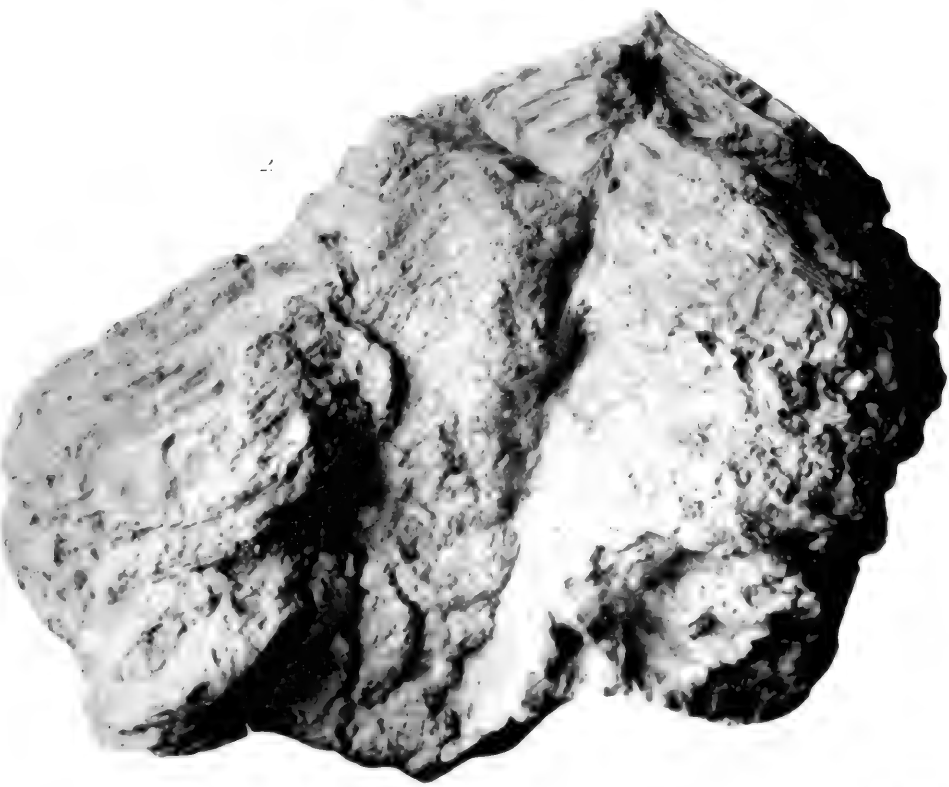
EXPLANATION OF PLATE VII.

Radiolites nicholasi Whitf. Page 186.

Fig. 1.—View of a section of the specimen shown on Plate VI, Fig. 1. *a*, *a*, indicates the upper valve where cut through; *b*, *b*, calcareous filling of the visceral cavity; *c*, *c*, fragments of limestone in the cavity; and *d*, the upper surface of the expanding lamella of the lower valve.

Fig. 2.—View of the back or cardinal side of an example measuring eighteen inches across. The central depressed area is that corresponding to the hinge area, or ligamental area.





EXPLANATION OF PLATE VIII.

Radiolites nicholasi Whitf. **Page 186.**

Fig. 1.—View of a specimen retaining a part of a lower valve with the upper valve in place. The latter has been cleaned out and shows the interior surface, with the walls of the visceral cavity of the lower valve on the upper side. The figure is three-quarters natural size. The view is of the inside of the upper valve which is turned upside down.

EXPLANATION OF PLATE IX.

Radiolites nicholasi Whitf. Page 186.

Fig. 1.—Lateral view of the upper valve shown on Plate VIII removed from the lower valve. Figure reduced to five-sevenths natural size.

Fig. 2.—View of the inner surface of the same, showing the projecting tubercles for muscular attachment ; the denticulated, projecting process on the right end is seen fitting against the inner surface of a fragment of the lower valve, at *a*, still remaining attached to the valve.

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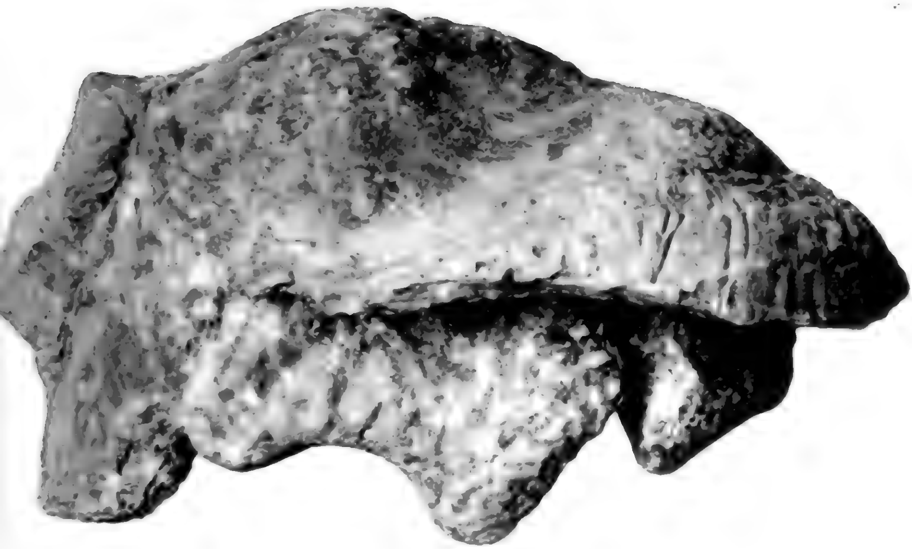

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EXPLANATION OF PLATE X.

Radiolites adhærens Whitf. Page 188.

Fig. 1.—View of a specimen of *Caprinella occidentalis* with a group of small examples of *R. adhærens* attached to it. The group consists of twelve young individuals. Figure natural size.

Figs. 2 and 3.—Two views of a large specimen which had grown with others on a valve of *Caprinella occidentalis*. Figures natural size.

EXPLANATION OF PLATE XI.

Radiolites adhærens Whitf. **Page 188.**

Figs. 1 and 2.—Views, natural size, of a medium-sized specimen attached to *Caprinella occidentalis*, and showing the visceral cavity seen in Fig. 1, while Fig. 2 shows the back of the specimen.

Fig. 3.—A longitudinal section, natural size, of a specimen of this species, showing the depth of the central cavity and the direction of the lamellæ.

Radiolites rudis Whitf. **Page 189.**

Fig. 4.—View of the specimen described, natural size.

EXPLANATION OF PLATE XII.

Radiolites adhærens Whitf. **Page 188.**

Fig. 1.—Another view, somewhat different, of the specimen figured on Plate X, Fig. 1.

Radiolites macroplicatus Whitf. **Page 190.**

Fig. 2.—Side view, two-thirds natural size, of a large, nearly perfect individual retaining the upper valve in place.

Fig. 3.—View, natural size, of two young specimens attached to a fragment of *Caprinella occidentalis.*

Radiolites cancellatus Whitf. **Page 190.**

Fig. 4.—Profile view, natural size, of the specimen figured on Plate XIII, Figs. 3-5.

Caprinella quadrangularis Whitf. **Page 193.**

Fig. 5.—View, natural size, of the apex of a lower valve of this species. See Plate XIV, Figs. 4 and 5, for other illustrations.

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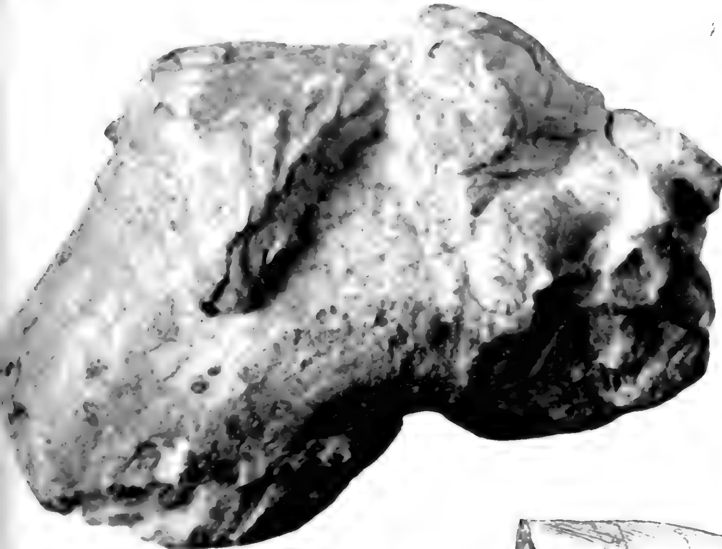
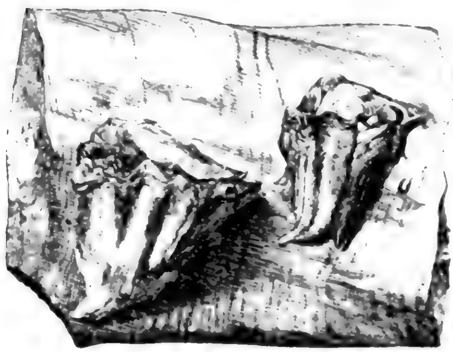




2

EXPLANATION OF PLATE XIII.

Caprina jamaicensis Whitf. **Page 192.**

Figs. 1 and 2.—Upper view showing the upper valve, and lateral view of what is thought to be a young shell of this species. Natural size.

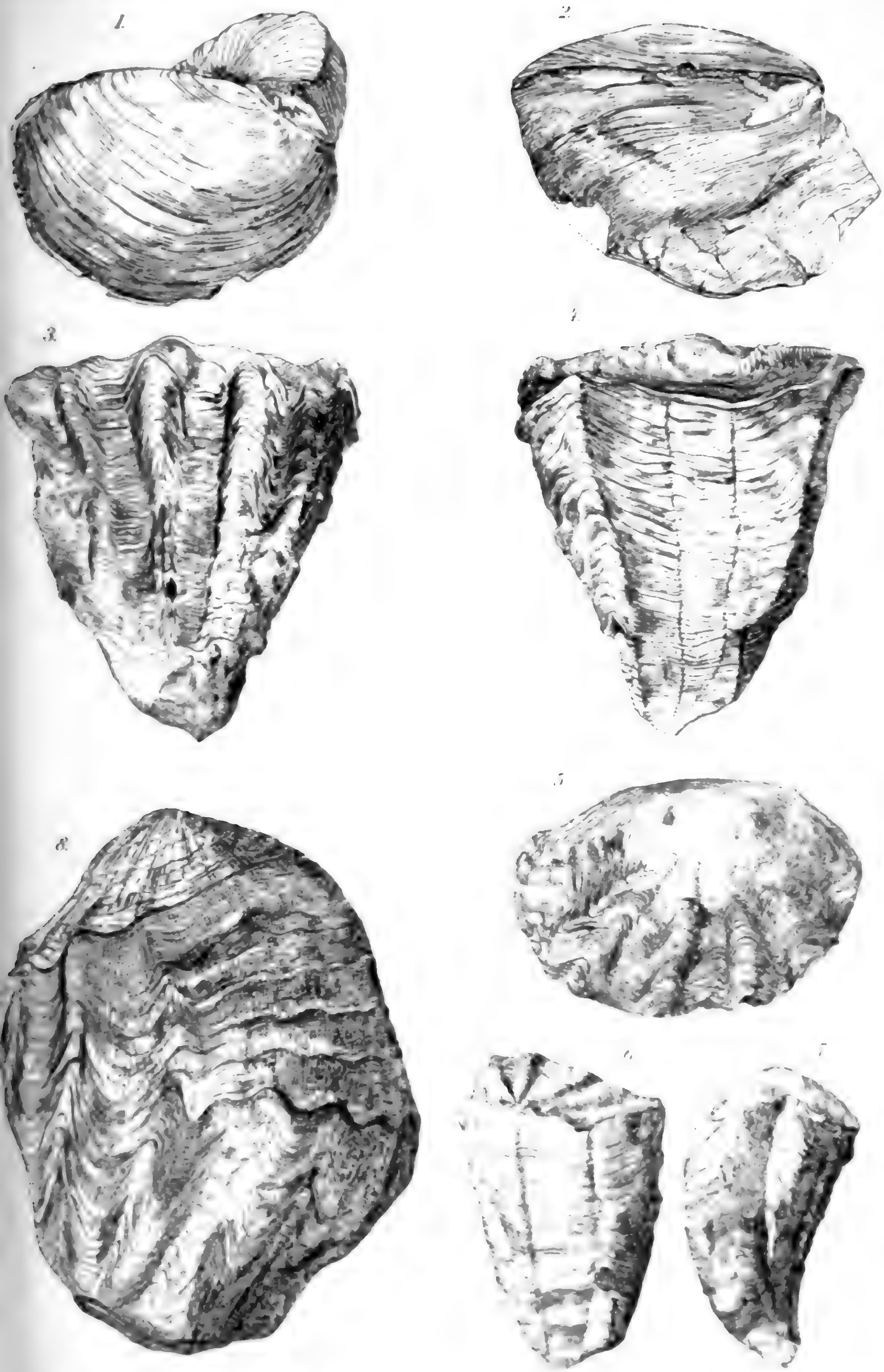
Radiolites cancellatus Whitf. **Page 190.**

Figs. 3, 4 and 5 —Front, back and top views of the largest, nearly perfect individual obtained.

Figs. 6 and 7.—Back, or cardinal, and lateral views of a smaller shell, referred to the same species.

Radiolites macroplicatus Whitf. **Page 190.**

Fig. 8.—View, natural size, of a small imperfect shell of this species, retaining only the cast of the upper valve, and showing irregularities of growth in the lower valve.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EXPLANATION OF PLATE XIV.

Radiolites macroplicatus Whitf. **Page 190.**

Fig. 1.—View, natural size, of a section of a small individual of this species, showing the upper valve in place, and also the lamellæ of both valves.

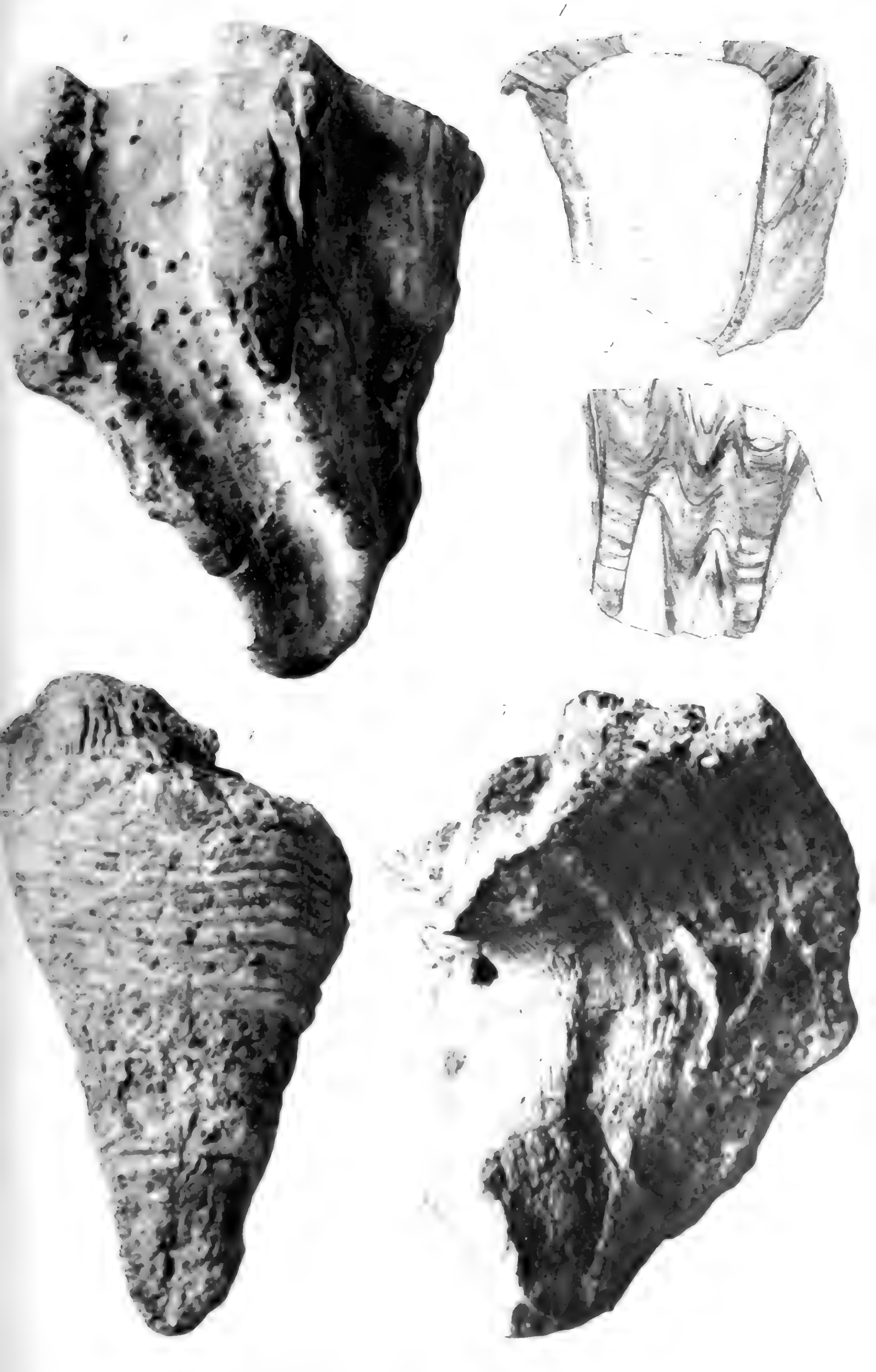
Fig. 2.—View of the back of the same specimen ground off to show the lamellæ and the vertical lines also.

Radiolites annulosus Whitf. **Page 191.**

Fig. 3.—Lateral view, natural size, of the specimen described. The upper valve has been nearly all removed by the solvent action of weathering, and shows the ridges of the muscular scars.

Caprinella quadrangularis Whitf. **Page 193.**

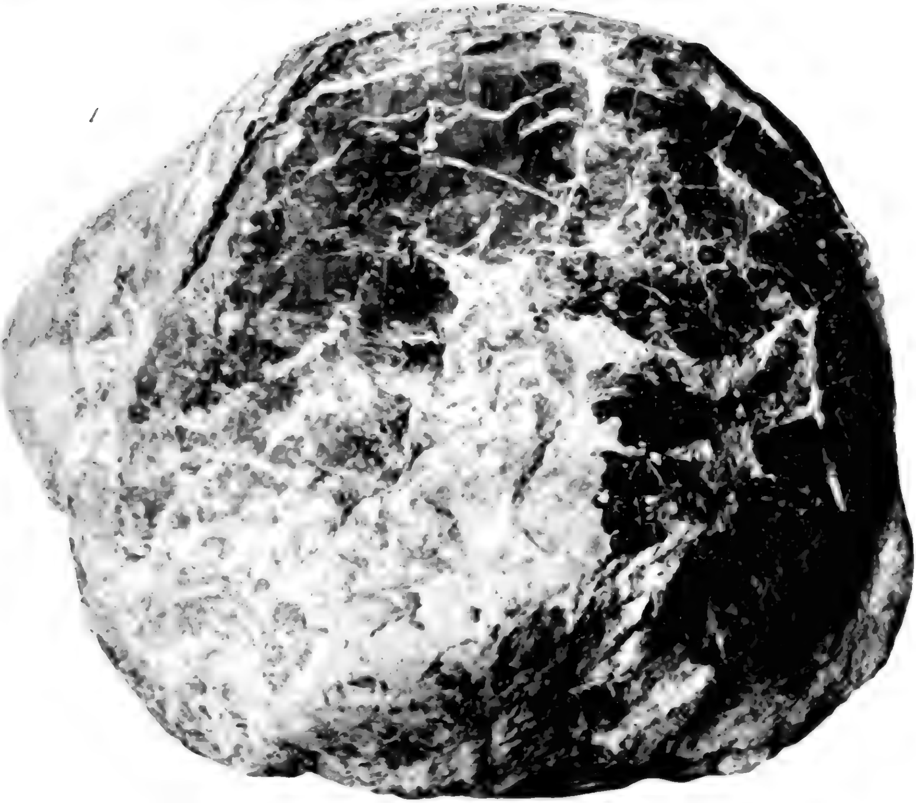
Figs. 4 and 5.—Back and lateral views, two-thirds natural size, of a lower valve of the species, showing the specific features. In the back view, one of the projecting flanges is broken away on the upper half. The shell is partly covered by numbers of a Nullipore, and in Fig. 5 may be seen a young shell of *R. adhærens* in section.

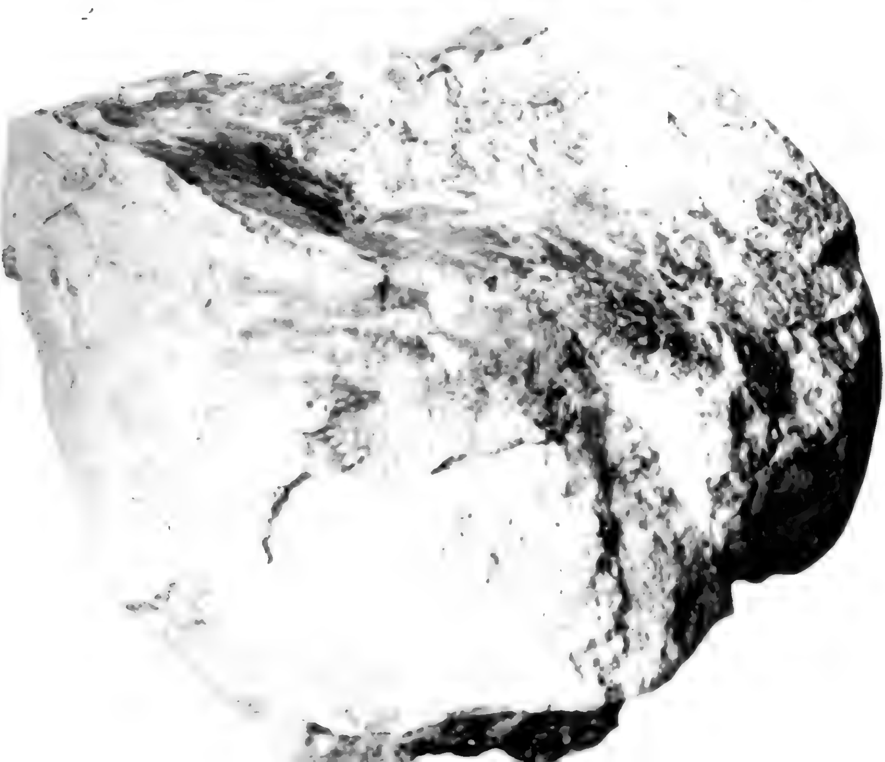


EXPLANATION OF PLATE XV.

Caprina jamaicensis Whitf. **Page 192.**

Figs. 1 and 2.—Top view, showing the upper valve and a lateral view in which the lower valve is shown. This valve is imperfect in the lower part where it was broken from its attachment. The figures are half natural size.





EXPLANATION OF PLATE XVI.

Caprinella occidentalis Whitf. Page 193.

Figs. 1–4.—Views of upper valves showing various forms of coil. Fig. 1 shows the apex dextrally spiral; Fig. 2 is symmetrically coiled and involute; Fig. 3 has the apex slightly turned downward but not involute; Fig. 4 is sinistrally coiled, and also shows the internal surface of the valve. These figures are all two-thirds natural size.

EXPLANATION OF PLATE XVII.

Caprinella occidentalis Whitf. **Page 193.**

Fig. 1.—Side view of an upper valve showing a closely-involuted apex. Reduced one-third.

Figs. 2–4.—Views of three lower valves presenting different forms. Figs. 2 and 4 are two-thirds natural size, and Fig. 3 is natural size.

EXPLANATION OF PLATE XVIII.

Caprinula gigantea Whitf. Page 194.

Fig. 1.—Lateral view of what is supposed to be a fragment of an upper valve, reduced one-third in size. A large part of the back of the shell has been broken off, probably one-half the original width, exposing the inner surface of the large central cavities. The top of the specimen shows the openings and pits like those on the lower valve shown on Plate XX, Fig. 1.

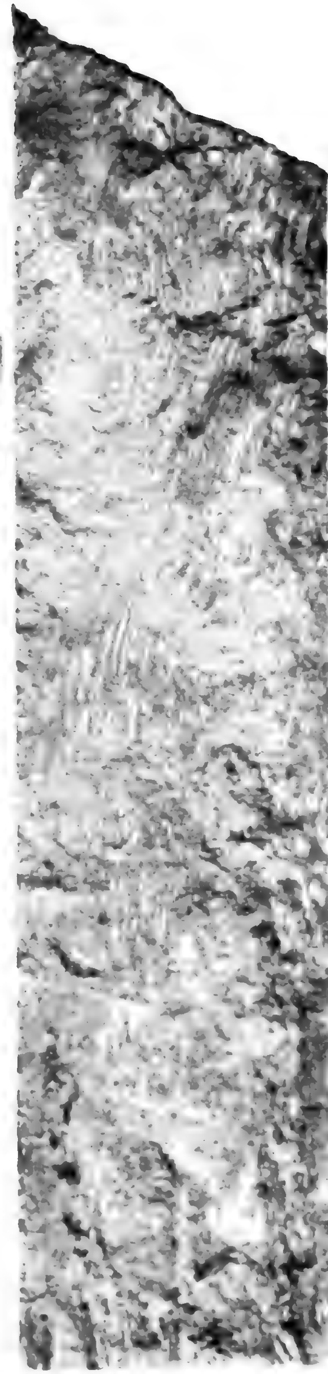
EXPLANATION OF PLATE XIX.

Caprinula gigantea Whitf. **Page 194.**

Fig. 1.—View, two-thirds natural size, of the apical portion of a lower valve which has been split longitudinally, retaining only the inner half of the shell. On the broken surface at the top it shows, at *b*, the large septate cavity, and at *a*, several of the longitudinal tubes which open upon the inner surface of the living chamber of the shell.

Fig. 2.—View, natural size, of a portion of the inner split surface of the specimen, the end of which is shown on Plate XXI, to show the capillary tubes which traverse the entire length of the valve.

1



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EXPLANATION OF PLATE XX.

Caprinula gigantea Whitf. Page 194.

Fig. 1.—Shows the back of the same specimen figured on Plate XIX, reduced to the same extent, and illustrating the large cavities of the central portion of the valve. In the outer one there is the filling of one of the smaller tubes that penetrate the marginal portion of the valve.

EXPLANATION OF PLATE XXI.

Caprinula gigantea Whitf. Page 194.

Fig. 1.—View of a broken end of part of a lower valve, natural size, showing the large septate tube or chamber which traverses its length, and at *a*, *a*, two of the smaller tubes. Around the outer margin can be seen the small tubes spoken of in the description. All the intermediate substance is finely fibrous, and a strip of lower surface of this specimen is shown on Fig. 2, Plate XIX, natural size. The specimen has been split longitudinally near the middle and weathered so as to show this structure very finely.

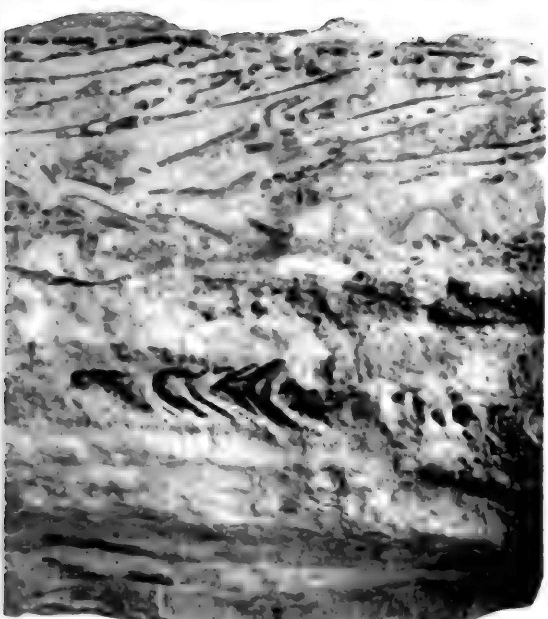
EXPLANATION OF PLATE XXII.

Caprinula gigantea Whitf. **Page 194.**

Fig. 1.—View of a fragment, natural size, of a lower valve showing the surface of the interior imperfectly. The top of the figure shows the edge of the valve at *a*; at *b*, is seen the surface of one of the large vertical chambers, and over the rest of the surface many of the orifices of the smaller vertical tubes are shown, while the ends of the fibrous capillary structure may be recognized in the finely pitted surface caused by their concave ends.

Fig. 2.—View of a part of a specimen split longitudinally and weathered, showing the septa in one of the large central cavities. Along the lower edge of the figure is seen one of the smaller septate cavities.

Fig. 3.—View of a part of a split specimen, showing the septa of a large cavity and also those of one of the smaller ones, the two having the same relations to each other as those in Fig. 2 above it. These figures are all from photographs, natural size.



Caprinella quadrangularis, n. sp.

PLATES XII AND XIV.

Shell known only by the lower valve, which, in all the cases seen, is rudely quadrangular and twisted, so as to present about one-fourth of a turn in the length of a shell. Valve rapidly expanded from the apex, which was the point of attachment, and marked by numerous longitudinal ribs or costæ, which vary in size from 1 mm. in width to three or more centimeters, some of them often becoming broad, projecting, flange-like expansions, which produce the quadrangular outline when seen in a transverse section. The intermediate ribs may become obsolete and leave comparatively smooth spaces on the exterior of the cup. Upper valve and interior unknown.

This species is readily distinguished by the greater size of the longitudinal capillary tubes, of which the outer part of the shell is composed, as they are often fully one, and not uncommonly 2 mm. in diameter, whereas those of the other species are generally not much more than half of one mm. in diameter.

Formation and locality.—In the Cretaceous limestones at Christianna, Manchester Parish, Jamaica, W. I.

Caprinella occidentalis, n. sp.

PLATES XVI AND XVII.

Shell of moderate size and very inequivalve, the lower valve long, straight, slightly enrolled, twisted or loosely spiral like a corkscrew, smooth, ribbed, or slightly channeled on the exterior surface, and gradually expanding from the apex outward. Upper valve coiled and generally more or less involute, often closely so and nearly symmetrical, the exterior surface being nearly smooth or with spiral ridges extending from the apex to the border of the valve; the ridges, from five to ten in number, are elevated and distinct, rounded or subobsolete.

Interiorly the substance of both valves is made up of fine longitudinal tubes, which are divided transversely at distances about equal to their own diameter by horizontal septa, very like those of the palæozoic coral *Favosites*, giving to the weathered shell a strongly fibrous structure. A large central cavity traverses the entire length of the lower valve subcentrally, which is strongly and distantly septate by very oblique, curved septa. The upper valve is also traversed by a central cavity in which the septa are very irregular, very much more oblique, and generally much more delicate in texture than those of the lower; some of them appear to extend into the central cavity as free lamellæ before cutting off the cavity from the space below.

The internal surface of the valves shows the ends of the capillary tubes, or rather the surface of the transverse diaphragms or septa, and the tubes seem to be pretty generally hexagonal in form, although varying in size. The surface of the upper valve presents the large, rather deep oblique central cavity, a large, somewhat flabellate muscular scar with a broad shallow depression to the right of it, also flabellate, as well as a large, abrupt, irregular marginal depression. The detail of the interior of the surface of the lower valve has not been observed in full, but it appears somewhat similar to that of the upper.

The fibrous appearance dependent on the existence of the capillary tubes depends to a considerable extent on the presence of the outer layer of these tubes, which if septate at all, are only distantly so, and they are also much wider in a radial direction of the body than in a concentric direction, so that in a transverse section of a shell the tubes of a marginal range are elongate-oval radially; while the others in the outer layer are polygonal and of various sizes, as well as pretty closely septate.

Formation and locality.—In the Cretaceous limestones at Logie Green, Clarendon Parish, and near Christianna and elsewhere in Manchester Parish, Jamaica, W. I.

Caprinula gigantea, n. sp.

Plates XVIII, XIX, XX, XXI and XXII.

The genus *Caprinula* of D'Orbigny is represented in the collection by a large number of fragments of a gigantic species, which must have been several feet in length, judging from the size of some of the larger fragments, one of which indicates a diameter of twelve inches (30 cm.), if the shell was elliptical in a transverse section, but if it was round it must have been at least sixteen inches (about 40 cm.) in diameter. The specimens are curved apparently in a plane. Some of the apical portions where the length, measuring along the outer curvature, will be about twenty inches, represent about one-half of one volution. The shells are strongly ribbed longitudinally on these sharply-curved individuals, which would indicate them to be the upper or smaller valves according to the generic description given by D'Orbigny, while the larger ones are straighter, sometimes almost straight, with a comparatively smooth exterior, or with a few longitudinal ribs on the inner curvature, and also distant, broad, indistinct annulations marking the shell.

Interiorly the shell of the lower or straighter valve is traversed by a large subcentral cavity which is rudely septate, sometimes quite distantly so, and very oblique; at other times somewhat regularly and approximately septate, the septa less oblique. In one specimen there are two smaller cavities with funnel-shaped septa arranged at variable distances of a fourth of an inch or less, and not open at the points, so as to connect with each other. Besides these there are longitudinal tubes of various sizes, traversing the entire length of the shell and opening on the surface of the visceral cavity of the valve, so that the living surface of the shell is occupied by these openings from just within the border of the shell to within a short distance of the central cavities. In one part of one individual there are six ranges of these tubes visible side by side radially, varying from an eighth of an inch in diameter to half an inch, some round, some oval, and others irregular in shape; on other parts of the same specimen there are only one, two or three ranges, one within the other, but all very irregularly placed. In D'Orbigny's figure of the generic type, *Caprinula boissyi*, he shows four ranges of tubes, each varying in size from minute ones near the outer edge to very large ones bordering the visceral cavity. In our specimen they are entirely without order, either as to size or arrangement in their relations to the outside or inside of the thickness of the shell. All the intermediate substance of the shell is composed of minute capillary tubes, as in *Caprinella*, except that the tubes, although quite small, are only distantly septate, sometimes a centimeter distant and occasionally only half a millimeter apart. Only fragments of the natural surface of the visceral cavity have been observed; on these the longitudinal tubes are seen to open upon the surface as round or oval holes, having a raised rim, the intermediate portion being depressed slightly, and the entire surface covered by small pits representing the ends of the capillary tubes, which gives to the surface a beautifully punctate structure.

This species seems to be exceedingly abundant, as there were large numbers of the fragments obtained, but none of much more than ten or twelve inches in length, except two of the rapidly-curved specimens, which may possibly represent the upper valves, and even these have been broken and split lengthwise so that the entire diameter, except near the apex, is not present. Only a single small fragment shows the entire diameter of what is supposed to be the lower valve, so that only a partial description can be given. It is altogether probable that this species is the one referred to in several places in J. G. Sawkin's Geology of Jamaica, 1869, and in the appendix of that report, as a Hippurite, which occurs of six or seven feet in length.

Formation and locality.—In the Cretaceous limestones at Logie Green, Clarendon Parish, Jamaica, W. I.

Development of the Young Radiolites.

In the collection are numbers of young specimens of *Radiolites* measuring from 3 mm. upward, which are attached to some of the other specimens by the whole width of one surface, but are too small to possess the specific features necessary to refer them to their kinds. Some of these would appear from their rapid expansion in width to pertain to *R. macroplicatus*, while others are quite slender. Most of them agree in being quite angular on their outer surfaces, and when the core which has filled the visceral cavity can be obtained, it appears to be generally hexagonal. The lower valve shows the minute apex to be coiled to the left in all the cases noticed, and to consist of only one coil, or in some cases of only half a coil, and looking much like the first coil of a *Spirorbis*, except that the coil is dextral.

At this period of growth the upper valve is frequently in place and situated, with the apex sublateral, generally to the right and near the attached side. The surface is convex and concentrically and radiately marked.

One specimen, which is rather more than a centimeter long, has a slightly greater width at the top, the lower valve is somewhat triangular in transverse section; and has the commencement of two strong angular plications, partially developed, showing on each valve. This I have supposed might be the young of *R. macroplicatus*.

Article XIII.—ON A COLLECTION OF MAMMALS FROM JALAPA AND LAS VIGAS, STATE OF VERA CRUZ, MEXICO.

By J. A. Allen and Frank M. Chapman.

This paper is based mainly on a collection of some 250 specimens made by the junior author, with the assistance of Señor Mateo Trujillo, at a point distant one and a half miles east of the city of Jalapa, from March 28 to April 16, 1897. The country is here largely under cultivation in corn and coffee, but there are also grazing lands, tracts of scrubby bushes, young second-growth, and fairly large areas of fine old forests containing an occasional bit of first-growth timber. The region is by no means wild, and the larger mammals have long since disappeared, while even certain smaller mammals which rank as game—*e.g.*, Squirrels and Rabbits—are now comparatively rare. The representatives of the family Muridæ, however, are exceedingly abundant, the large quantity of corn raised annually doubtless proving an attraction, to which the seeds of weeds growing in the old cornfields probably adds.

Jalapa, at an altitude of 4400 feet, is in the *tierra templada* or temperate region of Mexico, where, in addition to certain indigenous forms, species characteristic of the adjoining tropical (*tierra caliente*) and alpine (*tierra fria*) regions are also found, as shown, for example, by the occurrence of *Marmosa* and *Microtus*.

April 20 to 26 was passed at Las Vigas, on the border of the table-land, 3600 feet above Jalapa. This locality is in the *tierra fria húmeda*, or humid alpine region, and possesses a fauna wholly unlike that of Jalapa. The faunal position and relationships of both localities, however, will be dwelt upon in a future paper on the birds of the region. Little time was here given to mammal work, and only the following species were secured: *Reithrodontomys saturatus*, sp. nov., *Peromyscus melanotis*, sp. nov., *Sciurus niger melanonotus*, *Cratogeomys estor*.

Acknowledgments are due Mr. John Brookes, of Jalapa, for kind permission to camp and hunt upon his estate, and especially to Señor Mateo Trujillo, of Jalapa, whose thorough knowledge of the ground, and skill as a collector, proved of the utmost value.

1. **Sciurus niger melanonotus** *Thomas.*— One specimen, ♂ ad., Las Vigas—a topotype of the species.

2. **Sciurus deppei** *Peters.*—Two specimens, both males, Jalapa, March 29 and April 14.

Apparently uncommon. The two specimens secured were the only ones observed.

3. **Sciurus leucops** (*Gray*).—Two specimens, both adult females, Jalapa, April 5 and 11.

These specimens are referred with some hesitation to *S. leucops*, with which they agree fairly well in all features except that the general color above is a darker, clearer gray than in true *leucops*. This, however, may be due to the condition of the pelage, which is mostly of the new coat, and rather short, being not fully grown.

Formerly abundant, but now not common in the immediate vicinity of Jalapa.

4. **Mus musculus jalapæ,** subsp. nov.

Middle of dorsal region, from front of head to base of tail, uniform deep black; sides yellowish gray or ordinary mouse color; ventral surface pale buffy gray; tail black; feet and ears dark brown.

Total length, 164; tail vertebræ, 82; hind foot, 18; ear, 14. (Average of 10 adults.)

Type, No. $\frac{12520}{10830}$, ♀ ad., Jalapa, April 14, 1894; Frank M. Chapman.

A series of 16 specimens, taken in the fields at Jalapa, conforms very closely to the above description, and represents the opposite extreme from the red phase of *M. musculus* met with so frequently in the southwestern parts of the United States, as notably at several localities in Texas and Arizona. The striking feature is the generally dark coloration, and the broad black dorsal band occupying one-third to one-half of the whole dorsal area.

A common inhabitant of old fields where it was associated with *Reithrodontomys mexicanus*, *R. rufescens*, *Peromyscus musculus brunneus*, *Oryzomys fulvescens*, and *Microtus quasiater*.

5. Reithrodontomys mexicanus *De Saussure.* — Represented by 14 specimens, 10 males and 4 females, all adult, taken at Jalapa, March 29–April 14. They present the following measurements :

	Total Length.	Tail Vertebræ.	Hind Foot.	Ear.
10 ♂♂	161.5 (153–169)	90 (80–100)	18.4 (18–20)	15.8 (15–17)
4 ♀♀	160 (155–165)	87 (85– 88)	18.5 (18–19)	15.7 (14–17)

In this species the tail is dull light brown above, and much lighter, grayish white below, being sharply and distinctly bicolor. The dorsal half is practically naked, while the ventral half is so well clothed with whitish hairs that the annulations are wholly concealed.

The upper surface of the body is brown, rather darker medially as a rule, suffused to a slight extent with fulvous, passing gradually to a clear bright fulvous lateral band ; the ventral surface is dull grayish white, with often a barely perceptible wash of pale buff, and an indistinct pectoral area of fulvous.

A comparison of this large series of what is evidently true *R. mexicanus* with our *R. mexicanus gracilis* (*anteà*, p. 9), from Yucatan, shows that the latter is specifically separable, and should stand as *Reithrodontomys gracilis*, characterized by its much smaller size, much paler and more yellowish coloration above, clear white underparts, and blackish, naked, and nearly unicolor tail.

Common in old weedy fields and the scrubby growth about cornfields.

6. Reithrodontomys rufescens, sp. nov.

Above rufous, varied with black, the black prevailing over the middle region of the back, forming a broad median blackish band ; sides orange rufous ; top of head rather lighter and more rufous than the back ; ventral surface orange buff, varying in different specimens from dull buffy gray to deep orange buff ; chin, throat and inside of fore limbs lighter, whitish ; ears very large, clothed thinly with fine dusky hairs, nearly black on both surfaces, lightening to dark horn color basally, especially within ; fore feet dusky, the toes whitish ; hind feet dusky with a grayish cast ; soles of hind feet brown, of fore feet flesh color ; tail blackish, almost unicolor, being only slightly lighter below than above, nearly naked.

Measurements.— Total length (of type), 177 ; tail vertebræ, 99 ; hind foot, 20 ; ear from notch, 17. Eleven adult males and 4 adult females measure as follows :

	Total Length.	Tail Vertebræ.	Hind Foot.	Ear.
11 ♂♂	175.5 (168–190)	95 (91–104)	19.5 (19–20)	16.5 (15–17.5)
4 ♀♀	172 (168–179)	96.5 (93–103)	19 (18–19)	17 (16–18)

Skull.— Total length, 23; basal length, 18.7; zygomatic breadth, 11.3; width of brain-case, 11; interorbital breadth, 3.5; length of nasals, 9; palatal length, 9; length of anterior palatine foramina, 5; upper tooth row, 3.6; diastema, 5.5.

Type, No. $\frac{12488}{10802}$, ♂ ad., Jalapa, April 5, 1897; Frank M. Chapman.

This species is based on a series of 17 specimens – 13 males and 4 females, all adult except two, which are nearly full size. The young specimens are darker and much less ferrugineous than the adults. The latter are very uniform in coloration above, differing mainly in the shade of ferrugineous tint on the sides; below two or three specimens show much more whitish than the others, one being nearly clear white. In most examples the plumbeous tint of the under fur is mixed with and more or less obscured by the buffy wash that forms the prevailing hue of the underparts; in some specimens this buffy tint deepens into orange buff, and wholly conceals the plumbeous under fur.

Reithrodontomys rufescens differs from *R. mexicanus* in its much larger size, relatively as well as absolutely larger and blacker ears, much darker dorsal region, brighter, more orange rufous on the sides, and uniformly buffy ventral surface. The skull is also larger, but otherwise similar, except that the nasals are more pointed behind, ending in a V-shaped point, and the posterior border of the frontals is evenly convex instead of forming a sharp angle, as in *R. mexicanus.*

In some respects this species appears to strongly resemble *Reithrodontomys sumichrasti* De Saussure[1], which is described as being of the same size as *R. mexicanus*, and from the description does not seem to differ from that species, except in the darker and brighter yellowish rufous of the upper parts. It thus differs from *R. rufescens* in smaller size, in having white feet, and a bicolored tail. No definite type locality for *R. sumichrasti* is given—simply "Mexicana tellus." *R. rufescens* is further distinguished from both *R. mexicanus* and *R. sumichrasti* in the absence of red hairs on the inner surface of the ears, which are clothed with black hairs on both surfaces.

Common; associated with the preceding species.

[1] Rev. et Mag. de Zool. (2), XII, 1861, p. 3.

7. Reithrodontomys saturatus, sp. nov.

Above very dark brown, much varied with blackish near the median line, faintly suffused with grayish fulvous, which latter becomes the prevailing tint on the sides near the lateral line; below plumbeous washed with whitish, the hairs being for the most part plumbeous tipped with whitish; ears very large, dark brown, well haired on both surfaces, darker than the surrounding parts; fore and hind feet dull grayish white, the hind feet a little darker than the fore feet; soles of the hind feet dull brown, of the fore feet much lighter; tail well-haired, sharply bicolor, dark brown above, gray below, short, barely equalling the length of head and body.

Measurements.— Total length (of type), 148; tail vertebræ, 74; hind foot, 18; ear from notch, 18. Four specimens, two males and two females, all adult, measure as follows: Total length, 141 (129–149); tail vertebræ, 70.2 (63–81); hind foot, 17.2 (16–18); ear, 16.7 (15–18).

Skull.— No very marked cranial characters. Total length, 21; basal length, 17; zygomatic breadth, 11; width of brain-case, 10; interorbital breadth, 2.5; length of nasals, 8; palatal length, 8; length of anterior palatine foramina, 4.5; upper tooth row, 3.3; diastema, 5.

Type, No. [illegible], ♂ ad., Las Vigas, State of Vera Cruz, April 26, 1897; Frank M. Chapman.

This species is based on 4 specimens, collected at Las Vigas, April 24–26, all adult.

Reithrodontomys saturatus belongs to the *R. megalotis* group, having for its nearest known ally *R. megalotis* (Baird), from which it differs externally in slightly larger size, larger ears, and very dark coloration, being in this respect very unlike other members of the *R. megalotis* group, being as dark even as the very darkest examples of *R. longicauda*. A comparison of the skulls of the two species shows no tangible differences.

The specimens secured were captured along the grassy banks of a dry arroyo.

8. Peromyscus furvus, sp. nov.

Above dark brown with a grayish wash and a rather faint suffusion of dull cinnamon fawn, darker, almost blackish, along the median line, more ruddy on the sides; below clear grayish white, with no trace of a fulvous or reddish pectoral spot; fore feet white with a tinge of flesh color, soles flesh color; hind feet soiled grayish white, soles blackish; both fore and hind feet quite thinly haired; ears dark brown, nearly naked (fine, short hairs can be seen under a lens); tail naked, dark brown, scarcely lighter below than above, the extreme tip often whitish; the annulations of the tail are not at all concealed by the very short hairs, which are scarcely visible except under a lens.

Total length (of type), 270; tail vertebræ, 131; hind foot, 28; ear, 23. Fourteen adult males and 8 adult females measure as follows:

	Total Length.	Tail Vertebræ.	Hind Foot.	Ear.
14 ♂♂	263 (248–282[1])	131 (123–145[1])	27.9 (26–29)	21.9 (20–23)
8 ♀♀	250 (243–260)	125 (120–130)	27.3 (26–28)	21.5 (21–22)

Skull.—Skull very large in comparison with the external measurements of the animal, and very strong and heavy for a *Peromyscus*, but it is nevertheless a true *Peromyscus* in dentition and cranial details, except in the rostral portion. Rostrum very broad, inflated anteriorly, and distinctly bell-shaped, the breadth across the tip of the nasals, in very old specimens, equalling the interorbital breadth, instead of narrowing to about one-half this width, as in most species of the genus. Posteriorly the nasals are pointed and extend considerably (about 2 mm.) beyond the intermaxillaries. Palate with a thickened, slightly upturned posterior border. Anterior palatine foramina very broad.

Total length (of type), 35; basal length, 29; zygomatic breadth, 16.7; width of brain-case, 14.3; least interorbital breadth, 5; breadth of nasals at anterior border, 5; length of nasals, 8; anterior palatine foramina, 6×3; upper toothrow, 5; diastema, 9.5.

Type, No. $\frac{12450}{10789}$, ♂ ad., Jalapa, April 2, 1897; Frank M. Chapman.

This species is based on a series of 25 specimens—16 males and 9 females—collected at Jalapa; all are adult except 3, which are nearly full grown. They are very uniform in coloration; some are a little more ruddy than the average, and others are less so, and blacker. The younger specimens are nearly uniform blackish brown above, with a slight hoariness, most pronounced on the head and sides of the body.

Externally *Peromyscus furvus* greatly resembles *P. californicus*, the two agreeing almost exactly in external dimensions,[2] except that the ears are about one-third smaller in *P. furvus* than in *P. californicus*. They further differ in the tail being naked in *P. furvus*, instead of well clothed with hairs as in *P. californicus*. They agree in the general darkness of the coloration, though *P. furvus* is much the darker of the two, and the yellowish suffusion seen in *P. californicus* is replaced by a dull reddish tint in *P. furvus*. In both species there is the same tendency to a white-tipped tail.

[1] Exceptionally large; no other specimen exceeds 270 in total length, and only one other exceeds 135 in length of tail.

[2] For measurements of a large series of *P. californicus*, see this Bulletin, Vol. VIII, p. 267.

In cranial characters they are widely separated, the skull in *P. furvus* being very much the larger, with the rostral portion of the skull very broad and widening greatly at the anterior border, forming a bell-shaped nose. The nasals are thus very broad anteriorly, but taper posteriorly to a broad V-shaped point, and extend much beyond the zygomatic process of the intermaxillaries.

Found only in the heavier woods, where it lives in holes in the ground or beneath the roots of trees.

9. Peromyscus melanotis, sp. nov.

Similar to *P. rufinus*, but paler, with much larger and blacker ears.

Above pale yellowish brown, varied with darker, darkest along the median line, brighter and more brownish on the sides; beneath and feet white; ears large, black, narrowly edged with white; tail well haired, slightly penicillate, sharply bicolor, a line of blackish running down the median line above, leaving nearly four-fifths of the circumference of the tail dull white.

Two-thirds grown young are dusky plumbeous with a slight wash of gray, tinged slightly with pale fulvous.

Total length, 162 (160–164); tail vertebræ, 68.5 (66–71); hind foot, 20 (20–20); ear, 20 (20–20). (Average and extremes of two adults.)

Skull.—Total length, 27; basal length, 22; zygomatic breadth, 14; width of brain-case, 12; interorbital breadth, 4; length of nasals, 11.5; palatal length, 11; length of anterior palatine foramina, 5.5; upper tooth row, 4; diastema, 6.

Type, No. [illegible], ♂ ad., Las Vigas, State of Vera Cruz, Mexico, April 30, 1897; Frank M. Chapman.

This species is represented by 3 specimens—1 ♂ ad., 1 ♀ ad., 1 ♂ juv.—taken at Las Vigas, April 23–26.

Peromyscus melanotis appears externally like a pale phase of *P. rufinus*, with larger and *black* ears. The skull, however, is relatively larger, and the rostral portion is more slender.

10. Peromyscus musculus brunneus, subsp. nov.

Similar to *Peromyscus musculus* (Merriam), but much darker and rather smaller, with smaller ears and shorter hind feet

Above dark drab gray with a decided tinge of reddish, and slightly varied with black-tipped hairs, paler on the sides; lower parts grayish white with a strong tinge of buff; ears very dark brown, naked (very fine short hairs are visible under a strong lens); tail brown, nearly naked, a little lighter below than above; feet soiled whitish; soles of hind feet nearly naked, with conspicuous blackish tubercles.

Measurements.— Total length (of type), 120; tail vertebræ, 50; hind foot, 15; ear, 13. The averages and extremes of 38 adults are as follows:

	Total Length.	Tail Vertebræ.	Hind Foot.	Ear.
20 ♂♂	118 (110–130)	46.8 (40–51)	15.3 (14.5–16.5)	13 (12.5–15)
18 ♀♀	119 (110–126)	46.5 (40–53)	15.5 (14–16)	13.1 (12–15)

Skull.— Total length, 15; basal length, 12.5; zygomatic breadth, 11; width of brain-case, 10; interorbital breadth, 4; length of nasals, 7.5; palatal length, 7; length of anterior palatine foramina, 4.4; upper tooth row, 3.2; diastema, 4.5.

Type, No. $\frac{12535}{10848}$, ♀ ad., Jalapa, State of Vera Cruz, Mexico, April 13, 1897; Frank M. Chapman.

This subspecies is represented by 38 specimens (20 males and 18 females), all adult, taken at Jalapa, March 29–April 15. They are quite uniform in coloration. The range in measurements has been already indicated. It may be further stated that 17 of the 38 specimens fall below 120 mm. in total length, and 4 exceed 124 mm.; 7 specimens fall below 45 mm. in tail length, and 3 exceed 50 mm.

Peromyscus musculus brunneus differs from *P. musculus* in slightly smaller size, including a shorter hind foot and smaller ears, but more especially in its much darker coloration throughout.

We are indebted to Dr. C. Hart Merriam, Chief of the Biological Survey, U. S. Department of Agriculture, for 4 topotypes of *P. musculus*, loaned for examination in the present connection.

Common in weedy fields, and abundant in old cornfields from which the stalks had not been cleared.

11. Peromyscus aztecus (*De Saussure*).—An adult female was taken in a piece of heavy woodland, March 30.

12. Rhipidomys sumichrasti (*De Saussure*).—One specimen, from Jalapa, presented by Mr. John Brookes.

13. Oryzomys fulvescens (*De Saussure*).

Hesperomys fulvescens De Saussure, Rev. et. Mag. de Zool. (2), XII, March, 1860, p. 102. "Habite le Mexique."

This species is represented by a series of 37 specimens—19 males and 18 females—all practically adult, taken at Jalapa in April.

These specimens average slightly larger than the measurements given by De Saussure, though those of the half-dozen smallest specimens of the series practically agree with the measurements given by De Saussure.

	Total Length.	Tail Vertebræ.	Hind Foot.	Ear.
19 ♂♂....	180.5 (168–200)	103.7 (96–116)	21.3 (19–23)	14.5 (13–16)
18 ♀♀....	181 (169–205)	105 (96–116)	20.5 (20–23)	14.3 (13–16)

Of these 37 specimens 8 fall below a total length of 175 mm., and 5 exceed 190 mm.; the tail length falls below 100 mm. in 8 specimens, and exceeds 110 mm. in 6 specimens.

This species finds a near ally in *Oryzomys costaricensis* Allen, from Boruca, Costa Rica, which differs in being less dark above, and less strongly washed with fulvous below. They are perhaps, however, only geographical forms of the same species. *Oryzomys delicatus* Allen & Chapman, from Trinidad, and *Oryzomys gracilis* Thomas, from Colombia and Nicaragua, are also near allies.

Abundant in old fields, and occasional in small grassy swamps.

14. Oryzomys melanotis *Thomas.*

Oryzomys melanotis THOMAS, Ann. & Mag. Nat. Hist. (6), XI, 1893, p. 404. Mineral, San Sebastian, Jalisco, Mexico.

This species is represented by 28 specimens, taken at Jalapa, March 30–April 13; only about one-half prove to be adult, and only four of these are old, the greater part of the series being more or less immature, although none are very young. One very old male greatly exceeds any of the others in size, and is the reddest specimen in the whole series.

Taking the 16 oldest specimens, although some are obviously under mature size, we have the following averages and extremes:

	Total Length.	Tail Vertebræ.	Hind Foot.	Ear.
11 ♂♂...	222.4 (210–265[1])	119 (111–132[1])	25.2 (24–27)	17.5 (15.5–19)
5 ♀♀...	219 (208–235)	116 (110–125)	24.6 (24–25)	17.6 (17–19)
Type of *O. melanotis*,	224	127	28	18

Mr. Thomas states that the type of his *O. melanotis* is an old male, "with the molar teeth much worn down." The few specimens in the present series comparable with this as regards age, equal or exceed the size of Mr. Thomas's type, but the large

[1] The next largest specimen has a length of 238, and only two others reach 235 in total length. Two other specimens reach a tail length of 128

proportion of 'young adults' among the Jalapa specimens, of which the measurements are above summarized, considerably reduces the average, as would be expected.

The large black ears, the grizzled rufous coloration of the upper parts, the whiteness of the lower surface, and the generally slender form, together with the size and proportions given as the distinctive features of *O. melanotis*, so clearly characterize the Jalapa animal that it seems advisable to accept Mr. Thomas's name for it in spite of the fact that the type locality of *O. melanotis* is on the western slope, and doubtless in a very different physiographic region. The cranial characters, however, do not agree so well, in *O. melanotis* the "anterior palatine foramina ending in front of ^{m1} a distance nearly equal to the length of $\underline{m2}$," whereas in the Jalapa specimen's the anterior palatine foramina end on a line with the front edge of $\underline{m1}$.

An abundant inhabitant of the woods.

15. Oryzomys jalapæ, sp. nov.

Above dark brown, suffused with yellowish, and lined profusely with black, darkest along the median line, where forming an indistinct broad median dorsal band; chin and throat grayish white; rest of ventral surface buffy, varying in different specimens from pale buffy white to deep buff; ears dark brown, rather darker than the surrounding parts, thinly covered on both surfaces with short hairs; tail indistinctly bicolor, dark brown above, somewhat lighter below, apparently naked, but very short hairs can be seen under a lens; fore and hind feet pale grayish brown, very thinly haired; soles of hind feet dark brown.

Measurements (of type).—Total length, 278; tall vertebræ, 140; hind foot, 30; ear, 18. Four adult males measure as follows: Total length, 276.5 (260–288); tail vertebræ, 143.5 (134–155); hind foot, 30 (29–31); ear, 18 (17–20).

Skull.—Nearly as in *Oryzomys palustris*, differing mainly in somewhat larger size. Total length, 32; basal length, 27; zygomatic breadth, 16; width of brain-case, 12.4; interorbital breadth, 5; length of nasals, 13.4; palatal length, 13; length of anterior palatine foramina, 6.3; upper molar series, 4.5; diastema, 8.

Type, No. $\frac{12651}{10861}$, ♂ ad., Jalapa, April 16, 1897; Frank M. Chapman.

This species is based on 8 specimens, taken at Jalapa in April, of which 4 are adults and 4 young adults, all but one being males. The upper parts in all are characterized by a strong, deep yellowish suffusion, more intense in some specimens than in others; below the color varies from grayish white faintly tinged with buff, to deep strong buff. The pelage is full and soft, but not wooly, as in *O. aquaticus* Allen and *O. fulgens* Thomas, which also have buffy underparts. In size, and texture of pelage, it more resembles *O. mexicanus* Allen, which has, however, wholly white underparts, and the upper parts are paler, more yellowish, and much less black.

Found only in certain small, wet grassy marshes or 'cienagas,' where it was apparently common.

16. Sigmodon toltecus (*De Saussure*).—Few animals are more easily trapped than *Sigmodon*, and the fact that but a single specimen was secured apparently indicates that the species is rare at Jalapa. This example was taken in a grassy marsh inhabited also by *Oryzomys jalapæ*.

17. Microtus quasiater (*Coues*).

? *Arvicola* (*Hemiotomys*) *mexicanus* DE SAUSSURE, Rev. et Mag. de Zool. (2), XIII, Jan. 1861, 3. ("Mexicana tellus.")
Arvicola (*Pitymys*) *pinetorum*, var. *quasiater* COUES, Proc. Nat. Acad. Nat. Sci. Phila. 1874, 191. (Jalapa, Mexico.)
Arvicola (*Pitymys*) *quasiater* COUES, Mon. N. Am. Rodent. 1877, 226.

This species, the type locality of which is Jalapa, Mexico, is represented by 53 specimens—21 males and 32 females—all taken at Jalapa in April. All except ten are adult; of these latter the greater part are nearly adult.

Respecting external characters, there is little to add to Dr. Coues's description. The general color above is ruddy blackish brown; the younger specimens are darker, while very old specimens are several shades lighter and more ruddy or 'auburn' than the average adult.

The adults of the series measure as follows:

	Total Length.	Tail Vertebræ.	Hind Foot.	Ear.
17 ♂♂ . . .	130.3 (121–136)	19.6 (17–22)	17 (16–18)	14 (12–16)
24 ♀♀ . . .	128.8 (120–135)	19 (16–22)	17 (16–18)	14 (12–15)

Only 6 specimens out of 41 fall below 125 mm. in total length, and only 6 exceed 134 mm.

It seems quite probable that De Saussure's *Arvicola mexicanus* may prove to be an earlier name for this species, to which

De Saussure's very unsatisfactory description seems to point, except that the species is referred to the subspecies *Hemiotomys*—whether of Baird or of De Selys-Longchamps is not stated, but which in either case would indicate only distant relationship with *M. quasiater* (Coues).

Abundant in weedy fields, and especially so in old cornfields, where it lives in holes in the ground.

18. Cratogeomys estor *Merriam.*—Three specimens (♂ ad., ♀ ad., and ♀ juv.), Las Vigas, April 24 and 25—topotypes of the species.

19. Heterogeomys hispidus (*Le Conte*).—One specimen, ♀ ad., Jalapa, April 13.

This specimen is peculiar in possessing a pure white transverse band, about 10 mm. broad, across the lower part of the back. There is also a large irregular area of white on the ventral surface, mostly confined to the right side of the median line. These large white markings are doubtless due to albinism.

Locally common.

19. Marmosa murina mexicana *Merriam.*

Marmosa murina mexicana Merriam, Proc. Biol. Soc. Washington, XI, 1897, 44. (March 16, 1897.)

Represented by 2 males and 4 females, collected in the heavier forest growth at Jalapa, March 29–April 4. All are young adults, except one very old male.

This subspecies is smaller, with relatively much smaller ears, than true *murina*, and the general color is a lighter, clearer rufous, but in the color of face between the eyes there is little difference, the rufous only exceptionally reaching forward to the nose. In true *murina* this part is much lighter than the general color of the upper parts.

M. murina mexicana was described from Juquila, Oaxaca, and its range given as the States of Oaxaca and Chiapas. The present locality therefore extends its range on the eastern slope considerably to the northward of Oaxaca. It is probable that the specimen recorded as *murina* by Mr. Thomas from Ventanos, Durango, is referable to this form.

Article XIV.—NOTES ON SOME SPECIES OF NORTH AMERICAN MOTHS.

By William Beutenmüller.

The following notes are based upon types and specimens in the Hy. Edwards Collection, which is now the property of the Museum. With regard to the Western and Pacific Coast species of *Catocala* much is yet to be learned, and I hope to be able before long to give a more detailed account of the species from that section of country than is given in the present paper.

Aëllopos fadus (*Cramer*).

An example of this southern species was taken at Summit, New Jersey, by Mr. Francis Child Nicholas, who kindly donated the specimen to the Museum.

Oiketicus davidsonii *Hy. Edw.*

Head, legs, thorax and abdomen mouse brown, without any markings whatever. Fore wings mouse brown, with the veins darker. Hind wings uniform mouse brown.

This species was described from its larval-case only, and the moth has been hitherto unknown.

The above description was taken from an undeveloped specimen cut from a pupa of one of the types in the Edwards Collection, and may serve to identify the species. Hy. Edwards describes the larval-case as being about one and a half to one and three-fourth inches in length, a little thicker in the middle, and composed of pieces of sticks or twigs from one-third to one and a quarter inches in length, laid side by side longitudinally, one or two pieces nearly always extending posteriorly some distance beyond the termination of the case. The fragments with which the case is covered are of different lengths, and are about fifteen in number, the interstices being filled with wood dust, closely woven into the silken ground work of the case. The edges of the pieces of wood are always neatly rounded by the larva, and all outstanding branches are bitten off.

The cases were collected at Mt. Diablo, California, on the branches of chinquapin chestnut (*Castaneopsis chrysophylla*). A rediscovery of the species is earnestly hoped for.

Dasychira plagiata (*Walker*).

Acyphas plagiata WALKER, Cat. Het. B. M. Pt. IV, 1855, p. 799.
Dasychira atomaria WALKER, Cat. Het. B. M. Pt. VII, 1856, p. 1739.
Parorgyia clintonii GROTE & ROBINSON, Proc. Ent. Soc. Phil. Vol. VI, 1866, p. 3, pl. I, figs. 2 and 3.
Olene plagiata NEUMŒGEN & DYAR, Journ. N. Y. Ent. Soc. Vol. II, 1894, p. 58.

Regarding this species Mr. Hampson kindly sent me the following notes: "As far as the condition of the types allows me to judge, this is the same as *Parorgyia clintonii* G. & R. *A. plagiata*, type male, and *Dasychira atomaria*, type female, are without locality, but the male agrees fairly well with *clintonii*, of which we have four males, and the female agrees with a female we have from W. Canada."

Catocala californica *Edw.*

Some time ago I called attention to the fact that this species had been made a variety of *C. electilis* Walker, but that *californica* was a good species, and *electilis* a Mexican species allied to *C. junctura* (Journ. N. Y. Ent. Soc., Vol. IV, p. 98). A good figure of *C. electilis* was published by Mr. Druce in 'Biologia Centrali-Americana,' Het. Vol. I, Pl. XXXI, fig. 8, and it is very distinct from *californica*. To verify my statement I asked Mr. Hampson, of the British Museum, to examine for me the type of *electilis* and to compare the same with *californica*. He writes me as follows: "Druce's figure represents *electilis* very well. It is much larger than *californica*, and without the dentate, white submarginal line. They are as distinct as any species in the group."

Catocala electilis *Walker.*

Catocala electilis WALKER, Cat. Het. B. M. Pt. XIII, 1857, p. 1209; DRUCE, Biologia Centrali-Americana, Het. Vol. I, pl. xxxi, fig. 8.
Catocala cassandra HY. EDWARDS, Proc. Cal. Acad. Sci. July, 1875.

The type of *C. cassandra* is a very much worn specimen, and it is without doubt the same as *C. electilis.* A specimen agreeing with the figure of *electilis*, given by Mr. Druce, is in the Hy. Edwards Collection, and another with the markings on the fore wings much heavier, is in the Angus Collection. Both are from Mexico. *C. sara* French (Can. Ent., XV, p. 163) has been made a synonym of *cassandra*, but the description does not agree with the type of *cassandra* nor with *electilis*. *C. babayaga* is probably a variety of *electilis*.

Catocala meskei *Grote.*

Catocala meskei GROTE, Can. Ent. Vol. V, 1873, p. 161.
Catocala rosalinda HY. EDWARDS, Bull. Brooklyn Ent. Soc. Vol. III, 1880, p. 55.

Rev. Geo. D. Hulst in his synopsis of the genus *Catocala* (Bull. Brooklyn Ent. Soc., Vol. VII, 1884, p. 45) places *C. rosalinda* as a distinct species. It is, however, identical with *C. meskei*, and not even worthy of a varietal name. A specimen of *meskei*, compared and agreeing with the type, is in the Edwards Collection, as is also the type of *C. rosalinda*.

Catocala irene, var. virgilia *Hy. Edw.*

This is a good variety, and is not identical with the typical *irene* Behr, as placed by Rev. G. D. Hulst. An example of *irene* agreeing with the type and the types of the variety *virgilia* are in the Edwards Collection. *Irene* is brown, with the reniform spot very dark and surrounded by a cloud of a shade darker, and has a dark basal patch and an apical dash of the same color. The variety *virgilia* has the fore wings almost entirely suffused with dark brown, so as to nearly obscure the ground color and markings. The subterminal line is whitish and very distinct.

Catocala faustina, var. **carlota,** var. nov.

FIG. 1.

Fore wings almost entirely uniform whitish gray, middle portion whitish. The transverse lines very conspicuous and deep black. The one across the middle of the wing very angular and irregular in its course; a little below the middle it suddenly turns inwards for some distance, forming a distinct open loop. On the upper angle where the line turns inwards, rests a distinct black blotch. Subterminal line almost invisible. Terminal row of spots black. Hind wings rosy, with the band and border as in *faustina*. Expanse, 58 mm.

One female, No. 11908, Coll. Hy. Edwards.

Habitat: Sierra Nevada, California.

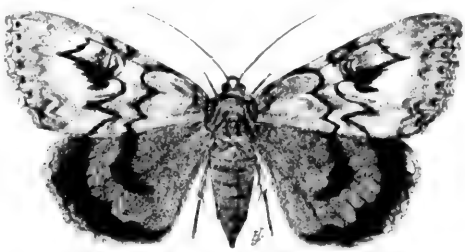


FIG. 1.

Catocala stretchii, var. **sierræ,** var. nov.

Fore wings very thickly scaled with black so as to almost entirely obscure the ground color and the transverse lines. The subterminal line is very distinct and dentate, creamy white, edged black outwardly. Hind wings same as in the typical *stretchii*.

Four specimens, No. 12653, Coll. Hy. Edwards.

Habitat: Sierra Nevada, California.

This variety bears the same relationship to *stretchii* as the variety *somnus* does to *C. luciana*. It may be easily known by its dark fore wings and light subterminal band.

Article XV.—NOTES ON NORTH AMERICAN SESIIDÆ, WITH DESCRIPTIONS OF NEW SPECIES.

By William Beutenmüller.

Since the publication of my paper on Sesiidæ (Bull. Am. Mus. Nat. Hist., Vol. VIII, pp. 111–148) the following notes and descriptions have been made.

Sciapteron dollii, var. castaneum, var. nov.

Female.—Head, thorax and abdomen bright chestnut brown, the latter with a narrow yellow ring at the posterior edges of the second and fourth segments above and below. Legs and palpi bright orange chestnut; femora blackish. Antennæ orange chestnut, except for a short distance before the tip above black. Thorax blackish beneath with wings the same as in *dollii*. Expanse, 40 mm.

Male.—Very much like the female, but the thorax is darker and the palpi are mixed with black. Expanse, 30 mm.

One female from Texas. Coll. B. Neumœgen. Two males from Kentucky, No. 15778, Coll. Hy. Edwards, A. M. N. H.

The MS. name *castaneum* was given to this variety by the late Hy. Edwards, and the species was subsequently described as *dollii* by Mr. Neumœgen. It differs from *dollii* by having the head, thorax and abdomen bright chestnut brown, and the tibiæ and tarsi wholly bright orange chestnut, while in *dollii* the tibiæ and palpi are black outside, and the abdomen is blackish.

Sciapteron tricincta (*Harris*).

This species was bred by me from willow infested with larvæ of *Cryptorhynchus lapathi* and *Saperda concolor*, found near Van Cortlandt Park, New York City. It is possible that *denotata* may prove to be the same as *S. tricincta* when a good series of specimens can be obtained.

Sciapteron simulans *Grote.*

A freshly-emerged female of this species was found by me under a red oak on Manhattan Square, New York City. Hitherto it was only known from Rhode Island, Ohio, Illinois and Minnesota. Only the female is known, and it would be interesting to learn what the male looks like.

Sesia sigmoidea, sp. nov.

Female.—Head black; collar black, narrowly yellow in front and on each side behind; palpi yellow with appressed scales. Antennæ black. Thorax black, with a yellow mark posteriorly above, beneath with a large yellow spot on each side at the base of the insertion of the fore wings. Abdomen bronzy black with a yellow ring on the posterior edge of the second, fourth and last segments, the one on the fourth encircling the body, and is broader beneath than above. On each side of the base of the abdomen to the end of the second segment is a short, broad yellow line, which almost touches the ends of the first ring. Legs yellow and black; fore coxæ and all the femora black; tibiæ and tarsi yellow inside and yellow and black outside. Anal tuft black, narrowly yellow on each side of the middle above. Fore wings transparent with the margins black, outer margin very broad. Transverse discal mark orange, narrowly edged with black inside. Hind wings with black margin narrow, fringes concolorous, yellow at the base of wings. Fore wings beneath washed with yellow, and scaled with orange between the veins on outer margin. Discal mark like above. Hind wings beneath same as above. Expanse, 18 mm.

Habitat: Walpole, Mass. One female, No. 15948, Coll. Hy. Edwards, A. M. N. H.

This is the species which was considered by the late Hy. Edwards to be identical with the European *Sesia asiliformis* Rott., and was recorded as such in Papilio, Vol. II, p. 56. It, however, is sufficiently distinct to warrant separation from the European species. In *asiliformis* the wings are more elongate, with the outer margin more oblique. The yellow markings are very much more vivid than in *sigmoidea*, and this color predominates in the anal tuft. The orange on the discal mark is in shape of a transverse bar, while in *sigmoidea* it is merely a round spot. Between the veins on the outer part of the wings *asiliformis* is scaled with bright orange, and on the underside is almost wholly brilliant orange. Hind wings beneath also margined with orange. The outer transparent area of the fore wings in *asiliformis* is also larger than in *sigmoidea*.

Sesia ithacæ, sp. nov.

Female.—Head black; collar narrowly yellow; palpi black above and at the tip, yellow beneath. Thorax above wholly black as is also the abdomen and anal tuft. Legs black, joints with yellow rings; fore coxæ pale yellow. Antennæ black with a white patch before the tip. Fore wings with the costa, inner margin and outer part broadly black. Discal mark broad black. Basal transparent space small, elongate triangular; outer area very small, irregularly rounded. Hind wings narrowly bordered with black. Underside: Fore wings washed with yellow basally, and streaked with yellow between the veins at the outer part; transverse mark black. Hind wings same as above. Expanse, 18 mm.

Male.—Black and yellow like the female, but the basal transparent space is longer and broader, and extending beneath the median vein, the inner margin as a consequence is narrowly bordered with black. The outer transparent area also larger and subquadrate. Anal tuft flat, fan-like, black. Expanse, 15 mm.

Habitat: Ithaca, New York. One male and one female, No. 16755, Coll. Hy. Edwards, A. M. N. H.

Sesia rubrofascia (*Hy. Edw.*).

Head and thorax above and below deep steel blue black; before each eye is a short, pure white line. Palpi black above, bright orange red beneath; abdomen deep steel blue black, with the fourth and fifth segments bright scarlet red above and below; sixth segment scarlet red beneath. Anal tuft blue black with a few white hairs on each side above. Legs blue black; hind tibiæ whitish inside, and with a white ring at the middle; all the tarsi orange inside, blue black outside. Antennæ blue black, with the tip, for one-third the length, yellowish on one side. Fore wings transparent, costal and inner margins narrowly violet black; discal bar straight, black; outer margin broad and heavily marked with scarlet between the black veins; fringes brown black. Hind wings transparent, fringes brown black. Underside of wings same as above, except the fore wings which are scaled with golden yellow along the costa, and the costa of hind wings marked with orange. Expanse, 17–21 mm.

Two females, Coll. A. M. N. H.

The above description was taken from two perfect female specimens bred by Mr. J. Doll and myself from willow infested with larvæ of *Cryptorhynchus lapathi* and *Saperda concolor*, found in Van Cortlandt Park, New York City, in June. Hitherto the species was only known from Georgia and Illinois, and I have also seen a specimen from Manitoba, Canada.

We did not succeed in raising the male, but the specimen described by Hy. Edwards lacks the red on the fore wings, and the orange on the palpi.

Pyrrhotænia præstans (*Hy. Edw.*).

Female.—Head brassy black, with the vertex and palpi orange. Collar blackish, edged in front with orange. Thorax blackish, patagia tipped with orange. Fore coxæ orange. All the femora blackish; tarsi orange with a blackish ring at the end of each; tibiæ orange. Fore wings brassy green with an orange red streak along the inner margin, from the base to nearly the hind angle. The basal and outer transparent spaces filled with orange, as are also the spaces between the veins of the outer part of the wing. Fringes brownish. Hind wings transparent with an outer border, and the inner margin orange. Fringes blackish. Veins and discal mark black. Underside: Fore wings wholly orange, except the discal mark, veins of outer part and fringes same as above. Hind wings bordered with orange. Veins scaled with orange. Fringes like above. Expanse, 23 mm.

Habitat: Easton, Washington.

The above description was taken from a specimen, which is without much doubt the female of *P. præstans*, of which the type male was hitherto only known to exist. The specimen is from the collection of the U. S. National Museum, and was sent to me for examination by Dr. L. O. Howard. It is somewhat worn, but it shows the traces of the orange red bands on the abdomen as in the male. It differs from the male by having the transparent spaces on the fore wings filled with orange, and by narrow orange border of the hind wings.

Zenodoxus mexicanus, sp. nov.

Head fuscous with some white scales; palpi white, with a few fuscous scales at the tip. Stalk of antennæ rufous, pectinatious black. Thorax fuscous, tip of patagia with white hairs. Legs white with fuscous rings. Abdomen above brown-black with a white band composed of scales at the posterior edge of each segment. Anal tuft blackish brown with a few white hairs. Underside of abdomen wholly blackish brown. Thorax beneath brown-black with white scales. Fore wings blackish brown, streaked with white between the veins at the outer part, before the margin, thus forming a rounded whitish patch, crossed by the veins. Hind wings uniform blackish brown. Underside: Fore wings similar to the above, but with a narrow white streak along the inner margin and costa. Hind wings with scattered white scales. Expanse, 13 mm.

Habitat: New Mexico. One male, No. 16756, Coll. A. M. N. H. Received from Prof. J. B. Smith.

Allied to *Z. heucheræ*, but differs from it by having white bands on the abdomen, instead of yellow bands, and by the white patch on the fore wings.

Article XVI.—FOOD-HABITS OF NORTH AMERICAN SESIIDÆ.

By William Beutenmüller.

As will be seen from the following list, comparatively little is known about the food-habits of our Clear-winged Moths, and for this reason I have thought it advisable to bring together all the known information on the subject, in the hope that it may stimulate others to undertake to raise the species and to give us some additional information of this interesting family of Moths.

The larvæ, as is well known, are internal feeders, living in the roots, stems or pith of plants, or under the bark, solid wood or roots of trees. Some species are inquilinous in the galleries made by other species of insects, or in other words they prefer to breed in wounded places made by insects or through other causes. The species are all, as far as I am aware, single brooded, hibernating in their larval stages. The larvæ are fleshy, white, with testaceous or chestnut-brown corneous heads and cervical shields. They are not difficult to raise, if the plant in which they feed is kept moist and in a box well ventilated, so as to prevent the attack of fungus.

Melittia satyriniformis *Hübner*.

Lives in the roots and lower parts of the stems of squash vines, and probably other allied plants.

Melittia gloriosa *Hy. Edw.*

Has been bred from the roots of sumac, *Rhus laurina* (Proc. Ent. Soc. Wash., I, p. 85), and it also feeds in the herbaceous climbing stems of *Megarrhiza*.

Alcathoë caudatum (*Harr.*).

Feeds in the roots of virgin's-bower (*Clematis virginiana*).

Sannina uroceriformis *Walker*.

The larva lives in the roots of the persimmon.

Trochilium pacificum *Hy. Edw.*

Bores in the cottonwood, and very likely also in the willow.

Trochilium tibiale *Harris.*

The larva inhabits the trunks of poplar and willow.

Trochilium apiforme (*Linn.*).

This well-known European species breeds in the roots and lower parts of the trunks of poplar and willow.

Bembecia marginata (*Harris*).

Lives in the roots of the blackberry and raspberry.

Vespamima sequoiæ (*Hy. Edw.*).

Breeds in the California redwood (*Sequoia sempervirens*) and pines (*Pinus lambertiana* and *P. ponderosa*). It produces thick excresences on the branches and trunks.

Sciapteron tricincta (*Harr.*).

Lives in the canes and trunks of low swamp willows, infested with *Cryptorhynchus lapathi* and *Saperda concolor*. It also inhabits the poplar.

Sciapteron denotata (*Hy. Edw.*).

The habits are probably the same as those of the preceding species.

Sciapteron robiniæ *Hy. Edw.*

This is destructive to the locust (*Robinia pseudacacia*), and is also recorded as infesting the poplar.

Sciapteron simulans *Grote.*

Lives in the solid wood of the trunks of red oak.

Sciapteron dollii *Neumægen.*

Breeds in the solid wood of poplar, and possibly also in willow.

Sciapteron polistiformis (*Harris*).

The larva burrows in the bark and sap-wood of the roots of both wild and cultivated grape-vines.

Tarsa denudata (*Harr.*).

Lives in the roots and lower parts of the trunk of alder and ash.

Parharmonia pini (*Kellicott*).

The larva lives under the bark of pine.

Podosesia syringæ (*Harris*).

Affects the trunks of lilac, ash and mountain ash (*Pyrus americana*).

Podosesia fraxini (*Lugger*).

The larva inhabits the trunks of the ash, and it is very likely that it also lives in lilac.

Sanninoidea exitiosa (*Say*).

Lives under the bark of the peach and cherry, both wild and cultivated, at the base of the tree and very often beneath the surface of the ground.

Sanninoidea opalescens (*Hy. Edw.*).

Feeds like the preceding species, in the trunks of the peach and apricot, and without doubt also affects the cherry.

Sesia rutilans (*Hy. Edw.*).

Breeds in the roots of the strawberry, blackberry and raspberry.

Sesia bassiformis (*Walker*).

Bores in the stalks of *Eupatorium*.

Sesia rubrofascia (*Hy. Edw.*).

Inhabits the trunks and canes of willow infested with *Cryptorhynchus lapathi* and *Saperda concolor*.

Sesia albicornis (*Hy. Edw.*).

The habits are the same as those of *Sesia rubrofascia*.

Sesia culiciformis var. americana *Beut.*

Lives in the trunks and stems of the alder in Nevada.

Sesia acerni *Clemens.*

Bores under the bark of the maple, especially the silver maple (*Acer dasycarpum*).

Sesia corni (*Hy. Edw.*).

Breeds under the bark of maple.

Sesia tipuliformis (*Linn.*).

Bores in the stems of the cultivated currant, and in Europe it also lives in the young shoots of hazel.

Sesia pyri (*Harris*).

Lives in the trunks of pear and apple, between the outer bark and sap-wood.

Sesia scitula (*Harris*).

Lives under the bark of chestnut, oak and dogwood, also in the oak-galls *Andricus cornigerus*, and in galls on willow and hickory.

Sesia rubristigma (*Kellicott*).

Has been bred from the oak-gall, *Andricus cornigerus*.

Sesia sigmoidea *Beut.*

A specimen in the Museum Collection is labeled "from willow."

Sesia querci (*Hy. Edw.*).

Has been bred from galls found on live-oak in Arizona.

Sesia prosopis (*Hy. Edw.*).

Has been raised from galls found on mesquite in Arizona.

Sesia pictipes (*G. & R.*).

Lives under the bark of plum, cherry, beach plum, chestnut, and juneberry (*Amelanchier canadensis*). Usually bores under the bark some distance up from the base. It also feeds in the black knot fungus.

Pyrrhotænia floridensis *Grote.*

Specimens of the moths have been taken on scrub-oak by Mrs. Slosson, and it is possible that the larvæ may in some way feed on this tree.

Article XVII.—AN ANCIENT FIGURE OF TERRA COTTA FROM THE VALLEY OF MEXICO.

By M. H. Saville.

Plates XXIII and XXIV.

The Valley of Mexico still presents an inviting field to the archæologist, and from time to time important specimens of Nahuatl culture are brought to light. In the immediate neighborhood of the modern city of Texcoco much of great interest has been discovered, but unfortunately by far the greater number of objects found are either broken or lost by the Indians, or find their way into private collections, and thus are practically reburied so far as their being of service to archæology. This is also the case throughout Mexico and Central America, where many priceless relics of the past may be seen in private hands. These are of little scientific value, inasmuch as the circumstances of their discovery, and the place where they were found, have been either forgotten or never ascertained.

The terra cotta figure about to be described was found by an Indian in a cave near the modern city of Texcoco, and is now preserved in the American Museum of Natural History. It was broken in a number of pieces when found, and with these fragments were portions belonging to two other figures of a similar character. The figure is approximately life size[1] (see Plate XXIII), and represents a man with arms extended and mouth opened as if singing or shouting. The hands show that each formerly grasped some object; the ends of the fingers are broken off. The figure was made hollow and in three sections. The head is in one piece, and fits into the body by means of a tube, which is a continuation of the neck. The middle section com-

[1] The following measurements, made by Dr. A. Hrdlicka, are given: Height, 150.9 cm.; height of external meatus, 141.4; of the chin, 130.6; of the root of neck, 124.8; of centre of umbilicus, 95.2; of inferior plane of left forearm, 72.5; of the summit of angle between the thighs, posteriorly, 60.0; of left external malleolus, 11.6; of knee-cap (centre), 47.7. Circumference of the head (middle of forehead—horizontal), 55.3 cm.; of the neck, [illegible]; of the body at about the xiphoid, 86.5; of the right fore arm, between the wrist and the styloid, 23.5; of the right leg, just below the armor, 37.5. Breadth of the shoulders 46.0 cm. Diameter antero-posterior of chest, at about the nipples, about 19.0 cm.; transverse of chest, at about the nipples, about 28.0; biauricular (under the lowest notch of hair, in front of the ear), 16.8; bimastoid (the region of mastoids behind the ear), 15.0. Separation of external canthi, 9.7 cm.; of internal canthi, 2.7.

prises the main part of the body, and fits into the lower section forming the lower part of the trunk and the legs.

It was painted only on the parts representing the skin, which is of a dark red color, showing traces of a high polish, such as is found on the well-known red ware of the Valley of Mexico. The image is shown as clothed in garments of a dingy brick-red shade, mottled black in places, the result of burning in firing. It was evidently modeled on a frame of some sort, but there are no traces of such a frame to be found inside. The garments consist of a short jacket *uipilli*, with sleeves, tied at the back in two places, the ends of the jacket not being brought together. On the arms, just below each shoulder, are straps tied around with the ends hanging down. Around the waist below the jacket are the remains of a loin cloth *maxtlatl*. There was undoubtedly joined to this a covering similar to that in the figure shown in Plate XXIV. The legs were covered with leggings reaching a little below the knees and tied there with straps. In the fragments of the other figures these leggings do not reach the knees. The feet are shod with sandals, having protections on either side of the ankle, and held on the foot by two straps, one passing between the first and second toes, and the other between the third and fourth toes, and tied in front.[1]

The head of the image shows the ancient custom of artificial flattening of the frontal and occipital bones. The ears are pierced for ear ornaments commonly seen in Mexican sculptures. The nose contains an ornament which was usually the mark of distinction of the highest ancient Mexican war chief. The hair is arranged in a peculiar wig-like fashion. On the top of the head is a small ring which may have served as a means of lifting the head from the body by a cord, but it was more likely used to fasten a head-dress of some light material, as seen in Fig. 1.

There are holes bored in the arms, shoulders, and chest near the shoulders, which seem to have been to hold cords after the arms had become cracked or broken, and were strengthened by being tied to the body.

This life-sized figure is believed to be unique. I have reproduced a figure of somewhat the same general character but of

[1] On the subject of ancient Mexican and Central American sandals, see Mason's monograph, in Report of U. S. National Museum, 1894, pp. 364-5.

miniature size (Plate XXIV). This has been described by Dr. Uhle in 'Veröffentlichungen aus dem Königlichen Museum für Völkerkunde,' Berlin, Oct., 1888, pp. 15, 16, Plate X, where the figure is given natural size, being 28.8 cm. in height.[1] It is of terra cotta, made in one piece only, and was found in Yucatan. It is now preserved in the Maya collections of the Berlin Ethnographical Museum. In details the figure is markedly different from the larger specimen. An interesting feature is the head distorted by flattening. The sandal on the right foot shows the toe-straps passing between the first and second and fourth and fifth toes. The flesh, furthermore, is not painted, the whole figure being of a uniform shade.

The personage represented in the Mexican valley specimen is probably that of an ancient war chief dressed in an armor of quilted cotton. In the Lienzo de Tlaxcalla[2] are many representations of soldiers, and on Plate 52 is the figure of one of their leaders herewith reproduced (Fig. 1). This figure shows the warrior holding in the right hand the *maquahuitl*, a saw sword made of wood with a row of obsidian knives set in each edge, and in the left hand the *chimalli*, or shield. It will be observed that the hair is arranged in practically the same manner as in the terra cotta figure, over which is a kind of head-dress apparently made of rope and feathers. Rising above the warrior's head, in the original picture, is the large war eagle, which has been drawn of heroic size, and I have not reproduced it in the figure. In many of the plates of the Lienzo de Tlaxcalla the warriors are clothed with trousers of the same material as the jacket. These garments, according to Torquemada, were called *ichcauipilli*, which was an armor of quilted cotton, and so strongly was this made that many of the Spaniards early adopted it as a protection against the darts and swords of the Indians.[3] Representations are also to be

[1] A profile view has also been published by Dr. P. Schellhas in his paper, 'Vergleichende Studien auf dem Felde der Maya-Alterthumer,' in Internationales Archiv fur Ethnographie, Bd. III, 1890, plate xvii, p. 5.

[2] A contemporary history of the conquest of Mexico by the Spaniards, painted in pictures by a native Tlaxcallan soon after the conquest. This remained unpublished until 1892, when it was published by the Mexican Government in 'Antiguedades Mexicanas,' edited by Alfredo Chavero.

[3] Cubiertas de cuero de venado, y dorados, coracas de algodon tan gruesos, como el dedo, que llamaban *Ichcauhuiples*, de los quales, se aprovecharon despues los Castellanos, porque los hallaron provechosos par flechas, y para el mucho trabajo, que padecian, que con armas de yerro, y acero no pudiesen sufrir.—Torquemada, Monarchia Indiana, Tom I, lib 4, cap xxxi, pag. 423.

seen in the Codex Mendoza, in the celebrated tribute roll of Montezuma.[1] The terra cotta figure has, furthermore, red bands on each side of the face extending from the hair downward across the eye to the lower part of the face. This mark is also found

Fig. 1.

in the Mexican manuscripts in the delineation of warriors who have their hair fixed in the same manner as in the figure.

In conclusion, it seems evident that we have in this remarkable specimen of art in terra cotta, the actual portrait or statue of some distinguished war chief of the old Alcolhuan tribe, dressed in armor, and very probably having in his hands his sword and shield.

[1] See Lorenzana 'Hist. de Nueva Espana,' Plate II, and better given by Peñafiel in 'Monumentos del arte Mexicano Antiguo,' Plate 237. Also Nombres Geográphicos de México. A. Peñafiel.

"La figura representada en el jeroglifico no se parece á los huipiles femeninos que hay en el libre de los tributos y en otros manuscritos aztecas; corresponda más bíen al *ichcahuipilli*, armadura colchada para la guerra, de color amarillo *cozauhqui*, que en composicion se cambia en la radical cozo, 'o en coza, como en *cozatli* (*cocatli*), comadreja, cuadrùpedo amarillo; *huipile*, significa dueño de *huipilli*, y can lugar de; la interpretacion de toda la palabro, lugar de dueños de *ichcahuipilli*, 'o de los que usaban esas armaduras," p. 87.

TERRA COTTA FIGURE FROM VALLEY OF MEXICO. One-tenth natural size.

A. M. N. H. [illegible]

TERRA COTTA FIGURE FROM YUCATAN.

One-half natural size

(Original in Berlin.)

Article XVIII. — HYBRIDS BETWEEN THE GAME COCK AND THE GUINEA FOWL.

By Juan Viló, M.D.

Plates XXV and XXVI.

It has been my privilege to own six living specimens, resulting from the sexual union of male individuals of the genus *Gallus* with female individuals of the genus *Numida*. Four of these were dissected, three of which proved to be males, although all were without spurs. All were studied in life.[1] The results of these observations are presented in the present paper.

In life these hybrids had only one phonetic expression—a single chirping sound, which might be taken either as a complaint, a war-cry, or as a manifestation of fear. These were the only emotions which called forth the sound. It had not the least resemblance to the various notes or cries we are accustomed to hear from gallinaceous birds. It was rather like the creaking noise produced by vigorously rubbing together two pieces of iron. When thus agitated they erected the feathers of the head and neck, and the tail. They generally, even when perfectly at rest, kept their mouths open, a sign of difficult, panting respiration. (This is shown in Fig. 2, Pl. XXV, taken from a living specimen.)

They were all distinguished, especially the first four that came into my possession, by a quarrelsome, aggressive disposition common to Guinea-fowls. They gave their companions of the poultry yard no peace, not respecting even the chief, to whom all but the hybrids gave respect. For this reason I was compelled to sacrifice them, one after the other. They never, however, attacked each other. On the contrary they frequently gathered in a group for the attack on other fowls, and even relieved each other when persecuting an enemy. Although all but one were found on dissection to be males, none of them had spurs.

In order better to appreciate their peculiarities, it may be well to recall that in the genus *Gallus* there are wattles, a toothed

[[1] Four of the specimens here described have been kindly presented by Dr. Vilaro to the American Museum of Natural History.—Ed.]

crest or 'comb,' a folded tail, with long flowing coverts, and spurs in the male. In the genus *Numida* the head is naked, with a casque or protruberance on the forehead; there are wattles on the sides of the throat; the tail is very short, and the legs are without spurs.

The hybrids may be described as follows:

Number 1.—Product of a male game-cock called in Cuba *Gallo Inglés* and *Gallo fino*, and a female Guinea-fowl or Pintado, called in Cuba *Gallina de Guinea*, or *Guinea*. It measured from the end of the beak to the end of the tail, 650 mm., and from the base of the left foot to the back, 310 mm.

This hybrid was obtained, after various fruitless attempts, covering a considerable period, by Mr. Andrew Perez, on his estate, 'Industria,' Jurisdiction of Batabanó, Cuba. I have no further history of its origin. I was indebted for this, the first specimen of the kind I had seen or heard of, to the kindness of my friend Dr. Francisco Rayneri, a distinguished physician of Havana, who presented it to me in 1887. I kept it alive for two years, but its quarrelsome and aggressive disposition—a trait common to all Rooster-Guineas I have known—and its inclination to escape at every opportunity, compelled me at last to sacrifice it. Although a male, not the least procreative tendency was observed in this hybrid by either my attendants or myself. I presented the specimen in 1889 to the Academy of Sciences of Havana, with a note which was published (unfortunately with many errors) in the 'Annals' of that Society (Vol. XXV, pp. 731-733).

As represented in the accompanying illustrations (Pl. XXVI, Fig. 2), the scarcity of feathers on the forehead is not clearly seen, but the nakedness of the periorbital region is distinctly apparent. In the present specimen, as in the other five, a glance is sufficient to show the absence of the distinctive features of the *Gallus bankiva* type. The fleshy appendages are wanting, including the pectinated crest or comb, as well as the lateral caruncles and the wattles. Nor is there the least trace of the horny casque which surmounts the head of the Guinea-fowl. The absence of spurs may be traced to its maternal ancestor, as the presence of a fifth toe in specimen No. 2 (presently to be described) is to its paternal progenitor. We also miss the long hackles on the neck, which are scarce in No. 1, scarcer still in Nos. 2 and 3, but quite abundant in No. 4, but short and rigid in each case, and thus very unlike those of the cock. In the absence of hackles we note a resemblance to the Guinea-fowl. The tail in No. 1 is inclined downward, but the rectrices and their coverts are much longer than in *Numida meleagris*.

In respect to general coloration, the prevalence of the whitish and light gray tones is easily seen, the background of the wings being dark, and that of the general plumage dark gray. We look in vain for the white spots fringed with black, upon a bluish or reddish black, or more or less gray and whitish backgrounds common to the *Numida meleagris* of Cuba, both domestic and wild. These characteristic white spots are represented in hybrids Nos. 1 and 2 by alternate, undulating white or gray and black zones. The lesser, median and greater coverts are marked with these undulating, lanceolate markings, which are also seen on the back and rump, but the ends of the feathers are blunt and rounded.

In the primaries of the wings there is a faint reminiscence of the white spots of the Guinea-hen, but only on the outer vanes, the inner vanes being all black. The secondaries are also entirely black on the inner vanes, but the outer, while also black, have gray spots and a white border. The rectrices or caudal feathers differ from those of the Guinea-fowl, and are more like those of the cock, though straight. Some of the greater coverts of the tail are large and silky. Taken altogether the coloration recalls that of the Silver Pheasant, *Phasianus nycthemerus* Linn.

As is frequently the case with hybrids, they are larger than either progenitor, though never reaching the combined size of both. Consequently the legs, especially the scutellæ, nails, and and the beak, are proportionately larger.

Number 2.—This was obtained by Dr. Moreno, of Candelaria, Province of Pinar del Rio, Cuba. The male parent was a gamecock, of a brilliant cinnamon color, called in Cuba *canelo*. The mother was a Guinea-hen of the usual bright black plumage variegated with white spots. On the right foot is a fifth toe, an appendage of the fourth, inherited from the father. The extra toe is longer and thicker, with a more fully developed nail than the normal fourth toe on the left foot.

The yellowish-white spots of the plumage were more minute than in No. 1, as shown in Pl. XXVI, Fig. 1, photographed from the living specimen. On dissection it was found to be a male. It measured from the end of the beak to the end of the tail, 630 mm., and from the base of the left foot to the back, 310 mm.

Number 3.—White. Born on the 8th of June, 1893, in the house of Mrs. Nieves Hernandez, at Cuevitas, Jurisdiction of Colon, Province of Matanzas, Cuba. The male progenitor was a pure white Guinea-fowl; the mother was a white hen. The two parents were confined together for three days. From an early age this hybrid showed a very bad temper, unlike ordinary chickens of the same age.

It drooped its wings and, when attacking an enemy, erected the long feathers of the tail; it also raised some of the feathers of the occiput when intimidated.

On dissection it proved to be a female, a circumstance which did not in the least mitigate its excitable temper. On the contrary, this individual was worse than the others, which, as stated, also had 'tempers of their own.'

Number 4.—Full-throated, hump-backed, and bandy-legged. Product of a bright cinnamon-colored game-cock and a bluish Guinea-hen. It was born on the 12th of April, 1892, on the estate 'San José,' of Dr. Martinez, who presented it to Dr. Damian Cuencia, whose son Cesar, a pupil of mine, was kind enough to give it to me, April 2, 1894.

Besides the deformity of the back and the right leg, it was full-throated, a trait inherited from the father. This circumstance, implying great energy of transmission, easily explains the greater development of feathers on the head, throat and neck. While showing the same undulating coloration as Nos. 1 and 2, it has a greater abundance of fine white spots, especially upon the back and tail. The first three primaries are white, the rest totally black. (Pl. XXV, Fig. 1.)

Number 5.—A dark specimen. It was presented to me on the 24th of March, 1894, by one of my pupils, Mr. Comesañas. It was born on his father's estate in Moron, on the border between the Provinces of Camaguey and Santa Clara, Cuba. It disappeared from my house, in the suburb of Havana, on the 12th of December of the same year.

Its plumage was variegated with very distinct, fine gray spots, with undulations similar to those of specimens Nos. 1, 2 and 4. The coverts were immaculate white, with a tendency to gray at the ends. It was called dark on account of its generally blackish coloration.

Number 6.—White specimen. Came into my possession from the same source and on the same date as No. 5. It died in August, 1894, during my absence, and when I returned it was found in such condition that dissection was impossible. I noticed that in coloration it differed from the other specimen in having the markings less undulating and more linear. It was called whitish on account of the generally light color of the plumage.

The general characteristics of this individual, and of specimen No. 5, were the same as those of the rest, as regards their dissimilarity in coloration, size, habits, etc., from their parents.

I will add, in conclusion, that these cases of hybridity are by no means rare in Cuba. Among others, I may mention examples obtained by my friend and colleague, Dr. Leopoldo Berriel, Dean of the Law Faculty of the University of Havana, at his estate 'Pozo Redondo', in Batabanó. I can also add to the full-grown specimens already described, the case of two chicks, both of the same brood, presented to me by my excellent friend Mr. Diego F. de Urra, in 1894. One of these differed considerably from the other. Its casque, the caruncles at the base of the bill, and wattles, were red. The other exhibited none of these peculiarities, but was similar to the specimens already described in this paper.

EXPLANATION OF PLATES XXV AND XXVI.

Plate XXV.

Fig. 1.—*Gallus bankiva* ♂ + *Numida meleagris* ♀. Photograph from mounted specimen, No. 11,527, Am. Mus. Nat. Hist. Presented by Dr. Juan Vilaró.

Fig. 2.—*Gallus bankiva* ♂ + *Numida meleagris* ♀. Photograph from life.

Plate XXVI.

Fig. 1.—*Gallus bankiva* ♂ + *Numida meleagris* ♀. Photograph from mounted specimen, No. 11,528, Am. Mus. Nat. Hist. Presented by Dr. Vilaró.

Fig. 2.—*Gallus bankiva* ♂ + *Numida meleagris* ♀. Photograph from mounted specimen, No. 11,529, Am. Mus. Nat. Hist. Presented by Dr. Vilaró.

Fig. 1

Fig. 2

HYBRIDS BETWEEN GAME COCK AND GUINEA FOWL

Fig. 1

Fig. 2

HYBRIDS BETWEEN GAME COCK AND GUINEA FOWL.

Article XIX.—DESCRIPTION OF A NEW VESPERTILIONINE BAT FROM YUCATAN.

By J. A. Allen.

In a small collection of mammals recently sent by Dr. G. F. Gaumer from Izamal, Yucatan, to this Museum for identification, is a single specimen of a species of *Adelonycteris*, which appears to be undescribed. It may be called

Adelonycteris gaumeri, sp. nov.

Above dark brown, with an olivaceous wash, the fur being uniform dark brown to the base tipped with a slight tinge of olivaceous, the extreme tip slightly grayish in certain lights; below much lighter, the fur being dark brown basally and broadly tipped with pale buffy gray; ears and membranes black, naked, and with no trace of a whitish border. Ears of medium size, rather thin, evenly convex on the front border, slightly hollowed on the posterior border below the rounded posteriorly directed tip; tragus long and rather narrow, pointed, equal to half the height of the ear. Face semi-nude, about as in *A. fusca*.

Measurements.—" Length, 95 mm.; expanse, 286; wing, 124; tail, 40";[1] ear, 21; tragus, 11; fore arm, 39; thumb, 7; 3d digit, 79=phal. i, 37, phal. ii, 24; phal. iii, 11, phal. iv, 7; tibia, 70; foot, 8.

Skull.—Similar in a general way to that of *A. fusca*, but about one-half smaller. Middle inner upper incisors considerably worn, and the ridges for muscular attachment strongly developed, indicating an old individual. Greatest length (front base of incisors to end of crest), 18; mastoid breadth, 8.3; zygomatic breadth, 10.1; interorbital breadth, 4; length of molar-premolar series, 4.2; palatal length, 5.3.

Type, No. $\frac{13553}{11606}$, ♀ ad., Izamal, Yucatan, collected by Dr. George F. Gaumer, for whom the species is named.

In coloration *Adelonycteris gaumeri* resembles examples of *A. fusca* in immature dark pelage, but it differs from this species in the thinness of the ears, and in the greater relative length of the narrower and more tapering tragus, and in its very much

[1] Collector's measurements from the fresh specimen, the rest are from the dry skin.

smaller size. In size it resembles both '*Vesperugo*' *propinquus* Peters and *V.* (*Marsipolæmus*) *albigularis* Peters, respectively from Guatemala and Mexico. The peculiar structure of the ears, to say nothing of the coloration, in *V. albigularis*, render comparison with this species unnecessary. *V. propinquus* is described as reddish above, paler and more reddish yellow below, and in this respect is widely different from *A. gaumeri*. It has also a longer thumb and foot than *A. gaumeri*.

The type and only specimen of this species has been kindly presented by Dr. Gaumer to this Museum, with other specimens of Yucatan mammals.

Article XX.—OBSERVATIONS ON THE GENUS BARRETTIA WOODWARD, WITH DESCRIPTIONS OF TWO NEW SPECIES.

By R. P. Whitfield.

Plates XXVII–XXXVIII.

In 1862 Mr. S. P. Woodward described a fossil from the Cretaceous limestone on Grand River, Portland Parish, Jamaica, W. I., under the name *Barrettia monilifera*, basing the genus on it, and considering it as a member of the Rudistæ, and analagous to *Hippurites*, *Radiolites*, etc. He gives also two plates of illustrations.[1]

Since the original description was published, several authors have expressed doubts as to the correct reference of the fossil to the group Rudistæ, and have questioned its molluscan nature, considering it more in the light of a coral than a bivalve shell.[2] Even Mr. Woodward himself speaks of this resemblance to a coral in his opening paragraph, where he says: "Almost any person, at first sight of the specimen, would think he was looking at a coral, and it would seem like an attempt to impose on one's credulity to say it was a bivalve shell, like an oyster or a clam."

I have not been able to learn that any person has critically examined the original specimens since the paper by Mr. Woodward, above referred to, was published, or that other specimens have been collected or examined until the present time. During the winter of 1895 and 1896 Mr. Francis C. Nicholas, of New York, sent to the Museum, from Jamaica, quite a collection of this peculiar fossil, the specimens varying from four inches in length to about twenty, with diameters up to nearly a foot.

Among them there are some which show features not mentioned by Mr. Woodward or indicated on his figures, but which seem to throw additional light upon their nature, although perhaps not

[1] The Geologist, London, January, 1862, p. 372.

[2] Zittle, Traité Palæont. (French Edition), Vol. II, p. 8[illegible], 188[illegible]. Tryon, Syst. and Struct. Conch., Vol. III, p. 205. Fischer, Manuel Conch. et de Paléont. Conch., p. 1[illegible]4, 188[illegible]. Lindstrom, Operculate Corals of the Devonian Formation, Swedish Academy, Vol. VII, p. [illegible].

being conclusive as to their true position in the Animal Kingdom. None of these, however, show any indications of an upper valve, or any remains of any such plate, with the exception of what may possibly have been projecting tooth-like processes, remaining within the central cavity of three of the specimens. In this respect the specimen used by Mr. Woodward was far superior to any in this collection.

By an examination of the specimens in the Museum collection I have endeavored to ascertain something further as to the true zoölogical relations of these peculiar organisms, and present the following facts and observations as a result of these examinations.

The prominent feature of the genus, as shown by Mr. Woodward, is the presence of a series of rays, outside of a central cavity, extending to the circumference, but marked at close intervals by oval expansions. These he calls moniliform rays, and he says he counted sixty-five of them in the circumference of the specimen. The intervening spaces he describes as being filled with crystalline matter. He further states that the center is filled up with "a vesicular structure, as in the Silurian coral *Cystiphyllum*." Each of these moniliform rays or lines of beads originate, as shown by Mr. Woodward, in a lacuna somewhat greater in size than the other beads, and is connected with the others by a thin radial plate like the vertical ray or lamella of a coral. The beads are often distant more than their own diameter, but this radial plate connecting the different beads extends throughout the entire series.

These moniliform bodies are found to be vertical tubes, which are densely septate horizontally, with the septa all convex upward, the reverse of those in the cavities in the interradial spaces, and are distinctly double or divided in the middle by the radial plate. This feature is distinctly shown on the split surfaces, where the beads often separate from the surrounding substance and drop out entirely, or one-half may fall off and leave the other half in place. This latter feature also proves the existence of the thin radial plate which connects all the beads of a ray, or, as Mr. Woodward states it, they are "strung together by almost invisible lines." This thin radial plate begins near the center of the inner or first bead (the lacuna) of the ray, and is continuous throughout the line to the outer margin of the disc. These moniliform tubes must have projected on the surface, and, as Mr. Woodward says, formed a series of radiating ridges with furrows between, except that instead of the "furrows between" them, the spaces were occupied by rows of quadrangular pits or depressions with transverse walls which divide them into cells, which Mr. Woodward did not observe.

These moniliform rays originate in the young organism just outside of the central cavity, and are constantly extended at the outer end by the addition of new tubes and an extension of the thin radial plate mentioned by Mr. Woodward.

The principal feature observed in the most perfect examples in our collection is in the spaces between the moniliform rays. In all of our examples, these spaces, which might be called inter-radial spaces, are occupied by a series of quadrangular pits or depressions with strong cross partitions between them, mentioned above, giving to the surface a sort of honey-comb structure. This is the most conspicuous feature of the organism when properly preserved, and one that does not appear to have been observed by the author of the genus, probably owing to the presence of the upper valve and to their being filled with crystalline matter to which he refers, like the sample shown on our Plate XXX. The depressions, although quadrangular on the surface, are rounded below and at bottom, and as seen from below resemble the under side of a deep septum of an Orthoceras. They vary in depth in the species *B. monilifera* from one-fourth to fully five-eighths of an inch (six to fifteen centimeters). In a vertical section of the specimen these cavities are seen to be closely septate below the surface one, so as to show as a series of deep cups one within the other, the intervening spaces being filled with calcite. (See Plate XXVII, upper figure.) Wherever a new moniliform ray is added, these cavities are doubled from that point outward, but are of smaller size than the inner ones.

This feature, *i. e.*, the radiating lines of quadrangular cavities, is shown by the specimen represented on Plates XXVII and XXVIII, to have been the true surface feature of the organism, and to have existed during life nearly as in the condition shown by the figures.

Another of the prominent features of these organisms is the character of the central cavity or visceral cup. In some of the specimens this is seen to be quite large and comparatively deep; but the rays and their lacunæ do not enter into its structure at the surface, nor do the quadrangular cell-like cavities, unless it be just at the edge. In one example it is about half as deep as wide, quite regularly concave and marked in some parts with ramifying vascular lines. When the specimens are cut longitudinally or accidentally split, the entire course of the cavity from the apex of the body to just below the upper surface is seen to be strongly, closely, and distinctly septate, just like that of a Cyathophylloid coral. (See Plates XXXI and XXXIII.) Mr. Woodward mentions that the center is filled up with a vesicular structure, as in the Silurian coral *Cystiphyllum*. In our specimens the septa extends entirely across the center of the cup, as they do in the genus *Zaphrentis* or in *Omphyma*.

In several of the specimens in our collection, showing more or less of the interior cup or visceral cavity, there are noticeable two features which are somewhat peculiar. One of these is shown distinctly in the figure on Plate XXVIII, at *c*, on the upper margin of the body cavity, encircling nearly one-half its diameter. This object is somewhat fibrous in a horizontal direction, and is of a white somewhat pearly texture. The other one nearly fills the center of the cup inside of the one just mentioned, and is vertically columnar or fibrous, appearing on its upper end much like the weathered end of a specimen of the coral *Chætetes* (see at the letter *d*). In the figure of *B. multilirata*, on Plate XXXIV, the first mentioned feature is seen to form a nearly continuous line for fully one-half the circumference of the cavity, is of a more dense and lighter colored substance than the rest, and is interrupted at two points by other bodies which represent the objects marked *t*, *t*, in Mr. Woodward's figure 5, and which he supposed to be sections of the teeth of the upper valve. These points, as seen in the section, are over two inches below the top of the specimen. In another example (of *B. multilirata*) the spaces marked *t*, *t*, on Woodward's figure, are occupied by long triangular points or processes much resembling teeth, and they are apparently fitted into triangular sockets or pocket-like cavities on the side of the central cavity. In this specimen (see Plate XXXV) the cup is deep and rather narrow, but is partly filled by a calcareous crystalline deposit on one side; but the white pearly substance seen in many specimens of *B. monilifera* and the vertically columnar body seen in the cavity of that species, are both entirely absent from this one. The other feature, viz., the Chætites-like body, is seen in only some three or four specimens; one of these being a specimen of *B. sparcilirata*, in which it is very distinct and presents the appearance of a weathered fragment of *Stromatopora*, being formed of an interlaced network of ramifying, stolon-like branches. It is possible that this last feature in the several specimens may be objects foreign to the *Barrettia*, but it is not at all probable.

The question of the proper relations of these organisms is not clearly established by the evidence furnished by any of the specimens in the collection, notwithstanding there are many of them, and that they represent three distinct species. Neither would any one suspect from an examination of the collection that anything representing an upper valve had existed. But that such a feature was really present in the individuals used by Mr. Woodward there can be no doubt.[1]

That the objects are radial in their structure no one can question who examines the figures here presented, which are all from photographs of the objects, and consequently cannot misrepresent. There is no unsymmetrical side, like what would be seen in a body having a lateral hinge, not even as much so as in *Radiolites* or *Hippurites*, consequently the upper valve must have been held in place entirely by muscular action; but the homologies of the several features presented in the internal arrangement are hard to find in any living or known extinct coral or molluscan. When examined in transverse sections, the central cavity, below the living surface, appears to be separated from the marginal features by a distinct wall which is formed by the united edges of the plates which constitute the septa below, but none of the specimens showing the cup would lead one to expect such a

[1] I wrote to Mr. T. Rupert Jones, of London, requesting him to examine the type specimens for me, if they were still in the British Museum. He writes me that the upper valve is there "as figured" on Plate XX, fig. 2, of Woodward's article (copied on page 242 of this paper), but that "it has been slightly damaged, apparently since the drawing was made, at *x*, *x*, above *a*, on the left hand side (the spectators left hand)."

feature, any more than would the surface of the cup of a coral which would show the wall in a section.

The existence of an upper valve is a strong argument in favor of a molluscan affinity. Still we know there are bivalve or operculate corals, as *Calceola*, *Goniophyllum*, *Areopoma* and *Rhizophyllum* sufficiently attest. But none of these are sufficiently allied to *Barrettia* to form a basis for comparison, besides being so distantly separated geologically, none of them being known above the Devonian.

The increase in number of the moniliform rays being from the margin or outer rim is a distinctly radiate feature, and the increase in number of the tubes or beads in a ray taking place at the outer rim is also a distinctly radiate character. They are also seen to be cut off or obliterated at the central cavity by the latter's increased growth, as are the ray teeth of a coral to which they may be analagous. The radial plate is also seen to be composed of a double film, shown by the readiness with which it splits longitudinally, just as do the ray lamellæ of cup corals, having been formed by a folded film of the endoderm of the animal.

If these bead-like bodies were produced by anything like the expanded mantle of a mollusc during growth, they would most likely diverge upwards and increase in distance from each other, like the rays on a shell, or be added to in numbers at intervals, neither of which features occur ; but, on the contrary they are seen on the several longitudinal sections to drop out near the central cavity, which widens at the expense of numbers of these tubes. This probably explains why, in some of the larger individuals, many of the large lacunæ are not present, they having been obliterated by the widening of the central cavity. This feature is noticed in the increase and disappearance of the lines of bead-like tubes. They (the lines) appear to originate at the inner surface of the margin of the cup, and the increase in number of beads in a line takes place at this point, *i. e.*, on the inner surface of the outer wall of the cup. Owing to this fact the lines on a split surface are seen to be parallel to the outer margin after the body has attained its full size, and where there is an increase in dimensions, new ones are seen to come in on the outer border, while those near the inner margin at the border of the central cavity are displaced or obliterated by the increase in width of the central cavity. (See Plates XXXI and XXXII.)

Of the two lacunæ which are always present and continuous (those marked *n*, and *m*, on Woodward's figure 5, Plate XXI [copied on page 242 of this article] of the work cited), the large round one forms a cylindrical horizontally septate tube, extending the entire length of the body, and is situated close to the margin of the central cavity. The septa are concave, flat or convex, at different places in its length. The other one marked *n*, on Woodward's figure 5, is narrowly compressed laterally, and extends to about two-thirds of the distance toward the margin of the body, and is also septate horizontally. (See Plate XXXII, at *b*.) Beyond its outer end the usual bead-like tubes continue, but the earlier ones on the line are absorbed by its increase in length during growth, as can be seen on the left of the figure just referred to. These two features, in all the examples examined, bear the same relations one to the other, and were supposed by Mr. Woodward to represent the inflections of the mantle on the cardinal side, to form the ridges seen on the inside of the cup on the cardinal side of *Radiolites* and *Hippurites*, or as he supposed to form a hinge. (See *n* and *m*, Figs. 6 and 7, page 242, which is a reproduction of Woodward's Plate XXI.) In our specimens these two features are close to the central cavity, and do not become separated from it at its surface, but when, from further growth, the body cavity is contracted below by the partitions thrown across from time to time, in lessening its depth, these features will in a section appear as disconnected from the interior cavity, just as does the fosset in a Cyathophyloid coral, which the long narrow organ here mentioned *very closely resembles, if it does not represent.* That they do not form part of a hinge analagous to that of a bivalve mollusc, or more particularly like that of Hippurites, is shown in their distance from the margin of the body and in being connected with that margin only by the line of bead-like tubes between.

Besides the two features just described, there are others of the rays, as they are seen in transverse sections, which are constructed differently from the generality of them. These may be seen on page 242, at *c, c, c, c,* where they are more nearly solid and not as vesicular as the others, as if they had been filled up by a continuous deposit. The meaning of these I have not been able to determine, nor have I been able to trace them to their source on the surface of the specimens. But I have thought they might, with the features *a* and *b*, represent the primary rays of a coral.

It might be contended that these cells and partitions are analagous to the columnar or fibrous features of *Radiolites, Caprotina* and other Rudistæ, but all those features are divergent in their growth upward, whereas these in *Barrettia* are convergent or parallel, and the additions are all at the outer rim of the body and not at intermediate points and interstitially as in molluscs.

When examined in thin transverse microscopical sections, the thick wall separating the quadrangular interradial cavities or cells, in *B. monilifera*, is seen to be composed of vertical plates rather dense in substance, forming a rudely longitudinally vesicular structure, sometimes uniting in centers, like the rays of septate corals; they also formed compressed ovals or narrowly elliptical cavities, all arranged vertically. In vertical sections these plates are seen to be continuous for considerable distances, or are subject to frequent interruptions and conjunctions with each other, as is seen in longitudinal sections of cup corals. In longitudinal sections made along the moniliform ray the vertical plates are seen always a little oblique to the moniliform tubes, but entirely distinct from them; while the convex plates of the moniliform tubes are very perceptible. In a vertical section at right angles to the moniliform ray, cutting the tube transverse to its radial axis, the transverse plates or septa are seen to be raised in the center, pointing upward where they join the thin radial plate which divides them along the middle, appearing much like the plates or tabulæ which are seen in the Palæozoic corals *Syringopora, Lithostrotion,* etc., which form the columella of those corals.

So far as my observations extend I can find no evidence of a molluscan nature in these organisms except the presence of an upper valve. All the other features tend towards a radial affinity. The total absence of a hinge, even as much as the faintly marked

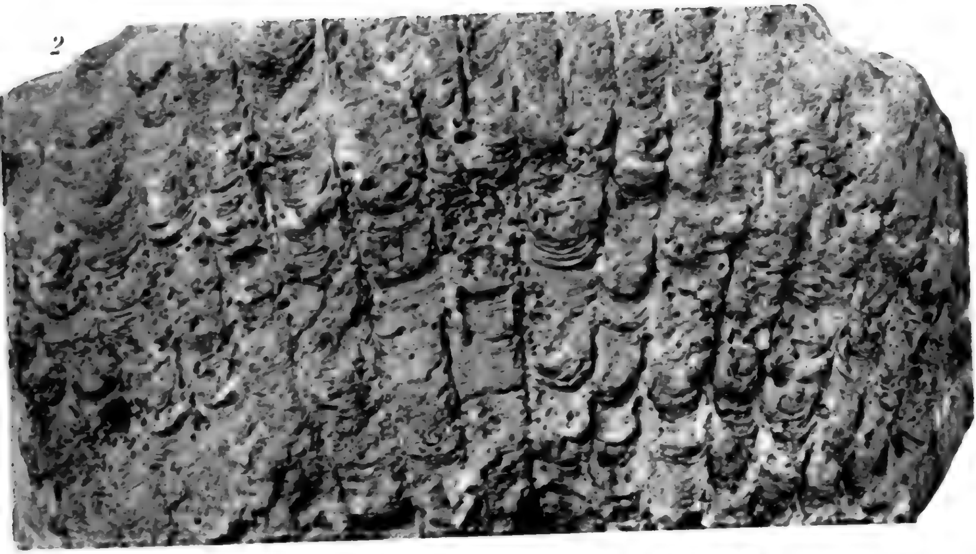
EXPLANATION OF PLATE XXVII.

Barrettia monilifera Woodward. Page 233.

Fig. 1.—View of the summit of a large weathered specimen reduced to one-half the natural size. The circular spot near *a* is the longitudinal septate tube; *b* is the fosset-like cavity filled by a calcareous deposit; *c* is the horizontally fibrous, pearly substance; *d* indicates the vertically fibrous, or Chætetes-like substance of the central cavity. The quadrangular cavities of cells are seen all over except in the centre, and in the ridges between the radiating rows of these may be seen the moniliform rays of Woodward.

Fig. 2.—Represents a vertical weathered section of a specimen showing the septa-like lower surfaces of the quadrangular cavities with vertical rays separating them. Natural size.

2



1

EXPLANATION OF PLATE XXVIII.

Barrettia monilifera Woodward. Page 233.

Fig. 1.—View, natural size, of a part of the weathered specimen represented half size on Plate XXVII, showing more plainly the features indicated on that figure. The lettering refers to the same parts as there. At *c*, a cavity, reniform in shape, is seen which is distinctly walled. The *moniliform* rays can be easily seen on the ridges between the lines of quadrangular cavities. Many of the cavities are filled with calc-spar.


b
a
d
e
c

EXPLANATION OF PLATE XXIX.

Barrettia monilifera Woodward. Page 233.

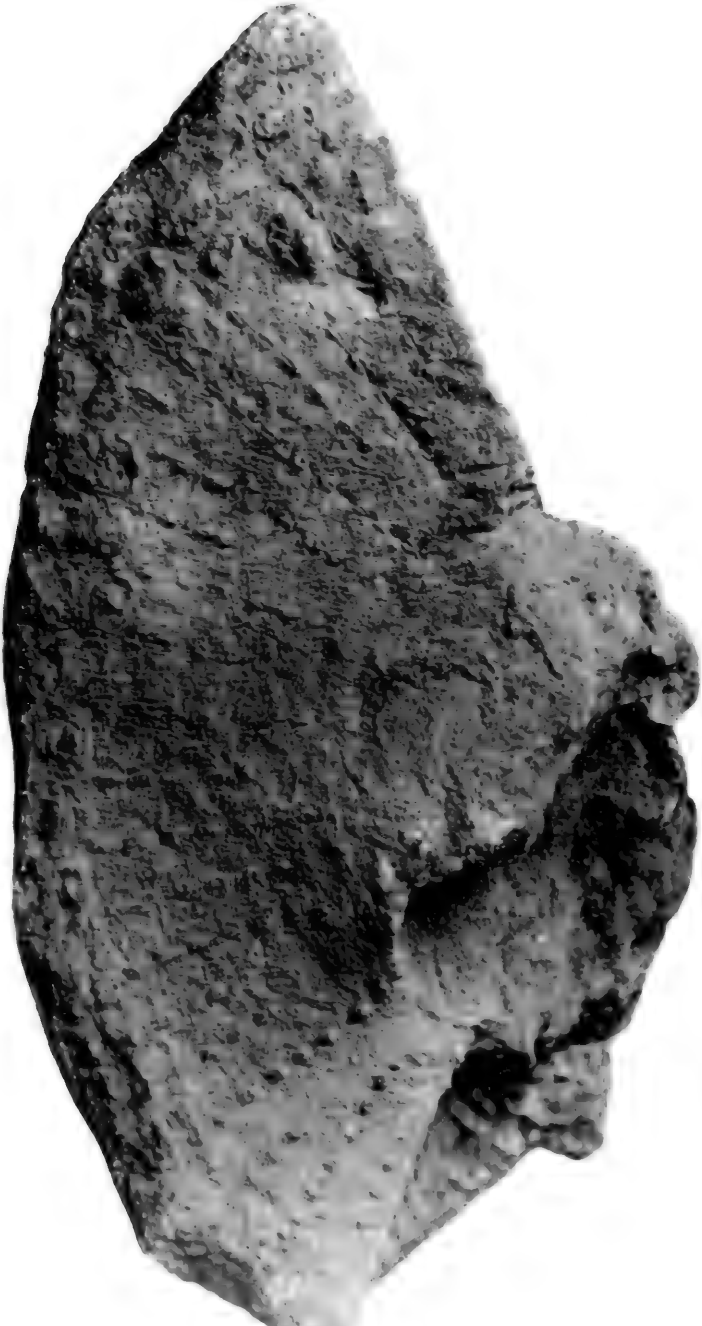
Fig. 1.—A view, natural size, of a weathered fragment viewed on the lower surface so that the features appear reversed from what they do on figure 1 on Plate XXVII and on Plate XXVIII. Some of the moniliform tubes are seen projecting on the surfaces where the quadrangular cells are filled with crystalline limestone.


c
c
d
a

EXPLANATION OF PLATE XXX.

Barrettia monilifera Woodward. Page 233.

The figure represents the upper end of a split specimen, where all the quadrangular cells are filled with crystalline matter so as to obliterate their outlines, similar to what Mr. Woodward's specimen must have been. The moniliform rays are seen projecting on the weathered surface. Natural size.



BARRETTIA MONILIFERA, Whitf.

EXPLANATION OF PLATE XXXI.

Barrettia monilifera Woodward. Page 233.

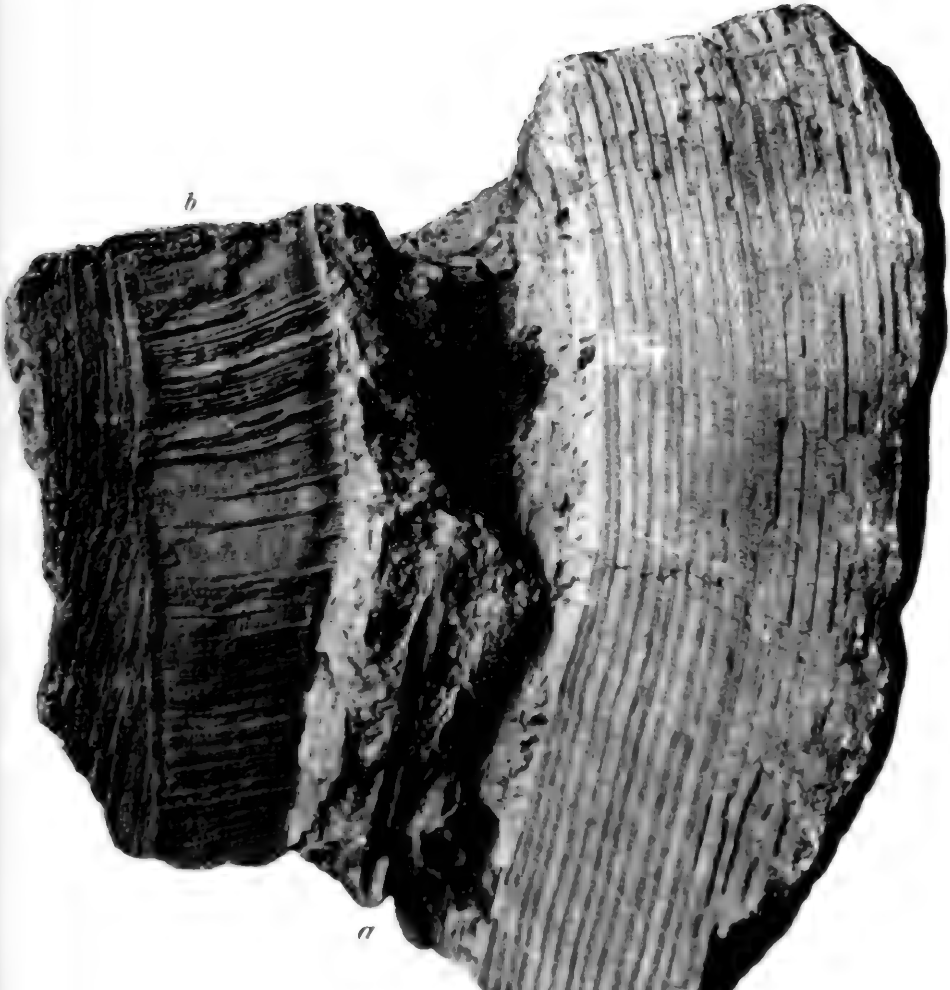
The figure represents a specimen split longitudinally and weathered, and shows the septæ of the central cavity, also the septate tube *a*, on one side of the central cavity, and on each side the sections of the moniliform bodies, most of which retain only the one-half of the tube with the septa curving upward. At the base of the figure at the right may be seen a few of these tubes retaining the front half in place, a common feature of some of these split weathered specimens.


a

EXPLANATION OF PLATE XXXII.

Barrettia monilifera Woodward. **Page 233.**

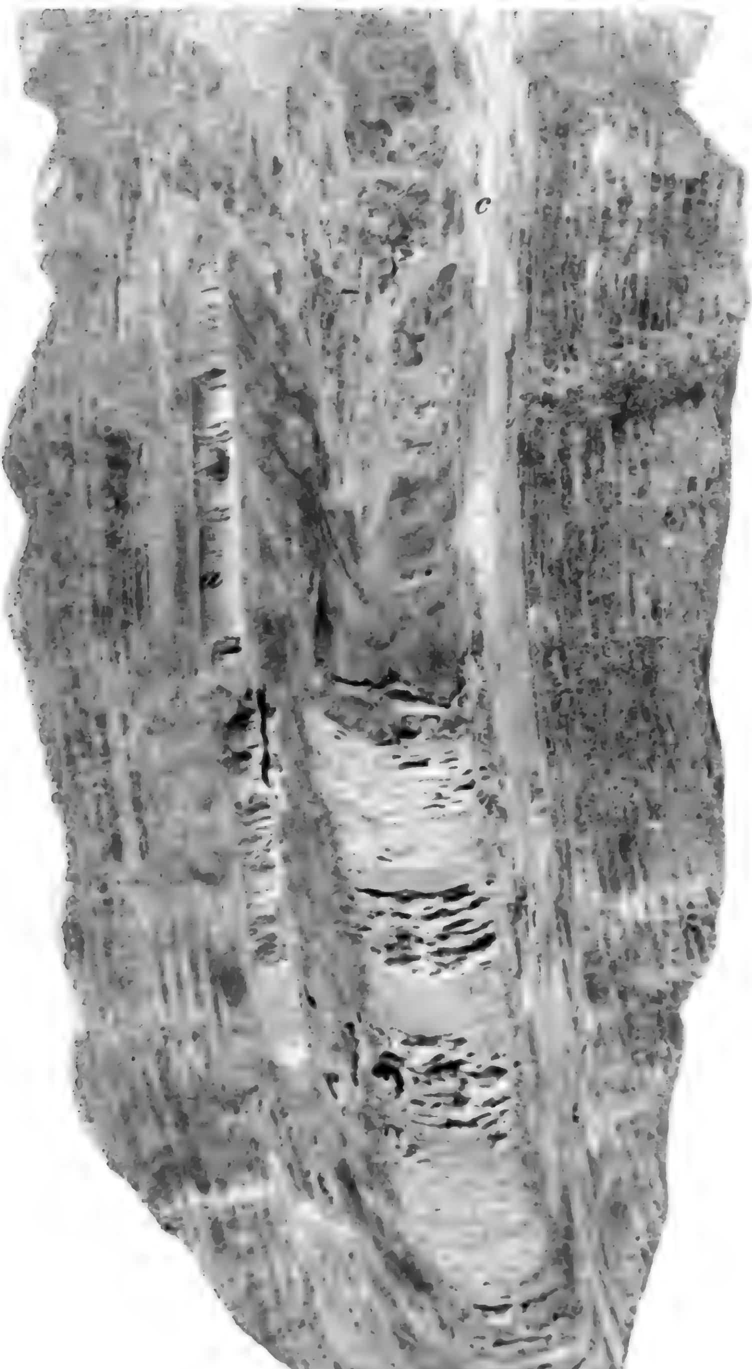
The figure is one-half natural size of a longitudinally split specimen, retaining a little more than half of the circumference of the original body, showing part of the visceral cup at the top and the succeeding septæ below filled with crystalline matter, the imprint of the small septate tube on its broken surface at *a*. At *b* is seen the track of the fosset-like cavity with remains of its diaphrams or septa and on both sides the moniliform tubes, some of which retain both halves, while others have both parts removed leaving the tube cavity empty. The manner in which these small tubes are displaced or obliterated by the addititional growth in width of this fosset is distinctly seen on the left side.



EXPLANATION OF PLATE XXXIII.

Barrettia multilirata Whitf. **Page 244.**

The view is of a polished longitudinal section reduced to about two-thirds of the natural size, of a specimen of this species, and shows the septa of the central cavity and also part of a section with the septa of the large septate tube *a*. On the sides may be recognized sections of the quadrangular cavities of the summit structure and fragments of the moniliform tubes. *C* probably represents the track of the horizontally fibrous body.


c

EXPLANATION OF PLATE XXXIV.

Barrettia multilirata Whitf. **Page 244.**

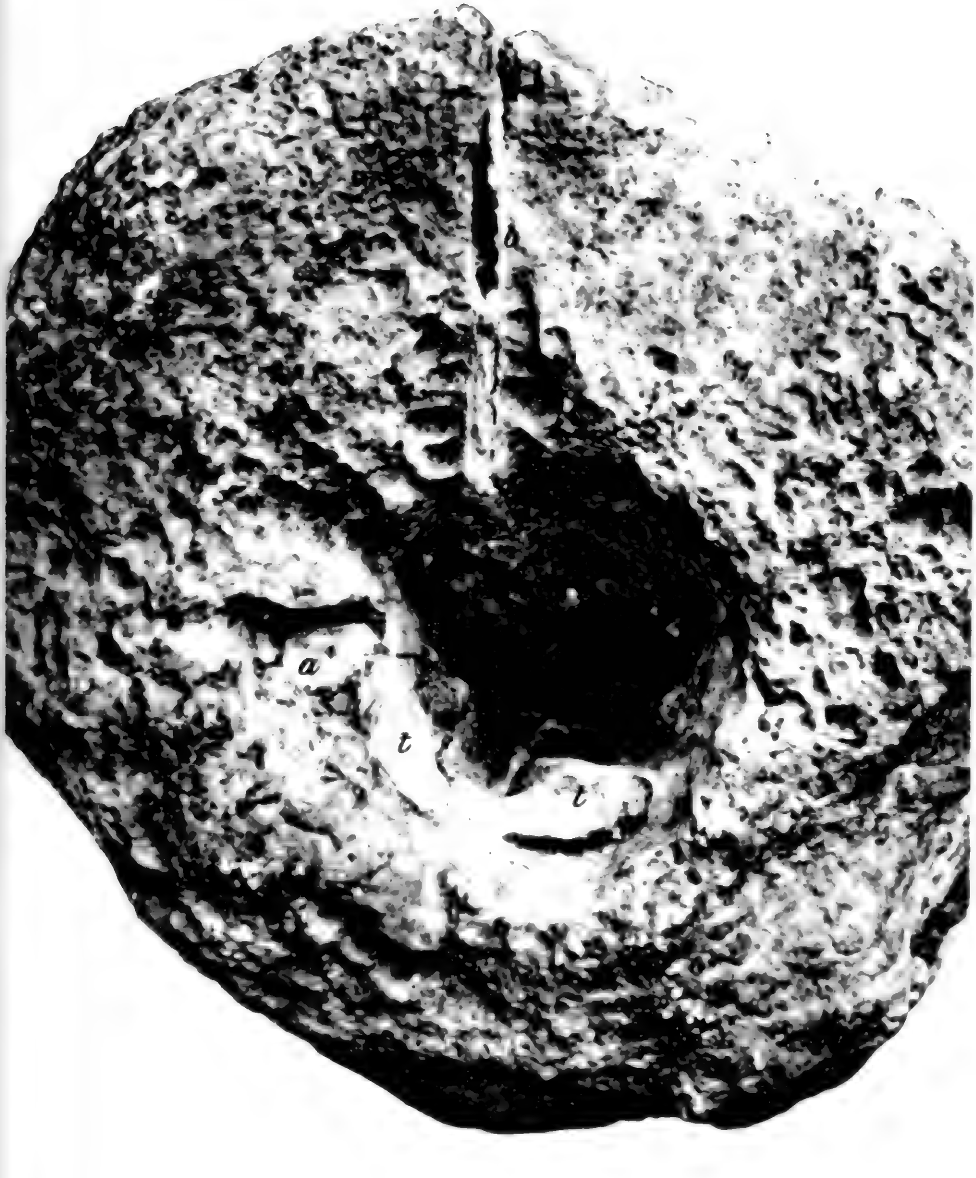
The figure is of a section, about four-fifths natural size, taken from the top of the specimen represented on Plate XXXIII, before the longitudinal section was made ; consequently it is seen from the under surface so that the features appear reversed from their natural positions. *a*, represents the longitudinal septate tube ; *b*, the fosset-like body ; *c*, *c*, *c*, three of the radial spaces filled with matter differing from that filling the others ; *t*, *t*, may represent the bodies supposed by Mr. Woodward to represent teeth of the upper valve. Around the side of the center embracing the bodies, *t*, *t*, is the pearly horizontally fibrous substance seen in *B. monilifera*. The quadrangular cells and moniliform rays are readily recognized.


c
t
t
b
c
a
c

EXPLANATION OF PLATE XXXV.

Barrettia multilirata Whitf. **Page 244.**

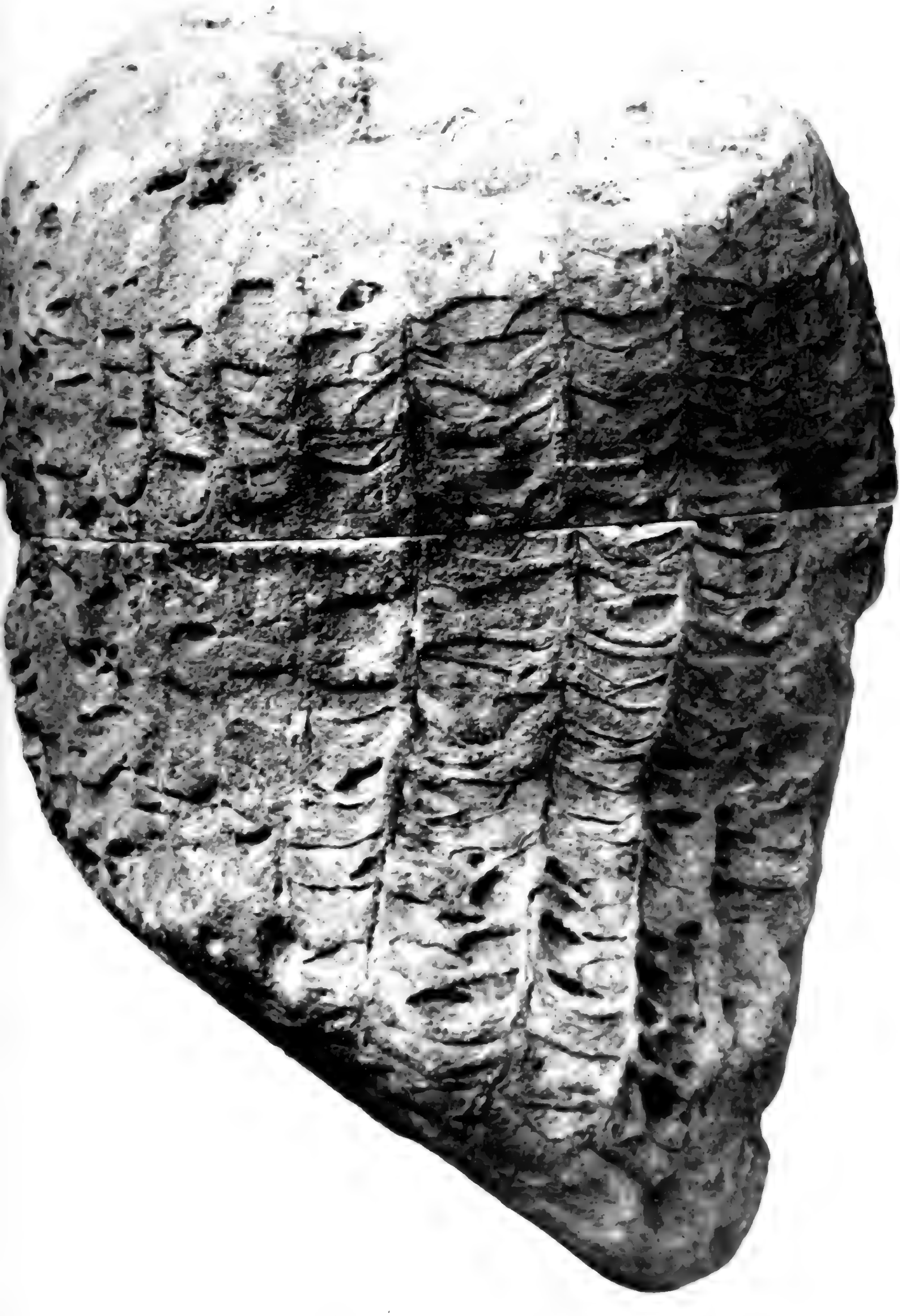
View, natural size, of the upper weathered surface of a specimen which shows the deep central cavity. At *a*, is the end of the septate tube, at *b*, the fosset, and at *t*, *t*, the remains of the two bodies supposed to be teeth of the upper valve by Mr. Woodward. These triangular points are distinctly limited around their sides and appear to be placed in a socket-like cavity. The horizontally fibrous body cannot be found in this and some other specimens.


b
a
t
t

EXPLANATION OF PLATE XXXVI.

Barrettia sparcilirata Whitf. Page 245.

View, a little less than natural size, of a specimen of this species which is only the upper end of the organism. The surface has been weathered or worn as if rolled in a stream, but shows the structure very distinctly. In a section made across near the middle it shows the moniliform rays to be very few in number, and the quadrangular cells between them are large and very irregular as seen on the exterior.



EXPLANATION OF PLATE XXXVII.

Barrettia sparcilirata Whitf. Page 245.

View of a section of a second specimen of the species, in which the position of the vertical septate tube is seen at *a*, and most of the moniliform rays are easily recognized ; but the fosset-like body has not been satisfactorily recognized in either specimens of this species, but is possibly represented at *b*, broken down.

EXPLANATION OF PLATE XXXVIII.

[Sections about six diameters.]

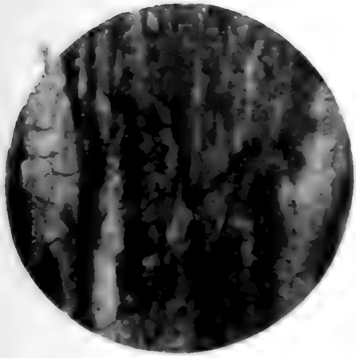
Fig. 1.—A vertical section of the transverse wall between the quadrangular cells. The vertical lines are the more solid plates. The checked area at the left of the figure is calcite. The vertical plates are seen to bifurcate upward.

Fig. 2.—A section along the ray, showing two of the moniliform beads with the numerous transverse septa curving upward. The oblique vertical lines between them are the vertical plates of the walls dividing the cells.

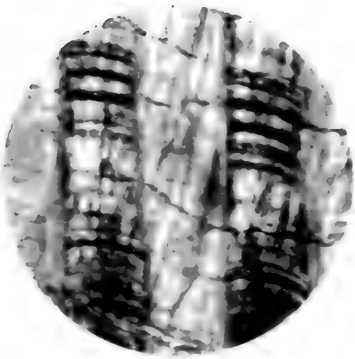
Fig. 3.—A horizontal section showing three monillæ. The band across the center is the transverse wall dividing the quadrangular cells, and shows the pseudo-stellate grouping of the plates.

Fig. 4.—A vertical section of one of the monillæ at right angles to the direction of the rays, and shows the columellar arrangement of the septa in the center. The specimen is badly fractured, causing the white patches.

1



2



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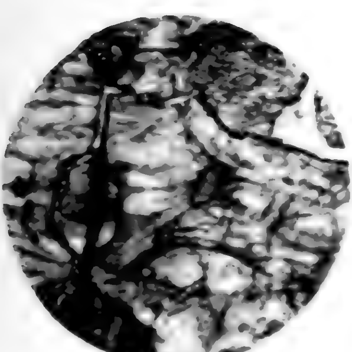

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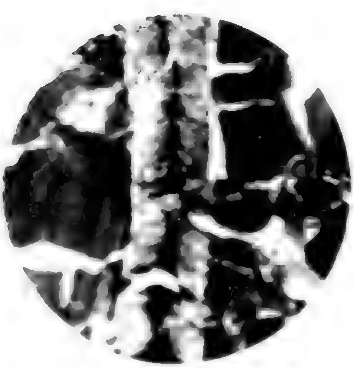

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BARRETTIA MONILIFERA (Woodward)

Fig. 1.

Fig. 3.

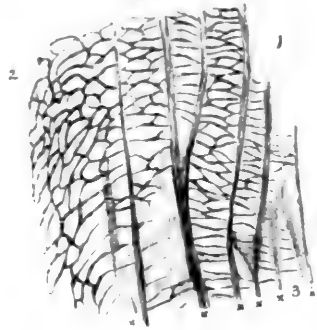
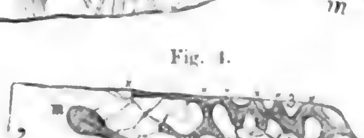


Fig. 2.

Fig. 4.



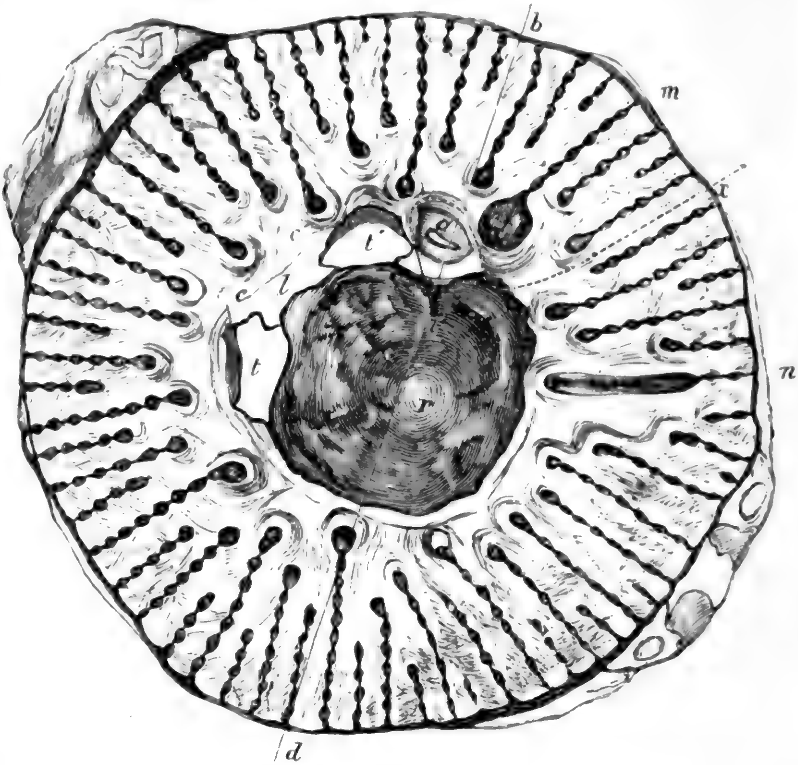
BARRETTIA MONILIFERA.

1. Reduced figure of a group of three individuals. 2. Longitudinal Section.
3. Tangential Section. 4. Transverse Section of Fig. 3.

REPRODUCTION OF WOODWARD'S PLATE XX.

(From 'The Geologist,' London, January, 1862.)

Fig. 5.

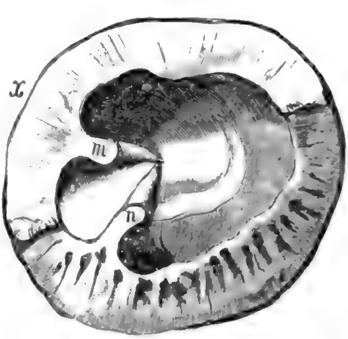


BARRETTIA MONILIFERA.

Hippurite Limestone, Jamaica.

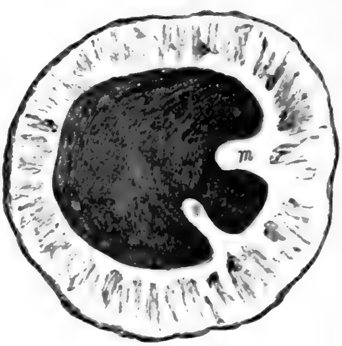
(Reduced one-fifth.)

Fig. 6.



Upper Valve.

Fig. 7.



Lower Valve.

INTERIORS OF HIPPURITE, ANGOULEME.

REPRODUCTION OF WOODWARD'S PLATE XXI.

(From 'The Geologist,' London, January, 1862.)

cardinal grooves of *Hippurites*, would be against a molluscan relationship. The growth of the ray-like features being from the margin inward is decidedly coral-like. The laterally compressed lacuna of one of the persistent rays closely resembles in all its features, as well as in its position, the fosset of a coral, and is decidedly unlike any molluscan feature; while the transversely septate feature of most of the cavities resemble peculiarities of the cup corals very closely. But the analogue of the round, persistent lacuna is not represented in any coral with which I am acquainted. Considering all these peculiarities I am much more inclined to consider them as pertaining to the Cœlenterates than to any form of the Mollusca.

More recently M. Douville has published in Memoir No. 6 of Vol. IV, Fasc. II, Geol. Soc. France, some studies of the Rudistæ, in which he has considered the genus *Barrettia* in connection with *Peronea* and *Batolites*. He seems to consider the rays of *Barrettia* as reduplications of the mantle of a mollusc, as Mr. Woodward did, and the moniliform tubes as analogous to the respiratory tubes in *Hippurites*, classing the three genera as a separate section of the Rudistæ. In *Peronea* there are a number of infoldings of the test, which, in a transverse section, have a strong resemblance to the rays in *Barrettia*, but so far as I can ascertain from his figures and description there is no structure in these infoldings resembling the moniliform bodies in the rays of *Barrettia*. In his figures of *Batolites* there are shown, in sections, features resembling these rays, penetrating the shell outside of the central cavity, which may possibly be similar in their nature, but they are in the otherwise solid outside shell, while those in *Barrettia* are entirely inside of the outer cup. No structure is assigned to those of *Batolites* like that seen in the moniliform rays of *Barrettia*. There can be no feature resembling the quadrangular interradial cells of *Barrettia* in a body like *Batolites*; on the contrary, the living surface of the valve shows the ordinary polygonal, reticulated, pitted surface, characteristic of the fibrous structure of *Caprotina* and other genera of the true Rudistidæ. All the features shown by the two genera mentioned above are such as might readily pertain to a mollusc, but those which we have shown to exist in *Barrettia* are entirely incompatible with the growth of a molluscan body, and are allied to those of cup corals. I think it very probable that had M. Douville seen all the features of *Barrettia*, instead of only Mr. Woodward's figures and description, he would have arrived at very different conclusions.

DESCRIPTIONS OF NEW SPECIES.

Barrettia multilirata, n. sp.

PLATES XXXIII, XXXIV AND XXXV.

Body more slender than that of *B. monilifera* Woodward, being pointed below and cylindrical above, usually slightly curved; the largest one observed having a diameter of six to six and a half inches (15 to 16 centimeters) on a specimen measuring about 14 inches in length ($35\frac{1}{2}$ cm.). In this specimen, about two inches from the top, at the point where the figure is cut off, or in the section photographed, there can be counted 125 rays on the outer margin, about 46 of which appear to reach the margin of the central cavity as seen in the section. Moniliform tubes rather small, but the ray material quite distinct. Interradial cavities small, appearing crowded and contracted, especially near the points where new or intercalated rays appear and toward the outer margin of the specimen. Transverse septa of the interradial cells flat or slightly concave, very irregular in their distances from each other. Septa of the moniliform tubes very numerous. Fosset-like body three-fourths as long as the distance between the margin of the central cavity and the outer border of the specimen, as seen on the section, and readily recognizable. Cylindrical tube oval in transverse section, large.

The distinction between this form and *B. monilifera* is in its more slender form, more numerous rays and more crowded interradial cells. In *B. monilifera* Mr. Woodward gives sixty-five rays in a specimen of five inches diameter; while here there are about double that number in one six inches in diameter, forty-six of which appear to reach within a little more than an inch of the center of the disc, or to what appears to have been the margin of the visceral cavity at that point.

From the Cretaceous limestone at Orange Cove, Hanover Parish, Jamaica, W. I., with *B. monilifera.*

Barrettia sparcilirata, n. sp.

PLATES XXXVI AND XXXVII.

Body cylindrical or turbinate, pointed below, and differing from the typical forms of *B. monilifera* in the fewer number of rays or divisions, but similarly constructed in other respects. In this form, an example very distinctly marked and measuring five or six inches in diameter, possesses only twenty-three rays on the outer margin; several of these being only slightly indicated on the surface and extending inward scarcely enough to be detected on the cut surface. Some of the interradial spaces are over an inch in width on the outer surface. The septa within these spaces are concave, sometimes deeply so, at others shallow, and many of them are interrupted and somewhat irregular. The moniliform lines, as seen on the cut surface of the specimen, are quite irregular in their direction from the margin of the body cavity at the point at which the section was made (three inches from the top), the one representing the septate cylindrical tube being comparatively small and laterally compressed, instead of pear-shaped or round as in *B. monilifera*. The fosset-like body has been crushed and broken down, but seems to have been very much the same in general characters as in the other species.

A second specimen which I have referred to this species is abruptly turbinate, attaining, in a length of about eight inches, a diameter of five by seven inches, and showing evidences on the outer surface of about thirty rays at the top; while seven or eight only can be determined at the present lower end, which is imperfect. The rays of moniliform tubes are quite distinct over most of the upper surface of this specimen, as also in the first or originating larger lacunæ. The one representing the septate tube is long, pear-shaped, but the fosset-like body cannot be determined satisfactorily. A line, however, which may represent it is seen, but at about one-fourth of the circle removed from the septate lucunæ, which is much further than in any other individual of the genus examined.

On this individual there occurs what is probably the only remains of the true external surface seen on any of the entire suite of specimens. This is probably owing to the protection afforded by the attachment of an oyster which coats this part of the body. The substance consists of a series of fine columns, arranged longitudinally on the organism, divided by finer transverse partitions, four to six of which equal the width of one of the vertical columns.

This form has only been recognized in Cretaceous limestones at Logie Green, in the northeastern part of Clarendon Parish, Jamaica, W. I.

Article XXI.—THE HUERFANO LAKE BASIN, SOUTHERN COLORADO, AND ITS WIND RIVER AND BRIDGER FAUNA.

By HENRY FAIRFIELD OSBORN.

In this paper will be discussed Professor Hills's observations upon the Huerfano Eocene Lake Basin, also those of the writer and Dr. Wortman, including a description of the fauna.

1.—GEOLOGY OF THE BASIN.

In 1888 Professor R. C. Hills,[1] of Denver, announced his very important discovery of Tertiary Beds in the Huerfano River Basin of Southern Colorado. This basin opens towards the Plains through the Huerfano Cañon south of the Wet Mountain Range, and some distance north of the Spanish Peaks. It therefore has at present an eastern drainage into the Arkansas River, and is of exceptional interest because of its isolation from the typical Eocene exposures to the north and west. Professor Hills first described as the 'typical exposures' those occurring upon the Muddy Branch of the Huerfano River in the centre of the valley, and he named them the Poison Cañon Series (1888, p. 16). He estimated them at eight thousand feet in thickness, and as consisting of three divisions: an 'upper series' of softer red and yellow sandy clays and marls, two thousand feet; and below this sandstones, in two 'lower series,' aggregating five thousand feet.

The 'lower series,' he observed, cover a much larger area than the soft sands and marls of the 'upper series,' and extend to the southeast far beyond the limits of the Huerfano into the Cuchara Valley and to the Apishapa, or nearly north and south for a distance of fifty miles, from the base of the Spanish Peaks to the

[1] R. C. Hills. 1888. Recently discovered Tertiary Beds of the Huerfano Basin, Denver, 1888.
" 1889. Additional Notes on the Huerfano Beds. Proc. of the Colorado Scientific Society, October 7, 1889.
" 1891. Remarks on the Classification of the Huerfano Eocene. Proc. of the Colorado Scientific Society, February 2, 1891.

Wet Mountain Valley. This area, having an east and west extent of ten to fifteen miles, he mapped as the former basin of the Huerfano deposits, representing it as bounded upon the east by a distant anticlinal axis extending from the eastern flanks of the Wet Mountain Range from five to ten miles southeast of the present main axis of the range and Spanish Peaks. He thus regarded the eruption of the Spanish Peaks and of Silver Mountain as occurring within the Huerfano Lake area subsequent (1888, p. 11) to the formation of the latest Huerfano Lake deposits, possibly during the Uinta period (1889, p. 223), and considered the upturned beds upon the slopes of the Spanish Peaks and Silver Mountain as part of the Huerfano deposition. Further (1888, p. 14) he suggested that the probable outlet of the Huerfano Lake was to the northward through the Wet Mountain Valley. In his first paper also (1888, p. 16) Professor Hills identified as probably of Pliocene age, the uppermost deposits of between seven and eight hundred feet in thickness, consisting of fawn or buff colored, compact marls, clays and sandstones, between the Muddy and the Huerfano in the centre of the basin, but in his second paper these were correctly determined as Eocene, while more restricted true Pliocene or Equus Beds sands were found above. The harder beds of the 'lower series' underlying these he compared lithologically with the Wasatch of the Uinta and San Juan Basins. In fact the first fossils he procured resembled the remains of *Coryphodon.*

In his second paper (October, 1889, p. 218) Professor Hills divided the Huerfano Beds into three series, as follows :

Total thickness exposed in Poison Cañon, and approximate total at West Spanish Peak.	Marls, clays, soft shales and sands, of red, gray, yellow, green and purple colors, red predominating. (Fully exposed in Huerfano Valley, removed by erosion in Cuchara Valley.)...	3,300 ft.
	Pink and white massive sandstones (well exposed in Cuchara Valley and West Spanish Peak)........	300 ft.
	Soft sandstones and fine conglomerates of a yellowish tint, with occasional bands of yellow clay or marl,	3,500 ft.

The upper marls and clays, he observed, were altered where they come in proximity to the laccolithic mass of West Spanish Peaks. In this paper he demonstrated positively that the upper variegated marls and sands belong to the Eocene, from the occurrence in these beds of a number of characteristic Eocene genera, such as *Tillotherium*, *Hyrachyus*, *Glyptosaurus* and *Palæosyops*.[1] He also distinguished as Pliocene[2] the superficial deposits of volcanic ash found between Muddy and Turkey Creeks, which contained remains of Horses, Llamas and Elephants. No fossils were reported from the deposits of the 'lower beds,' but the characteristic Bridger fossils found in the 'upper beds' furnished important evidence of their Bridger age.

In his third paper (1891) Professor Hills positively identified the 'upper beds' as equivalent to the Bridger group, and restricted the term HUERFANO to these beds, applying the terms CUCHARA to the middle division, and POISON CAÑON to the lower division. These divisions, correlated with the measurements previously assigned them, would then occur as follows:

Huerfano Series (Eocene).	Huerfano Beds.......	= Bridger Group..........	3,300
	Cuchara Beds......	....	300
	Poison Cañon Beds.	Lower Eocene (Green River, Wasatch and Puerco).....	3,500

While these studies were in progress a large collection of fragmentary bones was made by Mr. Milligan, of Gardner, which is now preserved in the Museum of the Colorado Scientific Society, and which Professor Hills kindly enabled the writer to carefully examine.

The essential features of Professor Hills's conclusions may be summarized as follows:

1. The identification of the total Huerfano series of 3,300 feet with the Bridger or Middle Eocene, and the provisional identification of the Cuchara and Poison Cañon series with the Lower Eocene, in the absence of fossils, upon stratigraphical evidence.

2. The Post-Laramie formation of a great anticlinal axis, as the eastern border of the Huerfano Lake to the east and southeast of the Wet Mountain range and Spanish Peaks, and the subsequent removal of this axis by erosion.

[1] Mainly identified by Professor Marsh.
[2] If equivalent to the *Equus Beds*, these would be termed Pleistocene.

3. The eruption of the laccolithic Silver Mountain and Spanish Peaks subsequent to the deposition of upper lake deposits of Bridger age.

4. The drainage of the Huerfano Lake to the north through the Wet Mountain Valley.

It should be stated here that these opinions were expressed at a time when several geologists had identified Laramie deposits east of the Rockies as Tertiary, owing partly to Professor Marsh's identification of a Laramie Dinosaur with *Bison alticornis.*

For the sake of clearness of contrast it may be well to summarize at this point the geological conclusions formed by the writer and Dr. Wortman during their brief reconnaissance of this region :

1. That west of the Huerfano Cañon the variegated marls, clays, soft shales and sands aggregate only 800 to 1000 feet in thickness, and are nearly horizontal in position. They may be positively divided into Upper Beds, equivalent to the Bridger, and Lower Beds, equivalent to the Wind River, or Upper Wasatch. These constitute the only true Huerfano Lake deposits.

2. That the Cuchara and Poison Cañon Beds are unconformable with the Huerfano Beds and older than the Eocene, probably marine Cretaceous, as partly determined by the presence of a species of *Baculites* in the yellow sandstone of the typical Poison Cañon section.

3. That the present cañon of the Huerfano River cuts through the base of the main anticlinal axis of Post-Laramie origin, which formed the eastern boundary of the lake. This axis extended to the south so as to include the base of Silver Mountain toward the Cuchara divide ; but it lies from three to seven miles west of the anticlinal axis described by Professor Hills.

4. That the Huerfano Lake deposition did not extend as far to the east or south as the Spanish Peaks, and that the variegated beds observed there are of older origin. This would materially affect the geological age of the prominent neighboring laccoliths,

The geological features of these conclusions can hardly be dignified by the term 'a theory of the Huerfano Lake,' for they were formed during a hasty reconnaissance of this basin, while Professor Hills's theory certainly deserves the deliberate consideration of a prolonged survey. In fact this basin, with its volcanic disturbances and eruptions, presents in compact form a fascinating problem in the geology of Tertiary times.

2.—Determination of Two Horizons.

We may now proceed with an account of our reconnaissance. Attracted by the prospect of adding to our knowledge of the Bridger fauna, and especially of the little-known genus *Tillotherium*, the writer, accompanied by Dr. Wortman, entered this Basin upon May 25 last.

In transportation and outfitting we were most liberally assisted by President E. T. Jeffery and other officials of the Denver and Rio Grande Railroad, to whom we return our hearty acknowledgments.

Aided by sketches of the topography and the fullest information as to localities kindly given us by Professor Hills, we proceeded directly to the Huerfano Cañon. There we observed the base of a great anticlinal fold originally of at least 1500 feet in thickness, but now greatly eroded and cut directly through its axis by the river. This Cretaceous axis appears to have been of sufficient thickness to have held back the drainage of the basin, and to have caused the deposition of the 800–1000 feet of Eocene sediment which we found above. We followed up the Huerfano and Muddy about twenty-five miles to the entrance of Poison Cañon, and explored first, the three large Eocene buttes between the Muddy and Huerfano Rivers, as well as Monument Bluffs opposite. Subsequently Box Cañon was carefully worked over by Dr. Wortman, and the whole region west of Gardner. Unfortunately, Mr. Milligan, who went over the ground for Professor Hills, was not experienced, and his very thorough gatherings from the surface had removed most of the indications of the underlying remains, which are invaluable to the trained collector. Thus the beds appeared to be generally barren, although originally, judging by the large number of fragments in the Museum of the Colorado Scientific Society, the indications must have been more plentiful. The surface also is naturally unfavorable to the collector, as compared with the Bridger, because the rock is much softer, the overcrust is deeper and comparatively few areas are free from trees and vegetation, whereas the Bridger buttes are absolutely bare, and the eye reaches long distances. All the remains were found in the sands, clays and marls, varying from red, purple, gray, green and yellow or whitish in color, the upper arenaceous clays containing the best deposits.

We nevertheless found very considerable portions of the skeleton of *Tillotherium*—a form which is very rare in the Bridger—besides remains of *Hyrachyus*, *Palæosyops*, *Microsyops*, *Calamodon*, *Stypolophus*, and the Bridger Horse, probably *Pachynolophus*. The region thus shown to be homotaxial with the Bridger is rendered peculiar by the scarcity of any remains of *Uintatherium*.

In the typical Poison Cañon section, described upon page 4 of Professor Hills's first paper, from Poison Cañon to Monument Bluffs, the yellow sandstones underlying the Upper Beds just south of Muddy Creek were proved to be Cretaceous by the presence of *Baculites* and other invertebrate remains in the clays immediately underlying them. These Cretaceous Beds are certainly not 800 feet below the summit of the Upper Huerfano Beds, yet they are directly in the path of the typical Poison Cañon section described by Professor Hills. This observation therefore not only affects the determination of the age of the Poison Cañon and Cuchara Beds, but it materially reduces the estimated thickness of the Upper Beds.

At all points, except close to the old northern lake border against the Wet Mountain range, where the Upper Beds partook of the mountain uplift, we observed a nearly horizontal position of the Upper Beds, and a very decided unconformity with the massive underlying pink and yellow sandstones, which at many points were sharply upturned. At distant points these Upper Beds were easily distinguished by their alternating bands of reds, grays and buffs. In fact the extensive view of the basin afforded from the uneroded buttes between the Muddy and the Huerfano—from Promontory Bluffs upon the north to the Sheep Mountains on the south (which we were unable to visit)—gave the impression of a typical lake deposit of about 800 feet in thickness, nearly horizontal, covering what were formerly insular masses of upturned rocks, and overlying here and there, in the valleys, cleanly eroded Cretaceous Beds. In several places these Eocene Beds are intruded by laccolithic dykes[1] and by fissures of recent origin, filled with gravel conglomerates similar to those which cap the beds. As in the Bridger of Wyoming, these Upper Beds were capped with conglomerates.

In examining Professor Hills's collection in Denver the writer found part of a molar tooth of *Coryphodon*, also the distal end of a humerus and a femur, confirming Professor Hill's original identification of a portion of the beds with the Wasatch or Wind River. This was fully corroborated by our own collections.

Subsequent to the writer's departure from the Basin, Dr. Wortman explored the region east of Gardner, our previous explorations having been to the north and west, and was surprised to find an entirely different fauna, containing none of the forms characteristic of the Upper or Bridger level, but on the other hand distinguished as of Wind River or of Wasatch age by the presence of *Coryphodon*, *Lambdotherium*, *Oxyæna*, *Pantolestes* and other lower Eocene forms. "These beds of the lower division," writes Dr. Wortman, "are indistinguishable, so far as their general appearance and lithological characters are concerned, from those of the upper level. The fossils occur apparently in a single stratum not exceeding 10 or 15 feet in thickness, and not more than 30 or 40 feet from the base of the formation. They underlie the beds of the upper division with perfect conformity, and there is at present no means of determining exactly where the one ends and the other begins. That sedimentation was continuous and uninterrupted

[1] "Near Gardner is found the small laccolith known as Rattlesnake Butte. It is a small volcanic mass standing almost in the center of the basin, not exceeding 250 feet in height, and apparently unconnected with the numerous dykes which cross the basin in the direction from northeast to southwest. That this laccolith antedates the deposition of the Huerfano sediment is proved by the fact that the beds in its immediate vicinity show no evidence whatever of any disturbance of level, which must have undoubtedly occurred had it been intruded into these sediments after they had been laid down. On the other hand they preserve their horizontality and unaltered condition even to actual contact with the volcanic rock. In the same manner the Huerfano Beds lie almost horizontal against the base of Silver and Sheep Mountains, a fact which must argue strongly for their pre-Huerfano formation. It is, however, a fact that many of the dykes were formed subsequent to the deposition of the Huerfano sediments."—J. L. W.

In discussing this paper at the Detroit meeting of the American Association, Mr G. K. Gilbert, of the U. S. Geological Survey, observed that laccoliths make a very slight disturbance of local strata.

from the beginning to the close of the whole deposit, I do not think there can be the slightest question. The exact locality from which the greater number of the fossils of the Lower Beds were obtained is Garcias Cañon, about one and one-half miles south of Talpa or the mouth of Turkey Creek."

He traced the distribution of the sediment southward around the base of Silver Mountains, but was unable to find it to the south of the Cuchara-Huerfano divide, nor to the east of the Huerfano Cañon. To the south of the Silver Mountains the Upper Bed formation thins out rapidly, giving the impression that the Huerfano-Cuchara divide is a continuation of the axis of the southern boundary of the Lake first observed at the Cañon. No traces could be found of the Upper Beds at Spanish Peaks, after careful search, but it is possible that the especial localities described by Professor Hills as exhibiting the Upper Bed formation were not met with.

The faunal division between the Upper and Lower Beds is therefore very clearly marked by fossils in the Museum of the Colorado Scientific Society (indicated by C.), and by those collected for the American Museum of Natural History (indicated by A.), as follows :

3. Huerfano Lake Fauna.

	I. Lower Beds. *Wind River.*	II. Upper Beds. *Bridger.*
Creodonta	Oxyæna huerfanensis (A.).	Patriofelis ulta (A.).
	Didymictis protenus (A.).	
	" dawkinsianus (A.).	
Ganodonta		Calamodon[1] (C.).
Rodentia	Plesiarctomys delicatior (A.).	Paramys (C.).
Tillodontia		Tillotherium fodiens (C. A.).
Primates	Hyopsodus powellianus (A.).	Microsyops (C.).
Amblypoda	Coryphodon, sp. indet. (C. A.).	Uintatherium, sp. indet. (C. A.).
Perissodactyla	Lambdotherium popoagicum (A.).	Hyrachyus (C.).
Artiodactyla	Pantolestes secans (A.).	Palæosyops paludosus (C.).

[1] This determination rests upon a tooth sent to Professor Marsh for identification in 1889, and described to the writer by Professor Hills. It is possibly *Stylinodon*, in which case it belongs to the Upper Beds.

I. Lower Beds.—Wind River Age.

Among the Creodonts is a small lower jaw (No. 2681) which belongs either to *Stypolophus* or *Didelphodus*.

Oxyæna huerfanensis, sp. nov.

Specific characters.—Reduced second superior molar, posterior nares partially enclosed by convergence of pterygoids in median line.

Oxyæna is represented by a fragmentary skull and jaws (No. 2683) of an animal differing from *O. forcipata* in its smaller size, and especially in the marked reduction of the transversely placed second superior molar, the proportions being :

	M^1.	M^2.
O. forcipata	.021	.023
O. huerfanensis	.018	.013

This reduction indicates that this is a distinct species, a successor probably of *O. forcipata* which is found in the Wasatch, and possibly transitional to *Patriofelis* of the Bridger, in which, according to Wortman, the second superior molar has disappeared entirely. The palate of this valuable new type is entire, and is of importance because it shows that the pterygoids bend over and unite in the median line as in certain species of *Mesonyx* and *Hyænodon*.

Didymictis protenus v. altidens *Cope.*

Didymictis is represented by several lower teeth (No. 2677, canine, fourth premolar, first and second molars) which nearly agree in size with those of *D. altidens* belonging to the Wind River period, but the form of the second lower molar is closer to that of the smaller *D. protenus* of the Wasatch. The reference of this specimen is therefore somewhat uncertain.

Didymictis dawkinsianus *Cope.*

This species is represented by two lower jaws (Nos. 2678, 2679) and a few limb bones. It is common to the Wasatch and Wind River levels.

Plesiarctomys ? delicatior *Cope.*

This rodent is represented by several individuals. The most complete animal (No. 2682) consists of limb and foot bones of great value, namely : humeri, ulnæ and radius, femora, tibiæ and a distinct fibula, calcanea, astragali, cuboid, navicular, metapodials, many vertebræ, and other less perfect parts.

Hyopsodus ? powellianus *Cope.*

Doubtfully referred to this species, which Cope has recorded only from the Wasatch, are remains of two individuals (Nos. 2675, 2676) represented by two molar teeth each.

Coryphodon.

Portions of the lower jaw and teeth of a *Coryphodon* (No. 2690) in our collection correspond with the *Coryphodon* of larger size found in the Wind River Beds, but cannot be specifically determined. An upper molar is preserved in Professor Hills's Collection.

Lambdotherium popoagicum *Cope.*

This species is represented by the upper molars and fourth premolar of one side (No. 2688), and by other fragments of one animal. The presence of this type seems to afford the best evidence that the 'Lower Beds' are of Wind River rather than of Wasatch age.

II. Upper Beds.—Bridger Age.

Patriofelis ulta *Leidy.*

This very rare animal is represented by portions of the lower jaws of one individual (No. 2691), the right ramus being nearly complete, including the canines, three premolars and the second molar, being the first teeth of *Patriofelis* secured for the American Museum Collection.

This individual, although an aged animal, is much smaller than Leidy's type of *P. ulta*, the canines and last molar being extremely worn. The linear measurements of the lower teeth are as follows :

	$P^2–M^3$.	$P^2–P^4$.
Leidy's type of *P. ulta* (approximate)	.074	
Huerfano specimen, No. 2691	.060	.034

The premolars exhibit rather blunt, conical cusps. The diastema between $P_{\overline{2}}$ and the canine is wanting, and it is possible there existed a small $P_{\overline{1}}$.

Tillotherium fodiens *Marsh.*

This animal was abundant in the Huerfano basin, leaving many remains.

The first fragments found of a skeleton representing this species (No. 2692) gave rise to hopes of the discovery of valuable material, but these were not realized. The specimen includes the upper incisor, last upper premolar, three lower molars, and fragments of other teeth which resemble in size the *T. fodiens* of Marsh. The animal is about the size of *Pachyæna ossifraga* or of the modern black bear. The associated skeletal remains afford several characters in addition to those given by Marsh.[1] The shaft of the femur is broad and flat proximally (partly owing to pressure), supporting an elevated great trochanter. The distal face of the tibia is very oblique, as in the Creodonts. The radius proximally gives evidence of some power of rotation, although not very extensive. The left cuneiform shows proximally a large pisiform facet, a slightly divided ulna facet, and distally a single facet for the unciform only. Metacarpal III is proximally wedge-shaped, abutting by an oblique outer face sharply against the unciform, as in many Creodonts. The first and second phalanges are rather short, and the numerous segments preserved indicate that the *fore foot was short, spreading and strongly clawed.*

With the exception of the flattened proximal shaft of the femur the resemblances throughout are with the Creodonta rather than with the Edentata-Ganodonta.

[1] Amer. Jour. Science, March, 1876, p. 251.

Uintatherium *Leidy.*

Uintatherium is certainly very rare in these beds, but its presence seems to be demonstrated by the proximal portion of a very small tibia, smaller even than that of *Palæosyops paludosus* (No. 2693), for which it was at first mistaken. It does not belong to any Perissodactyl, but is distinguished as an Amblypod tibia by the absence of a spine between the condylar facets ; these facets being continuous over a low intermediate ridge ; the internal facet being much larger than the external, as in many *Uintatherium* tibiæ in our collection.

Uncertainty as to this reference arises only from the diminutive size of this animal, the transverse diameter of the articular end of the bone being only .085.

Protorohippus *Wortman.*

There are several remains of *Hyracotheriinæ*, or primitive Horses, in the collection, the most perfect (No. 2685) being a lower jaw which agrees exactly in size with the small *Hyracotherium index* of the Wasatch, but has the developed postero-internal cusp on $P_{\overline{4}}$ characteristic of the subgenus *Pliolophus*. The total molar-premolar series, including the estimated $P_{\overline{1}}$, measures approximately, only .051.

In conclusion the writer desires to express his hearty appreciation of the assistance rendered by Prof. R. C. Hills, of Denver, who first made the existence of this interesting deposit known to the world. To Dr. J. L. Wortman the writer's thanks are due for valuable suggestions and coöperation in the field. Dr. W. D. Matthew has been of great service in the Museum in restoring and aiding in the determination of the types in this collection.

Article XXII.—A REVISION OF THE PUERCO FAUNA.

By W. D. MATTHEW.

The Basal Eocene Fauna of New Mexico, as described by the late Prof. E. D. Cope in numerous papers between 1881 and 1888, contained ninety-one species of mammals, to which three were added by Prof. H. F. Osborn and Mr. Charles Earle in their article on the Puerco in 1895. Many of these were based on extremely fragmentary material, and in comparatively few has much been recorded of the skeletal structure. The primitive unspecialized character of the fauna has made it very difficult to determine the ordinal position and relationship of the different species, the dental characters being often misleading.

The original collections made by Mr. David Baldwin and described by Prof. Cope were purchased by the American Museum in 1895. In 1892 and 1896 important collections in this field were made by the Museum Expeditions in charge of Dr. J. L. Wortman. The addition of a large amount of new material to the earlier collections, the careful comparison of all the known material, and the appreciation of the fact that the faunas of the upper and lower beds had not a species in common, made a thorough revision of the fauna advisable. For this purpose the entire collection was placed in my hands by the Curator, Professor Osborn, to whose kindness I also owe convenient access to the scattered literature of the subject, and many valuable suggestions. The past year has been given to this work. The original intention was to publish a joint paper with Dr. Wortman, but he found that lack of time would prevent the completion of his part of the paper, and he has very generously handed over his results to me, confining himself to an article on the stratigraphy of the beds, besides the paper already published on the Edentata (Ganodonta).[1]

This revision has consisted largely in the re-arrangement of the species and reduction of their number. The more perfect mate-

[1] Bull. Am. Mus. Nat. Hist., 1897, pp. 59-110.

rial at hand shows that several of the species described were based on a misapprehension of the characters of imperfect specimens, and that others are varieties not yet sufficiently distinct for specific separation. In no case, however, have I abandoned a species already described without definite evidence to prove that it is invalid; in the absence of such evidence species have been retained whose validity is doubtful.

It must be remembered that all the species of the upper beds come from a single thin stratum, those of the lower beds from two strata only.[1] Not a fragment has been found except in these layers, aggregating only a few feet in thickness. The varying forms of the upper beds were therefore strictly contemporaneous; we have in no case records of successive varieties. The same may be said of the lower beds, if we leave out the specimens from the lowest stratum. Variation in a species, therefore, does not represent successive phases of development of a race, but it does show precisely what characters were plastic at the time, and thus indicates in what points we may expect the successors of a species to differ from it.

The most important point brought forward in this paper is the entire distinctness of the species of the upper and lower beds. Cope in 1888 gave a list of twenty species peculiar to the lower beds. Osborn and Earle in 1895 gave a complete list of the fauna, correctly designating the horizon of thirty-six out of ninety-three species, and noted the important points in the vertical distribution as then known. But it was not until the complete records kept by the American Museum field parties afforded a secure working basis, that it was possible to demonstrate that the upper and lower beds contained two absolutely distinct faunas. They have not a species in common,[2] and in no case does a genus pass through without serious modifications of at least subgeneric value. Of fifteen families of the upper beds only eight are represented in the lower. The two faunas are as different as in any two successive Eocene formations. It becomes necessary to adopt a new name to designate one of these two, and Dr. Wortman proposes

[1] See Bull. Am. Mus. Nat. Hist., 1895, p. 2, and also Dr. Wortman's forthcoming paper on the Torrejon formation.

[2] One or two apparent exceptions are probably due to imperfect knowledge of the species in question or to incorrect records.

to call the upper beds the Torrejon formation, retaining the name Puerco for the lower. The reasons for this change will be more fully set forth in his article.

Composition of the Fauna.

The Puerco-Torrejon faunas are composed of the following elements:

1. The Mesozoic group of Multituberculates culminates in the Puerco and dies out in the Torrejon, true Rodents coming in to take its place.

2. The main body of the fauna is composed of the primitive types from which sprang the Ungulates on the one hand, the later Creodonts and Carnivores on the other. In the Puerco these two divisions are hardly distinguishable; in the Torrejon they are clearly separable although still closely allied, and the subdivisions of each group are foreshadowed. But it must not be supposed that we have here the direct ancestors of all the later types; on the contrary there are comparatively few forms even in the Wasatch, that are descended from known Basal Eocene species, and these are not the persistent types. It is clear that a large addition to the fauna must be made before we will come across the direct ancestors of most of the modern Ungulata. The Basal Eocene Carnivores and Ungulates were evolving into types corresponding to the modern differentiation, but to a large extent analogous only and not ancestral.

For such primitive Carnivores the term *Creodonta* is universally used. For the corresponding group of primitive Ungulates the term *Condylarthra* will here be used, making it nearly equivalent to the hypothetical *Protungulata*.[1]

3. A few more specialized lines may be separated from this main group. The *Edentata* are already well advanced in their differentiation. The *Amblypoda* and *Rodents* are just beginning, but clearly recognizable. A fourth type is allied to the *Primates*.

Table I shows the scope of the fauna and its relation to the later ones.

[1] See note at end of this article.

TABLE I.

	Eocene.									
	Puerco.	Torrejon.	Wasatch.	Wind River.	Bridger.	Uinta.	Oligocene.	Miocene.	Pliocene.	Pleistocene and Recent.
MULTITUBERCULATA...	——	——								
{ Polymastodontinæ.....	X									
{ Plagiaulacinæ.........	X	X								
Bolodontidæ..........	...	X								
PRIMATES...............	....	——	——	——	——	——	——	——	——	——
Anaptomorphidæ......	....	?X	X	...	X					
Hyopsodontidæ.......	....	....	X	X	X					
Microsyopidæ........	....	....	...	X	X	X				
RODENTIA...........	....	——	——	——	——	——	——	——	——	——
Mixodectidæ.........	...	X								
Ischyromyidæ........	....	....	X	X	X	X	X			
EDENTATA..............	——	——	——	——	——	· · ·	· · ·	——	——	——
Stylinodontidæ........	X	X	X	X	X	....	..(Ground Sloths).			
Conoryctidæ..........	X	X								
CREODONTA............	——	——	——	——	——	——	——	(Car	nivo	ra).
Oxyclænidæ..........	X	X								
Triisodontidæ........	X	X								
Arctocyonidæ	?X	X	X	....	..	...	....	(?Ur	sidæ	).
Mesonychidæ.........	....	X	X	X	X	X				
Proviverridæ.........	..	X	X	X	X					
Miacidæ.....	...	X	X	X	X	X	(?Ca	nidæ	).	
Oxyænidæ...........	....	....	X	X[1]						
Hyænodontidæ........	..	..	....	....	....	X	X			
Palæonictidæ........	....	..	X	X	X	....	(? Fe	lidæ	).	
CONDYLARTHRA..........	——	——	——	——	(Specialized Un			gula	tes).	
Phenacodontidæ.......	X	X	X	X						
Mioclænidæ..........	X	X	(? Artiodactyla)			.				
Periptychidæ.........	X	X								
Meniscotheriidæ......	....	....	X							
AMBLYPODA	....	——	——	——	——	——				
Pantolambdidæ.......	....	X								

[1] Lower Huerfano. See OSBORN, Bull. Am. Mus. Nat. Hist., 1897, p. 247.

The difference between the Puerco and Torrejon faunas appears to be mainly in the poverty of the former in families. This, however, is not due to any scarcity of specimens or of species, as is shown in Table II. It points to a large immigration at the beginning of the Torrejon. Another considerable immigration must have taken place before the beginning of the Wasatch.

Table II.

List of Species.

PUERCO.	No. of specimens determined.	*TORREJON.*	No of specimens determined.
		MULTITUBERCULATA.	
		PLAGIAULACIDÆ.	
		Polymastodontinæ.	
Catopsalis foliatus *Cope*	1	Polymastodon fissidens *Cope*	1
Polymastodon taöensis *Cope*	27	(Recorded as coming from	
" attenuatus *Cope*	9	the upper beds.)	
" selenodus *O.&E.*	1		
		Plagiaulacinæ.	
Neoplagiaulax, sp. ?	1		
" americanus *Cope*	4	Neoplagiaulax molestus *Cope*	1
		Ptilodus mediævus *Cope*	10
		" trovessartianus *Cope*	3
		BOLODONTIDÆ.	
		Chirox plicatus *Cope*	2
		PRIMATES.	
		? ANAPTOMORPHIDÆ.	
		Indrodon malaris *Cope*	4
		RODENTIA.	
		MIXODECTIDÆ.	
		Mixodectes pungens *Cope*	9
		" crassiusculus *Cope*	4
		CREODONTA.	
		OXYCLÆNIDÆ.	
Oxyclænus cuspidatus *Cope*	9	Chriacus pelvidens *Cope*	11
" simplex *Cope*	1	" baldwini *Cope*	6
Protochriacus priscus *Cope*	17	" truncatus *Cope*	10
" attenuatus *O.&E.*	2	" schlosserianus *Cope*	
" hyattianus *Cope*	5	Tricentes crassicollidens	1
		" subtrigonus	87
		? PROVIVERRIDÆ.	
		Deltatherium fundaminis *Cope*	28
		TRIISODONTIDÆ.	
Triisodon quivirensis *Cope*	1	Sarcothraustes antiquus *Cope*	6
" heilprinianus *Cope*	28	" sp. indesc	1
" gaudrianus *Cope*	4	Goniacodon levisanus *Cope*	16
		Microclænodon assurgens *Cope*	3
		MESONYCHIDÆ.	
		Dissacus navajovius *Cope*	13
		" saurognathus *Wortman*	5

TABLE II.—*Continued.*

PUERCO.	No. of specimens determined.	*TORREJON.*	No. of specimens determined
		ARCTOCYONIDÆ.	
? Clænodon protogonioides *Cope*.	1	Clænodon protogonioides *Cope*.	5
		" ferox *Cope*.	14
		" corrugatus *Cope*.	13
		MIACIDÆ.	
		Didymictis haydenianus *Cope*.	16
		" *cf.* leptomylus *Cope*.	2
		INCERTÆ SEDIS.	
Carcinodon filholianus *Cope*.	1		
Oxyacodon apiculatus *O. & E.*	6		
" agapetillus *Cope*.	5		
		Pentacodon inversus *Cope*.	2
		CONDYLARTHRA.	
		PHENACODONTIDÆ.	
Protogonodon pentacus *Cope*.	20		
" stenognathus.	4	Euprotogonia puercensis *Cope*.	189
		" minor.	3
		PERIPTYCHIDÆ.	
Ectoconus ditrigonus *Cope*.	45		
Periptychus coarctatus *Cope*.	27	Periptychus rhabdodon *Cope*.	157
		" carinidens *Cope*.	25
Anisonchus gillianus *Cope*.	22	Anisonchus sectorius *Cope*.	35
Hemithlæus kowalevskianus *Cope*	38		
Conacodon entoconus *Cope*.	27		
" cophater *Cope*.	5	Haploconus lineatus *Cope*.	66
		" corniculatus *Cope*.	19
		MIOCLÆNIDÆ.	
		Mioclænus turgidus *Cope*.	68
		" lydekkerianus *Cope*.	1
Mioclænus turgidunculus *Cope*.	5	" lemuroides.	16
		" inæquidens *Cope*.	5
		" acolytus *Cope*.	17
? Protoselene opisthacus *Cope*.	1	Protoselene opisthacus *Cope*.	14
		AMBLYPODA.	
		PANTOLAMBDIDÆ.	
		Pantolambda bathmodon *Cope*.	17
		" cavirictus *Cope*.	11
		EDENTATA.	
		STYLINODONTIDÆ.	
Hemiganus otariidens *Cope*.	2	Psittacotherium multifragum *Cope*.	17
		CONORYCTIDÆ.	
Onychodectes tisonensis *Cope*.	11	Conoryctes comma *Cope*.	13
" rarus *O. & E.*	1		
Total number of determined specimens	331	Total number of determined specimens	945
Total number of species...31.		Total number of species...44.	

MULTITUBERCULATA.

The distribution of the species of this group is peculiar. The large *Polymastodon* is common in the lower beds, but only one specimen is recorded as from the Torrejon, while *Ptilodus* and *Chirox*, the smallest and most primitive genera, occur only in the upper beds, and the intermediate *Neoplagiaulax* is found in both horizons.

PRIMATES.

Osborn and Earle have placed in this order the Chriacidæ, besides *Mixodectes* and *Indrodon*, which Cope considered of Primate affinities (Prosimiæ). The Chriacidæ seem more nearly Creodont in their affinities, as Cope and Scott considered them, and *Mixodectes* is probably a Rodent. *Indrodon* is shown by the skeleton described in 1895 to have Primate affinities though a generalized type. Yet its upper molars are curiously like those believed to belong to *Mixodectes*, showing how unreliable tooth-characters may be in this fauna.

? RODENTIA.

Mixodectes *Cope.*

Cope, Proc. Am. Phil. Soc. 1882–3, 559; Tert. Vert. p. 240; Schlosser, Affen, Lemuren, u. s. w. pp. 40, 49 (Sep.-Abd. aus Beit. z. Pal. Ost.-Ung. Bd. VI).

The discovery of some skeleton fragments in good association with a lower jaw of *Mixodectes pungens* makes it probable that this genus should be removed from the Primates and placed as an extremely primitive Rodent. *Microsyops* may perhaps go with it, but this is extremely doubtful, as the type of its lower molars is much more primitive and persistently so, and in several other respects different from *Mixodectes*.

The skeleton fragments in question include a well-preserved astragalus, which is wide, thin, sharply keeled, without astragalar foramen, and with moderately long neck and wide flat head. The ectal astragalo-calcanear facet is large, triangular and not strongly concave, the sustentacular is much smaller and oval, not confluent with the distal facet. The trochlea is wide, and continued back obliquely to the underside of the astragalus.

The shape of the astragalus and all the details of its facets sustain a close comparison with that of *Plesiarctomys* of the Wasatch. The absence of the foramen is an unusual character for a Basal Eocene mammal ; it is seen also in *Onychodectes*. There are fragments of the limb-bones preserved, which indicate a long hind leg.

Fig. 1.—*Mixodectes pungens* Cope. Natural size. *A*, upper and lower molar, No. 2385. *B*, lower jaw, type specimen, No. 3081.

Another specimen shows the character of the enlarged lower front tooth, which is not yet chisel-shaped, although approaching that form. It is long and slender, caniniform, the crown completely invested with enamel which extends but a little further down on the outside than the inside. The long axis of a section across the root of the tooth is antero-posterior, and this part is flattened on the inner side. The crown, however, is twisted around so as to have the long axis more nearly transverse, the flattening of the inner side disappearing. This seems to be a trace of its original incisive (spatulate) character ; it is difficult to see why such a peculiar shape should develop in a canine. The position and character of the smaller tooth behind it strengthens this supposition ; it is more on the outside of the jaw than a premolar should be, is oval and rather long-rooted. This is probably the canine, the first premolar being absent ; the front tooth is then one of the incisors, and the dental formula is $\frac{\quad}{1 \cdot 1 \cdot 3 \cdot 3}$.

The second premolar is very small, one-rooted; the third is small, two-rooted, with high cusp and small heel, and is often set somewhat transversely in the jaw. The fourth is large with strong heel, and high cusp in front and minute antero-internal cusplet or cingulum. The anterior position of the main cusp is characteristic.

The molars have four high cusps, the paraconid being reduced to an anterior ridge rising to the protoconid. The third molar has also a strong hypoconulid ; the position of this cusp is usually nearly behind the entoconid instead of median. The cusps are more peripheral than is usual, their outer surface rising nearly vertically from the side of the crown instead of sloping inward.

Associated with a lower jaw of *Mixodectes* is an upper molar of appropriate size which may belong to it. This tooth has high cusps, moderately strong spur-like hypocone, minute para- and mesostyle and no intermediates. In shape and character of the cones it strongly resembles *Indrodon*, but is much larger than *I. malaris*.

The strong resemblance of the astragalus of *Mixodectes* to those of the sciuromorph Rodents is in harmony with the indications of the teeth, which show progress towards a type with scalpriform incisors and four molariform teeth in the lower jaw, short-crowned with peripheral cusps. Such a type is *Plesiarctomys*, but to place the Torrejon *Mixodectes* as directly ancestral to this Wasatch genus would involve a greater change than we should expect during the interval. It is better to place it as a sciuromorph Rodent of the most primitive type. It has hitherto been considered a Primate,[1] and in the line of ancestry of *Chiromys*. But the astragalus is quite unlike that of the contemporary Primates, and still more different from *Chiromys*. The dental characters, except for the single doubtfully associated upper molar, indicate affinity rather to the Rodents than any of the early Primates.

CREODONTA.

OXCLÆNIDÆ *Scott*.

This family includes a number of genera whose characters as far as known seem to place them on the border line between Creodonts and Lemurs. Scott remarks : "The genera associated to form this family are known almost entirely from the dentition, and their relationship with each other, even their ordinal posi-

[1] *Cope*, Tert. Vert., p. 241 ; *Schlosser*, Affen, Lemuren, u. s. w., pp. 40, 49.

tion, is very obscure, the teeth being of that generalized and primitive character to which all mammalian types of dentition converge as we trace them back in time."[1] Osborn and Earle place the group, except *Oxyclænus*, among the Primates. The positive evidence of Primate relationship, aside from the merely primitive characters, is not very convincing, the strongest point being the character of the upper molars in *Chriacus*. Against this we may place the long slender jaw, characteristic of the family, with spaced premolars, strong canines and no tendency to a reduced dentition. The resemblance in dental structure to the Creodont *Deltatherium* must not be overlooked. The little that is known of the skeletal characters is equally unsatisfactory. A femur associated with *C. baldwini* is of moderate length with well developed trochanters, and compares with *Didymictis* rather closely. An imperfect astragalus with the type of *C. schlosserianus*, described in 1888 by Prof. Cope, is somewhat like that of *Indrodon*, but is more keeled and the ectal calcanear facet much wider. The resemblance is chiefly in the lack of specialization, and is therefore untrustworthy.

The type genus, *Oxyclænus*, shows a considerable resemblance to the Triisodontidæ, and perhaps should be included with them. In this case the remaining genera, *Chriacus*, *Protochriacus* and *Tricentes*, will be united under Osborn and Earle's family Chriacidæ.

Protochriacus *Scott.*

SYN. *Loxolophus* COPE, 1885, SCOTT, 1892.

Dentition: I.$\frac{1}{3}$,C.$\frac{1}{1}$,P.$\frac{4}{4}$,M.$\frac{3}{3}$. Upper molars tritubercular with hypocone little developed and no protostyle. Lower molars broad and low approaching the *Protogonodon* type; p^3 and p_4 with rudimentary dentocene. Intermediates minute or absent on upper molars.

Cope's *Loxolophus adapinus* was founded on a crushed specimen of his *Chriacus hyattianus*. The distinctions so far as made were based on error, and Scott's name, *Protochriacus*, is therefore preferred. The type is *P. priscus* Cope; another species, *P. attenuatus*, was described by Osborn and Earle, and a third, *P. hyattianus* Cope is probably referable, although the premolars are unknown. Scott's second species, *P. simplex* Cope, is, as

[1] Trans. Phila. Acad. Nat. Sci., 1892.

remarked by Osborn and Earle, widely different from *P. priscus*, and may perhaps be provisionally placed under *Oxyclænus*. All the above species are from the lower beds or true Puerco.

Protochriacus priscus (*Cope*).

Chriacus priscus Cope, Trans. Am. Phil. Soc. 1888, p. 337, fig. 6; (*Protochriacus*) Scott, Proc. Phila. Acad. 1892, 296; Osborn & Earle, Bull. A. M. N. H. 1895, p. 22.

Dimensions: M^{1-2}=.0185; m_{1-3}=.0133 (type, No. 3108); i_1-m_3=.055 (No. 803).

The lower teeth of *P. priscus* are remarkably like those of ***Protogonodon;*** the upper teeth are entirely different from those referred to that genus, and are much like those of *Tricentes*, except that the cusps are more angulate.

Protochriacus attenuatus *Osborn & Earle.*

Bull. Am. Mus. Nat. Hist. 1895, p. 22.

This species is much smaller than *P. priscus*, which it otherwise closely resembles. The teeth are not so wide, the paraconid is more internal, the notch between protoconid and entoconid deeper. It is doubtful whether the third molar described by Osborn and Earle belongs to the species; it does not seem to be the same individual. Length, m_{1-3} .0108 (type, No. 790).

Protochriacus hyattianus (*Cope*).

Chriacus hyattianus Cope, Am. Nat. 1885, 385; Trans. Am. Phil. Soc. 1888, 336; (*Loxolophus*) Scott, Proc. Phila. Acad. 1892, 297; ***Loxolophus adapinus*** Cope, Am. Nat. 1885, 386.

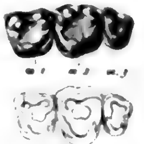


Fig. 2.—*Protochriacus hyattianus* Cope. *A*, upper molars of left side, crown view, distorted by transverse pressure. Type specimen No. 3121. *B*, outline of upper molars of left side No. 931. Both natural size.

The type specimen (No. 3121) is crushed transversely, as is also the type of *Loxolophus adapinus* (No. 3134). A third specimen (No. 931) which I refer to this species, gives the outline of the upper molars more satisfactorily. The species is smaller than *P. priscus* and m^3 much more reduced. The lower molars (No. 3124) show a corresponding reduction of m_3. In the absence of any knowledge of the premolars the position of the species is provisional; it may belong to *Protogonodon*. Satisfactory distinctions from *P. attenuatus* are lacking, except in the characters of the last molar tooth whose reference to the latter species, as above noted, is doubtful.

Length, m^{1-3}, .016; m_{1-2}, .011.

Tricentes *Cope*.[1]

Dentition: I.$\frac{?}{?}$, C.$\frac{1}{1}$, P.$\frac{3}{3}$, M.$\frac{3}{3}$. Hypocone moderate, no protostyle, very rudimental deuterocone, or none, on p^3 and p_4. Cusps conical and blunted. Canines well developed in both jaws, incisors small or reduced. A considerable diastema behind the upper and lower canines, which are short and directed nearly vertically.

Tricentes differs from *Protochriacus* in the more conical form of the cusps, the loss of the first premolar and close setting of the remaining ones, and the reduction of the paraconid. From *Chriacus* it differs in the simpler premolars, less development of hypocone, absence of pm.$\frac{1}{1}$, canines vertical instead of projecting forward, and in the much less trenchant and more rounded molar cusps.

Tricentes subtrigonus (*Cope*).

Mioclænus subtrigonus COPE, Proc. Am. Phil. Soc. 1881, 491; 1882-3, 555; Tert. Vert. p. 338, pl. lvii*f*, fig. 5, and xxiv*f*, fig. 4; Am. Nat. 1881, 490; Trans. Am. Phil. Soc. 1888, 321; (*Tricentes*) Proc. Am. Phil. Soc. 1883-4, 315; SCOTT, Proc. Phil. Acad. 1892, 297.

Mioclænus bucculentus COPE, Proc. Am. Phil. Soc. 1882-3, 555; Tert. Vert. p. 341, pl. xxiv*g*, fig. 10; (*Tricentes*) Proc. Am. Phil. Soc. 1883-4, 316; Trans. Am. Phil. Soc. 1888, 303; OSBORN & EARLE, Bull. Am. Mus. Nat. Hist. 1895, 24.

Phenacodus zuniensis COPE, Proc. Am. Phil. Soc. 1881. 492; Tert. Vert. 491, pl. lvii*f*, fig. 10; (*Protogonia*) Trans. Am. Phil. Soc. 1888, 359 (in part). Not *P. zuniensis*, Am. Phil. Soc. 1881, 180.[2]

Chriacus baldwini COPE, Trans. Am. Phil. Soc. 1888, 340 (part). *Not* previous references.

Upper canines straight, rather short, directed downwards, strongly striate longitudinally, somewhat ridged posteriorly. with a considerable diastema behind. Second premolar two-rooted, high and trenchant, without cingulum. Third and fourth three-rooted, with strong cingulum all around the base, the fourth with large deuterocone. Molars with strong enveloping cingulum,

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[1] Proc. Am. Phil. Soc., 1883-4, 315.

[2] Recorded from the Wasatch Beds; but the specimens were afterwards referred by Prof. Cope to *Hyopsodus* (*H. powellianus* Cope).

except sometimes on inner side of protocone. M^1 and m^2 subquadrate, with **small hypocone**, m^3 triangular. Intermediates not large, but distinct.

Lower canines with sharply curved root of round oval section, the cusp **directed upward**, not at all forward, and having a considerable diastema behind. **Second, third and fourth premolars** of nearly equal size, but successively wider **and less trenchant**, the third and fourth with cingulum around the base, developed into a small heel on the fourth. Lower molars with much reduced paraconid and an external cingulum more or less obsolete.

The **second** upper and lower molars are considerably larger than the first ; the **third** is somewhat variable in size and shape, the upper one considerably **smaller than** the second, the lower never larger.

The **premolar** and molar cusps are marked by a characteristic interrupted **striation** or wrinkling longitudinal to the cusp ; this is partly worn off on old **individuals**, but very distinct on unworn teeth.

Measurements, m^{1-2}=.017, No. 2399 ; c–m_3=.0455, No. 4001. Lower **diastema**, .008.

This is a very abundant form, represented by over eighty specimens in our collections. It shows a considerable range of variation in size, in the comparative width of the teeth, in the length and shape of the last lower molar, and in the relative size of the second molar above and below. The cingulum is sometimes discontinuous around the internal face of the protocone in one or more of the upper molars. Normally there are but three premolars above and below ; this condition is conclusively shown in four upper and fourteen lower jaws ; three lower jaws have a minute pit which may have held in the young a vestigial first premolar ; one jaw (figured by Cope) shows apparently the root of a well-developed first premolar.

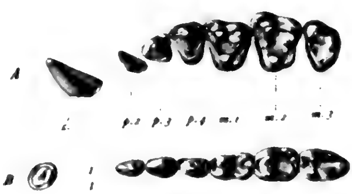

Fig. 3.—*Tricentes subtrigonus* Cope. Natural size. *A*, upper teeth of left side, crown view ; No. 2399. *B*, lower teeth of left side, crown view ; No. 4001.

On the above variations two species have been separated from the typical form. A careful comparison of all the material shows that neither of them is valid.

Tricentes bucculentus was described originally from a fragment of upper jaw with p^4–m^2, in which m^2 is unusually large. Subsequently specimens were referred to it showing the loss of p^1, and the genus was separated from ***Mioclænus*** on this ground. There is no evidence in the type specimens as to whether either ***M. subtrigonus*** or ***T. bucculentus*** lacked the first premolar. Only one specimen is known to have $p_{\overline{1}}$ present, and as this specimen is in all other respects like the rest, the extra premolar is probably abnormal. This leaves as a distinction between ***bucculentus*** and ***subtrigonus*** only the comparative size of the upper molars, a character quite variable in this group, and not of specific value. The type and all but two of the other specimens referred to ***Protogonia zuniensis*** Cope belong here, as is stated under the discussion of that species.

The surface of the teeth is corrugated in a characteristic manner, which, with the rounded, blunt-pointed cusps, make it easy to recognize a single tooth. Old or weather-worn specimens sometimes have this nearly obsolete, but in the young individuals it is very strong. It is somewhat like the surface corrugation of the teeth of *Hyracotherium* and *Systemodon*, but more constant. It appears on the premolars of *Protochriacus*, but is hardly noticeable on the molars.

Tricentes crassicollidens *Cope.*

Proc. Am. Phil. Soc. 1883-4, 315; Trans. Am. Phil. Soc. 1888, 304.—SCOTT, Proc. Phila. Acad. 1892, 297.

This species is the type of the genus, but is represented only by a very much damaged skull, which shows a similar dentition to *T. subtrigonus* so far as it can be determined. In absence of more satisfactory specimens the placing of ***T. subtrigonus*** as congeneric with this species must remain provisional.

Measurements, $m^{1-3} = .015$.

Chriacus *Cope.*[1]

Dentition: I. $\frac{3}{3}$, C. $\frac{1}{1}$, P. $\frac{4}{4}$, M. $\frac{3}{3}$. First and second upper molars with strong spur-like hypocone projecting inwards and backwards, and smaller protostyle on m^2, giving them a quadrate outline with concave sides. Intermediates small. Cusps higher than in the two preceding genera, trigonid more raised. Paraconid somewhat reduced, p^3 and $p_{\overline{4}}$ with well-developed deuterocone in the larger species.

[1] Proc. Am. Phil. Soc. 1883, 313.

The number of species belonging here is doubtful. Among the larger forms two appear fairly distinct, and there are two or three small ones not easily separated.

Chriacus pelvidens (*Cope*).

Lipodectes pelvidens COPE, Am. Nat. 1881, 1019; (*Chriacus*) Proc. Am. Phil. Soc. 1883-4, 313 (part)); (*Pelycodus*) Tert. Vert. p. 225 (part).
Chriacus stenops COPE, Trans. Am. Phil. Soc. 1888, p. 341; SCOTT, Proc. Phila. Acad. 1892, p. 295.
Chriacus baldwini OSBORN and EARLE, Bull. Am. Mus Nat. Hist. 1895, 21.

Third upper molar not reduced, being as wide transversely as the second. Lower jaw long and slender; canines strong, rather long, oval in section, projecting forward, striate longitudinally. First lower premolar one-rooted, second two-rooted, both spaced in front and behind. Third and fourth premolars considerably larger than the second, fourth with well-developed deuteroconid.

Measurements: M^{1-3} = .018 (No. 2384); c-m_3 = .056, p_{2-4} = .018, m_{1-3} = .0225 (No. 2378.) Transverse diameter m^2 = .0093, m^3 = .0095 (No. 2384).

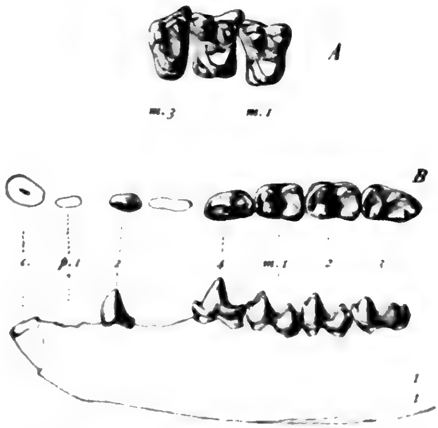

Fig. 4. *Chriacus pelvidens* Cope. Nat. size. *A*, upper molars of right side, No. 2384, crown view. *B*, lower teeth, crown view, No 2378. *C*, lower jaw from within, No. 2379.

The type of Cope's *C. pelvidens* appears to be a larger species than specimens later referred to it, and is probably identical with *C. stenops* Cope. The remaining specimens referred to *pelvidens* by Cope I am unable to distinguish from his *C. baldwini*. Several specimens obtained by the Expedition of 1896 fill out our knowledge to some extent.

Chriacus baldwini (*Cope*).

Deltatherium baldwini COPE, Proc. Am. Phil. Soc. 1882–3, 463; Tert. Vert. p. 282, pl. xxiii*d*, fig. 12; *Chriacus baldwini*, Trans. Am. Phil. Soc. 1888, 340 (part).
Pelycodus pelvidens COPE, Tert. Vert. p. 225 (all specimens except type), pl. xxiii*d*, figs. 7 and 8; (*Chriacus*) Proc. Am. Phil. Soc. 1883–4, p. 314 (part). Not *Lipodectus pelvidens*, Am. Nat. 1881, 1019.

There is much confusion about this species. The original type (No. 3114) is a part of a lower jaw containing two premolars and a molariform tooth. Prof. Cope describes these as the third and fourth premolars and the first true molar, but comparison with various other specimens shows that they are the second and third premolars and fourth milk molar. In 1888 he referred to *C. baldwini* a lower jaw which belongs to *Tricentes subtrigonus* (No. 3993) as well as jaws and part of a skeleton (No. 3115) which show the characters of *C. baldwini* as the present writer understands them.

Fig. 5.—*Chriacus baldwini* Cope. Upper molars and last premolar of left side, crown view. No. 3115. Nat. size.

C. baldwini is somewhat smaller than the preceding species, the last molar is reduced, and the second, third and fourth premolars are close together, of nearly uniform height, increasing successively in width. The deuteroconid on p_4 is small. The fourth milk molar in the type is smaller than the first true molar, but composed of the same elements, the paraconid more reduced, the other cusps too much worn for exact comparison.

Measurements: M^{1-3} = .018 (molars displaced); m_{1-3} = .022 (molars displaced, No. 3100). Transverse diameter m^2 = .0082, m^3 = .0071 (No 3099).

Fig. 6.—*Chriacus baldwini* Cope. Posterior view of femur X ⅔. No. 3115.

Chriacus truncatus *Cope.*

Proc. Am. Phil. Soc. 1883-4, p. 315; Trans. Am. Phil. Soc. 1888, 336, fig. 9.

This species is a close copy of *C. baldwini* on a smaller scale, the length of the three upper molars being only .014. There is some variation in size, but not much, among the five or six specimens referred here. The lower teeth are not known.

Fig. 7.—*Chriacus truncatus* Cope. Upper teeth of right side, crown view. Type specimen. No. 3101. Nat. size.

Chriacus schlosserianus *Cope.*

Trans. Am. Phil. Soc. 1888, p. 338; (*Epichriacus*) SCOTT, Proc. Phila. Acad. 1892, 296.

The only distinctions from *C. truncatus* are the absence of protostyle and less prominence of hypocone on m^2 and the comparatively greater transverse width of m^3. These are of somewhat doubtful specific value. The fourth lower premolar is badly preserved in the type specimen; Scott describes it as "having all the elements of a true molar, though not fully developed," and founds a new genus on it. The writer is not able to see any essential difference from the usual type of p_4 in *Chriacus* which is not accounted for by the crushing and displacement which the tooth has undergone. The anterior cingular cusp (paraconid) which is always present in the Chriacidæ, is well developed in all the species of *Chriacus*, and in *C. schlosserianus* does not materially differ from the larger species, so far as can be judged from the imperfect specimen. A jaw (No. 3915*a*) containing a perfect fourth premolar and the three true molars, and not otherwise distinguishable from the type of *C. schlosserianus*, shows a normal *Chriacus* p_4 with deuteroconid reduced apparently by wear, and paraconid as a basal cingular cusp of the same proportional size and form as in *C. pelvidens.* This specimen might of course equally well be referred to *C. truncatus*, if the latter be distinct from *C. schlosserianus*.

With the type of *C. schlosserianus* are some fragments of skeleton, already fully described by Prof. Cope. These are not sufficient to decide the relationship; there does not seem to be anything distinctively primate about them as distinguished from what we should expect to find in an early type of Creodont.

Oxyclænus (*Cope*) *Scott.*

"The anterior premolars form simple, compressed and trenchant cones; on p^4 there is also a well-developed deuterocone. The molars are simply tritubercular, with small, erect and acute cusps. . . . The para- and metacones arise close to the outer side of the crown . . The protocone is the largest of the elements. There is no distinct hypocone, merely a thickening of the cingulum at that point, which is most marked in m^2. Minute but very distinct proto- and metaconules are present. M^3 is very much reduced in size, and more oval than triangular in shape, but preserves all the cusps."[1]

Under this genus are included two or three species of doubtful family relations, being intermediate between the Chriacidæ and Triisodontidæ. They are small forms with a trigon like *Chriacus*, but with somewhat more rounded cusps. The type is *O. cuspidatus* Cope, represented by one specimen whose horizon is not recorded. A closely allied or identical species is represented by most of the specimens referred by Osborn and Earle to *Protochriacus simplex*. A third species represented by the type specimen only of *C. simplex* Cope can be placed here only provisionally, the premolars being unknown.

Oxyclænus cuspidatus *Cope.*

Mioclænus (*Oxyclænus*) *cuspidatus* COPE, Proc. Am. Phil. Soc. 1883–4, 312; Trans. Am. Phil. Soc. 1888, 321. (*Oxyclænus*) SCOTT, Proc. Phila. Acad. 1892, 295.

? *Protochriacus simplex* OSBORN & EARLE, Bull. Am. Mus. Nat. Hist. 1895, 23. Not *P. simplex* of Cope and Scott.

Most of the specimens referred by Osborn and Earle to *Protochriacus simplex* are of a form closely allied to or identical with this

[1] Scott, Proc. Phila. Acad., 1892, 295.

species. The true *O. simplex* Cope is much smaller and differs considerably in the upper molars. The upper teeth of these individuals are the same in character as the type except that the hypocone is rather more developed and the metacone is not pushed inwards. Their third molar is unknown. Fourth upper premolar with high sharp *pr.* somewhat ridged behind and usually rounded in front, and sharp well separated *de.* Third considerably smaller, with protocone ridged in front and behind and no *de.* Molars subquadrate, with round rather high cusps, and small hypocone on m², reduced to a wide cingulum on m¹. Paracone and metacone connected by a low narrow ridge. Intermediates very small. The third molar is reduced sub-oval and three-cusped in the type. Lower molars with high trigon, well developed paraconid, and deep basin heel partly closed by the entoconid, which is not very well separated from the hypoconulid. Last molar varying in size in different specimens.

Oxyclænus simplex (*Cope*).

Chriacus simplex Cope, Proc. Am. Phil. Soc. 1883–4, 314; Trans. Am. Phil. Soc. 1888, 336; (*Protochriacus*) Scott, Proc. Phila. Acad. 1892, 296. Not *P. simplex* of O. & E.

This is a very small species, much smaller than *O. cuspidatus*, but the molar teeth are of about the same type, except m³, which is wider and more trigonal. In the absence of any knowledge of the premolars it is placed here provisionally.

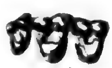

Fig. 8.—*Oxyclænus simplex* Cope. Upper molars of right side, crown view. Type specimen, No. 3107. Natural size.

TRIISODONTIDÆ *Scott.*

"Superior molars with low massive cusps, but sometimes having a well-developed hypocone on m²; trigonid much higher than talon, but not forming a shearing blade; paraconid reduced; premolars high and acute."[1]

Fourth lower premolar large, with strong bicuspid talonid, second and third premolars small. Jaw symphysis deep and short. Tarsus (in *T. heilprinianus*) non-serial, having an astragalo-cuboid facet.

[1] Scott, Proc. Phil. Acad., 1892, 294.

The Triisodonts are not very far removed from the Mesonychidæ, and were apparently undergoing a somewhat similar cusp degeneration, although it had not progressed so far. The molars are much wider transversely, and the difference in size between the third and fourth premolar is characteristic of the group. The following genera are recognized by Prof. Scott :

1. *Triisodon* Cope. Type, *T. quivirensis*, from the Puerco Beds.
2. *Goniacodon* Cope. Type, *G. levisanus*, from the Torrejon.
3. *Sarcothraustes* Cope. Type, *S. antiquus*, from the Torrejon.
4. *Microclænodon* Scott. Type, *M. assurgens.*

The last genus can be placed here only provisionally, as it is known from a single last lower molar with shattered outlines of the two preceding molars of the same specimen. A review of all the material of this group results in a considerable reduction of the number of species. *Triisodon biculminatus, Goniacodon* (*Triisodon, Mioclænus*) *rusticus, Sarcothraustes coryphæus, S. bathygnathus* and *S. crassicuspis* Cope appear to be all identical with *T. heilprinianus*, differing only in the depth of the jaw and wear of the teeth. Better material of *Goniacodon gaudrianus* Cope shows it to belong to *Triisodon. Sarcothraustes conidens* Cope is identical with *S. antiquus*. None of the genera as at present defined are found in both Puerco and Torrejon Beds. I believe, however, that *Sarcothraustes* was the successor of *Triisodon*, which it resembles. The short deep jaw and extraordinary wear of the teeth, characteristic of the family, indicate probably similar habits to those of the Palæonictidæ of Lower and Middle Eocene time.

Triisodon *Cope.*[1]

Prof. Cope's original generic diagnosis is : "Derived from the lower jaw. Probably only three premolars. True molars alike, consisting of three anterior cusps and a heel. The cusps are relatively small and the heel large. Of the former the internal is much smaller than the external and the anterior is rudimental, being merely a projection of the cingulum. The cutting edges of the large external cusp are obtuse. The heel is basin-shaped and its posterior border is divided into tubercles, of which the external is a large cusp. The fourth

[1] Am. Nat., 1881, 667.

premolar has no anterior inner tubercle, so that the anterior part of the crown consists of a compressed cutting cusp. The heel has two well-developed posterior cusps. The third premolar has a similar principal trenchant cusp, but a smaller heel. Canines large."

The present arrangement of species requires some modification of this definition. The characters are supplemented in large part from the other species.

Dentition: I. $\frac{?}{3}$, C. $\frac{1}{1}$, P. $\frac{4}{4}$, M. $\frac{3}{3}$. Second upper premolar two-rooted, third and fourth three-rooted, with well defined deuterocone. Upper molars wide transversely, subquadrate, with weak hypocone on m^{1-2}. Second and third lower premolars small with simple minute talonids, fourth large with strong bicuspid talonid, the outer cusp larger. Lower molars with moderately high trigon, the protoconid and metaconid of nearly equal size, paraconid lower and placed partly in front of metaconid.

There are three very distinct species, but no sufficient evidence of more. All are from the lower or true Puerco Beds.

Triisodon quivirensis *Cope.*

Triisodon quivirensis COPE, Am. Nat. 1881, 667; Proc. Am. Phil. Soc. 1881, 485; Tert. Vert. p. 270, Pl. xxv*c*, fig. 2; SCOTT, Proc. Phila. Acad. 1892, 301.

Triisodon heilprinianus *Cope.*

Triisodon heilprinianus COPE, Proc. Am. Phil. Soc. 1882–3, 193 (Dec. 1881); Tert. Vert. p. 273, Pl. xxiii*d*, fig. 11; SCOTT, Proc. Acad. Phila. 1892, 301; (*Mioclænus*) COPE, Trans. Am. Phil. Soc. 1888, 321.

Triisodon rusticus COPE, Proc. Am. Phil. Soc. 1883–4, 310; (*Mioclænus*) COPE, Trans. Am. Phil. Soc. 1888, 321; (*Goniacodon*) SCOTT, Proc. Phila. Acad. 1892, 302.

Conoryctes crassicuspis COPE, Proc. Am. Phil. Soc. 1882–3, 468; Tert. Vert. p. 201, Pl. xxiii*e*, fig. 6; (*Mioclænus*) Trans. Am. Phil. Soc. 1888, 323; (*Sarcothraustes*) SCOTT, Proc. Phil. Acad. 1892, 303.

Sarcothraustes coryphæus COPE, Am. Nat. 1885, 386; SCOTT, Proc. Phila. Acad. 1892, 303; OSBORN & EARLE, Bull. Am. Mus. Nat. Hist. 1895, 29; (*Mioclænus*) COPE, Trans. Am. Phil. Soc. 1888, 323.

Mioclænus bathygnathus COPE, Trans. Am. Phil. Soc. 1888, 320; (*Sarcothraustes*) SCOTT, Proc. Phila. Acad. 1892, 303.

Triisodon biculminatus COPE, Trans. Am. Phil. Soc. 1888, 343; SCOTT, Proc. Phila. Acad. 1892, 301; OSBORN & EARLE, Bull. Am. Mus. Nat. Hist. 1895, p. 28, fig. 7.

This species is the most abundant Creodont of the lower beds, and is represented by about thirty specimens in our collections. Its appearance varies greatly with the age of the specimen, as the wear on the teeth is great, and in old individuals the jaw becomes remarkably large and deep. The first three species here included were founded on very imperfect types which cannot be separated except by differences in the wear of the teeth from the more complete types of *Mioclænus coryphæus* and *M. bathygnathus.* The type specimen of *M. coryphæus* proves to be the same individual as No. 770 of the Amer. Mus. Coll. 1892 ; we are thus enabled to supplement former descriptions to some extent. *Mioclænus bathygnathus,* as Osborn and Earle have already observed, is founded on the lower jaw of an older specimen with teeth more worn and deeper jaw than the type of *M. coryphæus.* The type of *Triisodon biculminatus* is a very young individual with the last molar not emerged and m_{1-2} completely unworn; a second specimen referred to this species by Osborn and Earle is also young, with teeth unworn and shallow jaw. In none of these can any distinctions of specific value be detected ; the apparent difference is almost entirely due to the age of the individual. The further description given here is mainly from the type specimen of *M. coryphæus* Cope, from which the previously described *M. heilprinianus* cannot be distinguished.

Dentition : I.$\frac{?}{?}$, C.$\frac{1}{1}$, P.$\frac{4}{4}$, M.$\frac{3}{3}$.

Canines of moderate size and round oval section, the upper one larger, directed downward and forward, not lateral. Upper premolars four, the first one-rooted, the second two-rooted, the third and fourth three-rooted with internal cusp and strong cingulum with cusps developed at the anterior and posterior corners. The characters of the remaining teeth are given by Cope.[1]

Specimen 773*a* contains part of limb and a few foot bones, among which is a complete cuboid which shows a considerable astragalar facet about the same in proportion as in *Dissacus.* The limbs are somewhat shorter than those of *D. saurognathus* and about one-fourth smaller.

Triisodon gaudrianus (*Cope*).

Mioclænus (*Sarcothraustes*) *gaudrianus* Cope, Trans. Am. Phil. Soc. 1888, 326 ; (*Goniacodon*) Scott, Proc. Phila. Acad. 1892, 302.

To this species we refer, besides the type described by Cope, another individual, No. 4029, which includes the last four upper

[1] Trans. Am. Phil. Soc., 1888, 323.

molars somewhat damaged, most of the lower jaw, and fragments of the skeleton. This enables us to fix the species in the genus *Triisodon* rather than in *Goniacodon*, where it was placed by Prof. Scott.

There are three small incisors in the lower jaw; the canines are rather small and nearly round in section. The third upper premolar is three-rooted, the crown is not preserved. The molars are quadrate, remarkably wide transversely with strong external cingula; the cusps very like those of *T. heilprinianus*. The third lower premolar is small, the fourth large with high round protoconid and strong talon whose cusps are unfortunately broken off. The last lower molar is not reduced; the last upper one is narrowed antero-posteriorly, but not reduced transversely.

The reasons for placing this species in *Triisodon* rather than *Goniacodon* are: the transverse width of the teeth as compared to their length; quadrate shape of the first two upper molars, form and size of the last molar. The lower jaw fragment of the type specimen is too imperfect to show the character of the inferior molars, and p^3 is not preserved, although from the transverse width of the roots we may suspect that it had an internal cusp.

The comparative size of the three species of *Triisodon* is shown by the measurements given below.

	T. quivirensis.		*T. heilprinianus.*		*T. gaudrianus.*	
p^3- m^3			.052	No. 3181	.034	No. 4029
m^{1-2}			.031		.022	
m^2 transv			.0155		.013	
" antero-post			.0107		.0085	
m^3 transv			.0150		.011	
" antero-post.			.0084		.0058	
p_3- m_3			.062	No. 3177	.043	
m_{1-3}			.038		.027	
m_3			.0135		.0095	
m_{1-2}	.031	Type No. 3352	.0255		.0185	
p_4	.019		.013		.0095	

Goniacodon *Cope.*

Cope, Trans. Am. Phil. Soc. 1888, 321. (Subgenus.)
Scott, Proc. Phila. Acad. 1892, 301. (Genus).

Mioclænus levisanus is designated by Cope as the type species of *Goniacodon*. The other species referred here by Cope and Scott I remove to other genera. As thus limited the genus must be re-defined.

Family characters given above. Generic distinction especially in the upper molars which are much less quadrate than in *Triisodon*, m^3 reduced and m^1 as large or larger than m^2, instead of smaller. The third upper premolar is three-rooted without well-developed deuterocone. The paraconid is perhaps somewhat smaller than in *Triisodon*, and the proto- and metaconid higher and more equal in size. The position of the paraconid is not entirely constant, but it is usually submedian on m_1, internal on m_2, as in *Triisodon*. The third lower molar is reduced. A character observed in two specimens, and perhaps a constant one, is the position of the mental foramen underneath the *second* premolar instead of between the third and fourth. This is associated with the short deep symphyseal part of the jaw. The symphysis is ovate and widest behind, extending back to beneath the third premolar, while in *Triisodon* it is widest anteriorly and pointed behind.

Goniacodon levisanus (*Cope*).

Triisodon levisanus COPE, Proc. Am. Phil. Soc. 1882–3, p. 546; Tert. Vert. p. 273, Pl. xxiv*f*, fig. 3; (*Mioclænus*) Trans. Am. Phil. Soc. 1888, 321; (*Goniacodon*) SCOTT, Proc. Phila. Acad. 1892, 301.

A well-preserved lower jaw found by the American Museum Expedition of 1896 has the last two molars and roots of all the other teeth except incisors. The large lower canines were placed rather close together, so that the incisors must have been quite small in size if not reduced in number. Four premolars without any considerable diastema, the last much larger than the rest. The third molar is scarcely more than half as long or as wide as the second. The jaw is very deep in front, the width under the second molar being carried forward to the posterior part of the symphysis under p_2.

The third upper and lower molars are much reduced in this species, and have the cusps very low.

Sarcothraustes *Cope.*

Proc. Am. Phil. Soc. 1882–3, p. 193 (Dec. 1881).

The type of this genus is *S. antiquus* Cope, with which I identify *Triisodon conidens* Cope, both from the Torrejon Beds.

This genus shows a marked approach to the Mesonychidæ in certain characters as compared with *Triisodon*.

The prominent cusps on the teeth are enlarged and simplified, the cingula and accessory cusps obsolescent; this change is carried furthest on the posterior molars. But the width of the upper molars is retained, and the heel of the lower molars is wide and bicuspid.

Sarcothraustes is strictly a Torrejon genus, and may be considered the successor of *Triisodon;* if so, we have a case of degeneration parallel to that seen in the Mesonychidæ, but not leading into them, the tendency being to a dentition with upper molars of great transverse width and broad-heeled lower molars, the last premolar becoming molariform, and the anterior ones small and simple.

Sarcothraustes antiquus *Cope.*

Sarcothraustes antiquus COPE, Proc. Am. Phil. Soc. 1882–3 (read Dec. 1881), p. 193; Tertiary Vertebrata, p. 347, Pl. xxiv*d*, figs. 19–22; SCOTT, Proc. Phila. Acad. 1892, 303; OSBORN & EARLE, Bull. Am. Mus. Nat. Hist. 1895, 29; (*Mioclænus*) COPE, Trans. Am. Phil. Soc. 1888, 320.
Triisodon conidens COPE, Proc. Phila. Acad. 1882, 297; Tert. Vert. p. 274, Pl. xxiii*d*, figs. 9–10; (*Diacodon*) Am. Nat. 1884, 350; (*Mioclænus*) Trans. Am. Phil. Soc. 1888, p. 321.

In this species the paracone is larger than the metacone, while the protocone is much enlarged at the expense of the accessory cusps around it. The hypocone has disappeared except on m^1, where a small remnant still holds out. On m^1 the paracone is scarcely larger than the metacone, on m^2 the difference is considerable, while on m^3 the metacone is very small. The great transverse width of the molars is the most prominent distinction from the Mesonychidæ. P^3 and p^4 have deuterocones. In the lower jaw corresponding differences from *Triisodon* are seen. The protocone is larger than the other cusps of the trigon, progressively larger on the succeeding molars till on m_3 the pa^d and me^d are vestigial. In the heel the entoconid is not lost, but two high rounded cusps arise, internal and external.

The above characters are taken from the type and another specimen of *S. conidens* Cope. In the type specimen of *S. antiquus* the lower premolars are seen to be similar in character to those of *Triisodon;* the fourth large with strong bicuspid heel, the three anterior ones small and not spaced, front of jaw deep and canine of moderate size.

The type of *S. antiquus* is the anterior part of a lower jaw with the premolars, and a fragment of upper jaw with the second true molar and root of the third, besides fragments of the skull and skeleton figured by Cope. The type of *S. conidens* consists of the upper jaw with p^3–m^3, and lower jaw with $m_{\overline{1-3}}$. A third specimen consists of the last four upper teeth of both sides, very finely preserved. These three specimens show no differences in such parts as they have in common, and there seems to be no reason for considering the two species as distinct. A smaller species is clearly indicated by two upper molars (No. 3190); but in the absence of more evidence from other specimens it seems inadvisable to name it.

MESONYCHIDÆ.

The three genera of this family are fairly well known, and if they stand in direct descent, form a marked example of cusp simplification. The known species cannot be placed in direct line on account of the last upper molar, which is much reduced in both species of *Dissacus*, of full size in both species of *Pachyæna* and absent in *Mesonyx*. The three genera are, however, very closely related, and as Osborn and Earle remark, the transition stage between *Dissacus* and *Mesonyx* would be some as yet undiscovered species of *Pachyæna*.

Dissacus navajovius *Cope.*

Dissacus navajovius Cope, Am. Nat. 1881, 1019; Proc. Am. Phil. Soc. 1881, 484; Tert. Vert. p. 344, 741, Pl. xxiv*g*, figs. 3, 4; Trans. Am. Phil. Soc. 1888, 344.

Dissacus carnifex Cope, Am. Nat. 1882, 834; Tert. Vert. 1885, 345; Trans. Am. Phil. Soc. 1888, 304. Not *D. carnifex* of Osborn & Earle, 1895.

This smaller species of *Dissacus* is represented by thirteen specimens, one of which includes considerable parts of the skeleton, and has been fully described by Prof. Cope. *D. carnifex* Cope was separated on the longer and deeper jaw and the presence of an anterior cusp on the fourth lower premolar. As to the last character, a comparison of the two types shows the difference to be very small—the premolar has a cingulum in front, developing a rudimentary cusp in both individuals. Other specimens show some variation—in no case is it well developed, as it is in the species described below. The teeth of the type specimen of *D. carnifex* are not larger than those of *D. navajovius*, although they are spaced apart a little; they are otherwise precisely similar, the depth of the jaw and slight spacing of the teeth being the only distinctions. These are individual differences, due chiefly to age; other specimens are intermediate between the two types. The specimens referred to *D. carnifex* in the Puerco paper of 1895 are a much larger species, *D. saurognathus*.

The tooth which Cope describes in the Tert. Vert. as the third upper molar is the second, as shown by specimen No. 3357, the third molar being much reduced.

Dissacus saurognathus *Wortman.*

Dissacus saurognathus WORTMAN, Catal. Fourth Ann. Exhib. N. Y. Acad. Sci. (name only); *D. carnifex* OSBORN & EARLE, Bull. Am. Mus. Nat. Hist. 1895, p. 30, figs. 8 and 9.

The type of this species is a complete left ramus of the lower jaw, No. 2454, found by Mr. Brown of the American Museum Expedition of 1896. To the same species belong the teeth and skeletons, Nos. 776 and 777, described in 1895 as *D. carnifex*. It differs from *D. navajovius* in size, being about twice as large, in the presence of a second internal cusp (the postero-intermediate according to Osborn and Earle) on the fourth upper premolar, and a well-developed anterior cusp on the fourth lower premolar. The metaconid on m_1 is vestigial or absent; on m_2 and m_3 it is well defined, as is the case in *D. navajovius*. The fourth upper premolar cusp may be a variable character; it is present in *D. navajovius*, but very minute.

The skeleton has been quite fully described by Osborn and Earle. A complete humerus referred to this species has a well-developed greater tuberosity, but the lesser is very small. The shaft is less cylindrical than in the bear, the deltoid ridge more prominent and extending somewhat further down. The entepicondyle is prominent, the entepicondylar foramen large, the olecranal fossa much more open than in the bear. The proportion of the jaw and skeleton are about as in *Pachyæna*, the head of these animals being, as also in *Hyænodon*,[1] disproportionately large. Compared with the bear the disproportion is extreme, the jaw of *D. saurognathus* being one and four-fifths as large as that of the black bear, while the limb-bones average only five-sixths as long, and are not very differently proportioned. This species was of nearly the size of *Pachyæna ossifraga* of the Wasatch, and is the largest known Creodont from the Basal Eocene.

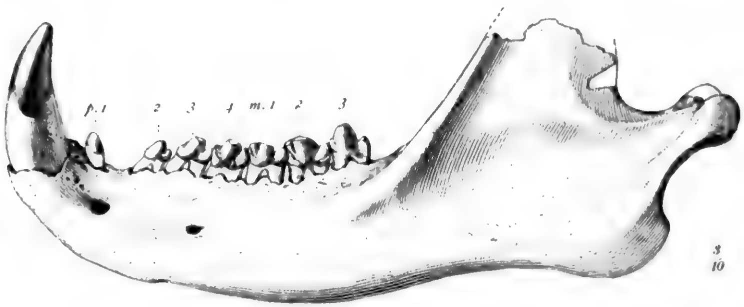

Fig. 9.—*Dissacus saurognathus* Wortman. Three-tenths natural size. External view. Type No. 2454.

MIACIDÆ.

This family is represented in the Basal Eocene only by the already highly specialized *Didymictis*, which became extinct at the close of the Lower Eocene. The ancestor of *Miacis* has not been found in the Basal Eocene of New Mexico. The known species of *Didymictis* of the Wasatch show no definite advance on the Torrejon one, whose position may be seen in the following table, which is somewhat altered from that given by Cope in Tert. Vert., p. 305.

I. $M_{\overline{2}}$ with high trigon and long compressed heel.
  *$P_{\overline{4}}$ rather large, with two small posterior lobes and an external cingulum.
  D. haydenianus, Torrejon.
  **$P_{\overline{4}}$ rather small, with one posterior lobe and no cingulum.
  D. dawkinsianus, Wind River (and Wasatch).

II. $M_{\overline{2}}$ with low trigon and long oval heel. $P_{\overline{4}}$ large, with one posterior lobe and an external cingulum.
  * Heel of $m_{\overline{2}}$ longer.
  $M_{\overline{1-2}}$=.016–.018.........*D. leptomylus*, Wasatch (and Wind River).
  $M_{\overline{1-2}}$=.019–.020......................... ...*D. protenus*, Wasatch.

[1] Scott, Jour. Phil. Acad., Vol. IX, p. 181.

**Heel of $m_{\overline{2}}$ shorter, cusps more conic.
$M_{\overline{1}-\overline{2}}=.025$ .... *D. altidens*, Wind River and Wasatch.

III. $M_{\overline{2}}$ short, subquadrate, with heel represented by a single median cusp.
*$P_{\overline{1}}$ small, with a posterior cutting ridge slightly lobed, and no cingula.
*$M_{\overline{1}-\overline{2}}=.011$.......................... *D. massetericus*, Wasatch.

To the last division may belong *D. curtidens* of the Wasatch, but only the root of $m_{\overline{2}}$ is known in this species.

The known species of *Didymictis* do not give any clear evidence of their evolution in the successive horizons in which they occur. It may be as well to state definitely the occurrence of species so far as the evidence in the American Museum Collections will go. In the Torrejon we find *D. haydenianus* as the characteristic species, *D. primus* being probably a synonym, certainly so in the type specimen. A single fragment indicates a larger species of the size of *D. protenus*. In the Wasatch *D. protenus* is the most abundant species; a smaller form may be either a small race of this species or a large variety of *D. leptomylus*. The large *D. altidens* and the small *D. dawkinsianus* are rare in the Wasatch, and two other species, *D. curtidens* and *D. massetericus*, are represented each by a single specimen. In the Wind River *D. altidens* and *D. dawkinsianus* are the common forms, and *D. leptomylus* is represented by a single specimen. It does not seem practicable to make any genetic arrangement from the above facts—indeed the characters of the teeth would seem to be associated with the *size* of the species and not its age.

Didymictis haydenianus *Cope.*

Didymictis haydenianus COPE, Proc. Am. Phil. Soc. 1882–3, 464; Tert. Vert. 306, Pl. xxiiic, figs. 12 and 13; Trans. Am. Phil. Soc. 1888, 304; SCOTT, Proc. Phila. Acad. 1892.
Didymictis primus COPE, Proc. Am. Phil. Soc. 1883–4, 309; SCOTT, *loc. cit.*

The type of *D. haydenianus* is a lower jaw fragment with two molar teeth. The second molar Cope describes as with a narrow compressed heel; this appearance is exaggerated, however, by the loss of the enamel from one side of the heel. The subsequently described *D. primus* is credited with a normal heel to the second lower molar, but allowing for the loss of enamel in the type of *D.*

haydenianus there is no difference in the form of the teeth. Two species may perhaps be separated on distinctions in the upper jaw, but the condition of the material at hand does not warrant it at present.

The fourth lower premolar in this species is peculiar. A strong ridge curves backward and inward from the protoconid to the posterior edge of the tooth, where the cingulum rises from each side to meet it. This ridge is divided by deep cross cuts so as to form two lobes or cusps posterior to the protoconid, besides the less distinctly separate cingular cusp. On its concave internal side is a small basin opening internally. The cingulum is carried around the outside of the tooth, ending anteriorly in a strong well-separated paraconid. This bilobate heel is not seen in other species of *Didymictis*; they have only one cusp inside the cingulum, except in a few Wasatch specimens referred to *D. leptomylus*, which have a rudimentary second cusp. The internal basin of the heel of $p_{\overline{4}}$ is not developed to any extent in the other species.

ARCTOCYONIDÆ (*Gervais*) *Cope.*

"True molars tubercular, last superior not transverse."[1]

Carpus alternating, centrale large, partly under lunar, fused with scaphoid in the known forms. Tarsus with astragalo-cuboid facet, not distinguishable on the astragalus. Digits 5–5, the first reduced. Claws compressed, bear-like.

Clænodon *Scott.*

Mioclænus Cope, in part.

Upper molars quadrate, with strong posterior intermediate cusp and weaker hypocone. Upper premolars triangular, high-cusped, without deuterocone. Inferior molars with low paraconid on $m_{\overline{1}}$, none on the others. Lower premolars with high trenchant cusps and small heels successively increasing posteriorly. Dental formula, $\frac{3\text{-}1\text{-}4\text{-}3}{3\text{-}1\text{-}4\text{-}3}$. Premolars and canines with sharp crenulate ridged edges anteriorly and posteriorly. Molars with low cusps and generally corrugated surface. Scaphoid fused to centrale, lunar separate. Trapezium large triangular. Astragalus with foramen. Calcaneum with large fibular facet.

[1] Cope, Tert. Vert., p. 259.

Clænodon ferox (*Cope*).

Mioclænus ferox Cope, Proc. Am. Phil. Soc. 1882–3, 547; Tert. Vert. p. 328, Pl. xxiv*f* and xxiv*g*; Trans. Am. Phil. Soc. 1888, 332; (***Clænodon***) Scott, Proc. Phila. Acad. 1892, p. 299; Osborn & Earle, Bull. Am. Mus. 1895, p. 26.

The *scapho-centrale* of this species was figured[1] but not recognized by Prof. Cope. It is formed by the union of the scaphoid with a large flat rectangular centrale which lay half under the scaphoid, half under the lunar. The radial facet is nearly at right angles to the distal facets, indicating probably a plantigrade manus. There is a small semicircular facet for the lunar, directed proximal-externally, and a large distal-external facet for the magnum. The two distal facets, for the trapezium and trapezoid, are large, the former being on the scaphoid proper, the latter on the centrale portion of the bone. There is also a small trapezium facet on the internal end of the centrale part. The *cuneiform* is rather short and thick, with two sub-equal proximal facets, and well-fitting distal and internal facets for the unciform and lunar respectively. The *unciform* has a lunar facet about half the width of that for the cuneiform, and moderately well distinguished from it; the distal facets are not separated. The shape of the unciform is much like that of *Euprotogonia*. The *trapezium*[2] is large, triangular, with an irregular proximal facet for the scaphoid proper, two small proximal-external ones not well separated from the first for the centrale and trapezoid, a large flat external facet for the second metacarpal, and a large distal-internal concave facet for the first metacarpal.

The astragalus and metapodials and some other bones of this individual are also described by Prof. Cope. The bone which he describes as the head of a marsupial bone[3] is probably the head of the fibula; it is much like that of the bear, differing however in that the tibia facet is mainly superior instead of internal—this is no doubt associated with the broad flange on the calcaneum for the support of the lower end of the fibula.

[1] Tert. Vert., Pl. XXIV*g*, fig. 8, *r*, *s* and *t*.
[2] *Loc. cit.*, figs. *u* and *v*.
[3] *Loc. cit.*, p. 336, Pl. XXIV*g*, figs. 8, *p* and *q*.

Clænodon corrugatus (*Cope*).

Mioclænus corrugatus Cope. Proc. Am. Phil. Soc. 1882–3, 556; Tert. Vert. p. 341, Pl. xxiv*f*, fig. 5; (*Clænodon*) Scott, Proc. Phila. Acad. 1892.

It is difficult to make much satisfactory distinction from *C. ferox*, except in the size. The spacing of the premolars is an inconstant character, as is also the depth of the jaw. The teeth seem to be more robust and massive in the larger species, and there is a fairly constant difference in size, *C. corrugatus* being about one-fourth smaller.

Specimen No. 2456, found by Mr. Brown, American Museum Expedition 1896, contains the nearly complete upper and lower dentition, and bones of the fore and hind feet. The lunar, magnum and scaphoid (scapho-centrale) of the left side are preserved, along with the metacarpals.

The *scaphoid* is like that of *C. ferox*. The *magnum* has its lunar and scaphoid facets of equal size, narrow, at right angles to one another and separated by a keeled edge. The *lunar* has two strongly concave distal facets at right angles for the magnum and unciform. The carpus is therefore not alternating only, but completely interlocking. The *pisiform* is long and slender. Of the *metacarpals* the first is short and stout, the second about one-half longer but no thicker, the fifth somewhat shorter and slenderer than the second. The distal ends of the third and fourth are not preserved. The first metacarpal was at an angle to the rest, but not opposable.

Enough of the hind foot is preserved to show the characters of the *tarsus*. There is a considerable astragalo-cuboid facet visible on the cuboid, but not on the astragalus.[1] The calcaneum had a broad flange for the fibula outside the external astragalar facet; the heel was not so long as in *Euprotogonia*, hardly as long as in *Dissacus*. The first *metatarsal* was reduced in length, but not the fifth. An *ungual phalange* preserved is high and compressed, much like that of a bear but rather longer and without basal sheath. It is very different from the small wide semi-ungulate type seen in *Oxyæna* or *Mesonyx*.

[1] Judging by analogy from the Mesonychidæ and others, this character would be constant within the limits of a family. I have therefore placed it in the definition of the *Arctocyonidæ*

? Clænodon protogonioides (*Cope*).

Mioclænus protogonioides COPE, Am. Nat. 1882, 833; Tert. Vert. p. 340, Pl. xxiv*g*, fig. 9, xxv*f*, fig. 17; Trans. Am. Phil. Soc. 1888, 329; (*Clænodon*) SCOTT, Proc. Phila. Acad. 1892.

The type of this species is from the Puerco, and consists of the two last upper molars. The rest of the specimens come from the Torrejon, and, considering the imperfection of the type and the improbability of a species passing through to the later formation without change, can be referred only provisionally to *C. protogonioides*.

It is a smaller and considerably less specialized species than *C. corrugatus*. The molar cusps are higher, the transverse width of the upper molars greater, the intermediates equal in size and the hypocone very small. Upper premolars unknown. The lower molars have the paraconid absent except on $m_{\overline{1}}$, where it is small. The last lower molar is long-heeled, as in *C. ferox* and *C. corrugatus*, but the trigon of $m_{\overline{1}}$ is not unusually small, nor the paraconid advanced as in those species. The third and fourth lower premolars have small anterior and posterior cingular cusps. The surface of the teeth is not corrugate, nor is there any serration on the edges of the premolars.

POSITION OF CLÆNODON.

Clænodon has made a marked advance toward the carnivore type in the fusion of the scaphoid and centrale.[1] The scapholunar contact with its small facet and large unfacetted area indicates perhaps the approaching fusion of the scaphoid and lunar. Yet the primitive character of the carpus is shown by its strong resemblance in many points to that of the Condylarths, especially *Euprotogonia* and *Pantolambda*. This is seen in particular in the large triangular trapezium, and in the shape of the unciform, lunar and magnum. The reduction of the first digit only, the shape of the claws, the thoroughly plantigrade foot, the shape and proportions of the scaphoid and lunar, and various minor characters of the skeleton, strengthen the resemblance to

[1] As opposed to the reduction and final disappearance of the centrale in the early ungulate types.

the Bears which the teeth at once suggest. Were the lunar to fuse with the scapho-centrale, the resultant bone would be very like the scapho-lunar of Ursus. The reduction of the trapezium and loss of fibulo-calcanear facet might be expected. The non-serial tarsus of *Clænodon*, and the chain of more or less intermediate forms between the Miocene Canidæ and the Ursidæ, are serious objections; nevertheless I believe that the Arctocyonidæ are probably ancestral to the modern Ursidæ.

INCERTÆ SEDIS.

Oxyacodon *Osborn & Earle.*[1]

Additional material enables me to add another species to the typical form, and amend the description as follows:

Lower premolars laterally compressed, high and trenchant with minute talons, deuteroconid on $p_{\overline{1}}$ minute or absent. Molars short and wide with high angular cusps, trigonid somewhat elevated above talon, paraconid reduced. Hypoconulid on $m_{\overline{3}}$ high and sharp. Premolars not crowded, the anterior ones not reduced in size. Upper teeth unknown. It may belong to the Anisonchinæ, but the molars do not show the closed basin of the heel peculiar to that group, and are wide instead of compressed.

Oxyacodon apiculatus *Osborn & Earle.*

Bull. Am. Mus. Nat. Hist. 1895, p. 25, fig. 6.

Premolars strongly compressed, deuteroconid absent.

Dimensions: $P_{\overline{2}}$-$m_{\overline{3}}$, .0258; $m_{\overline{1}-\overline{3}}$, .0123. Six specimens. Puerco.

Oxyacodon agapetillus (*Cope*).

Anisonchus agapetillus Cope, Proc. Am. Phil. Soc. 1883–4, p. 320; Trans. Am. Phil. Soc. 1888, 305.

Premolars moderately compressed, minute deuteroconid on $p_{\overline{1}}$.

Dimensions: $P_{\overline{2}}$-m_{3}, .0210; $m_{\overline{1}-\overline{3}}$, .0103. Four specimens. Puerco.

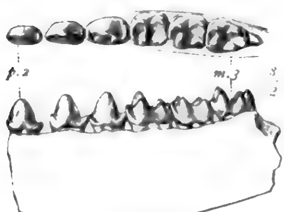

Fig. 10.—*Oxyacodon agapetillus* Cope. Three halves natural size. Crown and internal views of lower jaw. No. 3547*a*.

[1] Bull. Am. Mus. Nat. Hist., 1895, p. 25.

Carcinodon *Scott.*[1]

The genus is characterized, besides the points of difference pointed out by Scott, by a small trigon and long heel on the molars. The molars are much like those of the Chriacidæ, to which it may belong. Only the lower teeth of a single species and specimen are known.

Carcinodon filholianus (*Cope*).

Mioclænus filholianus COPE, Trans. Am. Phil. Soc. 1888, 329.

CONDYLARTHRA *Cope.*

Primitive Ungulates retaining many unguiculate features, including in particular the Creodont astragalus, with distinct neck and convex head. Podials arranged wholly or in part in serial order. Humerus with entepicondylar foramen. A third trochanter on femur. Teeth short crowned, bunodont or selenodont, tritubercular or developing quadrituberculy. Canines small, dental formula complete in all known forms. Plantigrade or digitigrade, toes 5–5, the lateral ones reduced in digitigrade forms.

This group comprises the primitive Ungulata of the Basal Eocene, together with certain inadaptive forms which persisted through the Lower Eocene (Wasatch and Wind River). It includes the ancestors of the later Ungulates, not yet sufficiently specialized to require removal to separate orders. It does not form a genetic line as do the divisions of the more advanced forms, but represents the first stage of ungulate evolution. The group is nearly related to the early Creodonta, and its hypothetical ancestral type or types would be strictly Creodont. The Condylarthra therefore do not form a homogeneous suborder. Its members had diverged more than they had progressed.

To Cope's three Condylarth families, the Phenacodontidæ, Periptychidæ and Meniscotheriidæ, Osborn and Earle have added a fourth, the Mioclænidæ, with the single genus and species *Mioclænus turgidus*. To the last I add several small species

[1] Proc. Phila. Acad. Nat. Sci., 1892, p. 321.

referred to *Mioclænus*, although probably meriting generic distinction, and one which certainly must be separated.

As thus constituted, the Condylarthra include four divergent lines. The first leads into *Phenacodus*, developing digitigradism and quadrituberculy, and related to the Perissodactyla. The second was strictly tritubercular, plantigrade, but with a non-serial tarsus, and related to the Amblypoda in skeletal structure. The third, with a peculiar type of selenodonty, retained a very primitive tarsus, and may perhaps be ancestral to the Litopterna and Hyracoidea, as suggested by Cope[1] and Wortman,[2] or to the Chalicotheres according to Osborn.[3] The fourth retained the most primitive type of teeth, but in the absence of any satisfactory evidence as to its skeletal structure, can be placed here only provisionally. If this family was truly condylarth, it was perhaps related to the Artiodactyls. In the first two groups the development of the teeth was mainly in the addition of cusps, and but little in the direction of altering their shape. In the fourth group we have a pronounced selenodontism; in the third there is a multicuspid tendency in *M. turgidus*, while in *P. opisthacus* there is a tendency towards selenodontism.

The four families are contrasted in the following table:

Of Amblypod affinities, PERIPTYCHIDÆ.	Of Perissodactyl affinities, PHENACODONTIDÆ.	? Of Artiodactyl affinities, MIOCLÆNIDÆ.	? Affinities with the *Litopterna* or *Chalicotheres*, MENISCOTHERIIDÆ.
Molars with persistently tritubercular symmetry.	Molars early developing quadritubercular symmetry.	Molars with tritubercular symmetry.	Molars with quadritubercular symmetry.
Bunodont multicuspid.			Selenodont.
Premolars generally enlarged.	Premolars not enlarged.	Premolars not usually enlarged.	Premolars not enlarged.
Tarsus not serial.	Tarsus practically serial.	Tarsus unknown.	Tarsus serial.
Carpus unknown, probably alternating.	Carpus becoming serial.	Carpus unknown.	Carpus serial, with centrale.
Plantigrade.	Digitigrade.	Unknown.	? Plantigrade.

The Pantolambdidæ might well be placed among the Condylarthra with the above definition of the term. Their evident re-

[1] Am. Nat., 1891, 688.
[2] Comparative Anatomy of the Teeth of the Vertebrata, 1886, p. 476. Science, Dec. 11, 1896, and Bull. Am. Mus. Nat. Hist., 1896, 262.
[3] Am. Nat., 1891, 911; 1892, 507, and 1893, 127.

lationship to *Coryphodon* of the Wasatch in the teeth, and to a less extent in skeletal structure, makes it more convenient to place them as Amblypods. If they are so considered it involves some difficulty as to the position of the Periptychidæ. In the Periptychinæ the skeleton, as Osborn and Earle have pointed out,[1] is very like that of *Pantolambda ;* in the Anisonchinæ, it seems to be intermediate between *Pantolambda* and *Euprotogonia.* The teeth in both Periphychinæ and Anisonchinæ are entirely distinct from either, and show resemblances which almost surely indicate the close relationship of the two sub-families.

Osborn has given this resemblance in foot-structure as a reason for removing the Periptychidæ to the Amblypoda,[2] and Prof. Cope in his last published words adopted this view.[3] If we adhere to Cope's original definition of the Condylarthra, this, indeed, is the only possible solution. But I do not think it the most natural arrangement ; the resemblances to the Amblypods, in the case of the Anisonchinæ at least, are only technical, and as to the Periptychinæ, it seems reasonable to consider that *Pantolambda* retained the primitive Condylarth skeleton while developing an Amblypod dentition. Osborn[4] has shown that Cope's classification of the Ungulates cannot be accepted without some modifications ; as re-defined above, the order Condylarthra covers a number of types which have much in common, and are very difficult to place in any of the specialized groups.

PERIPTYCHIDÆ.

In foot-structure this family shows a marked resemblance to the Pantolambdidæ, and through them to the Amblypoda proper. Astragali and many skeletal bones of *Periptychus rhabdodon* and *Pantolambda bathmodon* are almost indistinguishable. The dental characters, on the other hand, show no resemblance except in the persistent tritubercular symmetry. The Anisonchinæ, as far as known, stand in an intermediate position as regards the foot, between *Periptychus* and *Euprotogonia.* In *Ectoconus* the foot was much like that of *Periptychus*, but somewhat more primitive.[5]

[1] Bull. Am. Mus. Nat. Hist., 1895, 47.
[2] *Loc. cit.*
[3] Am Nat., 1897.
[4] Trans. Am. Phil. Soc., 1889, 558.
[5] The astragalus was described by Cope in 1888.

Subfamily PERIPTYCHINÆ.

Periptychus *Cope.*

This is one of the few genera that pass through from the Puerco to the Torrejon. I recognize only one species from the Puerco, *P. coarctatus.* The second one described from that horizon, *P. brabensis*, was based on specimens somewhat crushed laterally, so that the apparent proportions and outline of the teeth are changed.

Periptychus coarctatus *Cope.*

Periptychus coarctatus COPE, Tert. Vert. Pl. xxix*d*, explanation and figs. 7-8; Trans. Am. Phil. Soc. 1888, 354; OSBORN & EARLE, Am. Mus. Bull. 1895, 54.
Periptychus brabensis COPE, Trans. Am. Phil. Soc. 1888, 354. Not *P. brabensis* O. & E. Am. Mus. Bull. 1895, p. 55.

There is a wide difference between this species and its successors; the teeth are much less specialized. The antero-internal cusp of the lower premolars is entirely wanting; it is always strongly developed in the Torrejon species. The premolars, both upper and lower, are more pointed and less inflated. The molar cusps are higher and rounder, and no subsidiary cusps appear besides the six normal ones. Molars and premolars show more or less obsolete external cingula.

This species, with its synonym *P. brabensis*, occurs only in the lower beds. The specimen described as *P. brabensis* in the 1895 Bulletin, is the milk dentition of *P. carinidens.*

Periptychus rhabdodon (*Cope*).

Catathlæus rhabdodon COPE, Am. Nat. 1881, 830; Proc. Am. Phil. Soc. 1881, 487; 1882-3, 564 (brain-cast).
Periptychus rhabdodon COPE, Tert. Vert. 1885, 391, Pl. xxiii*f* and *g*, lvii, figs. 1 and 2; Am. Nat. 1884, 801, figs. 1-2 and 6-9; SCHLOSSER, Morph. Jahrb. XII, 35; OSBORN & EARLE, Bull. Am. Mus. Nat. Hist. 1895, 53.

The most abundant species of the Torrejon. It does not occur in the lower beds. The dentition and all that is known of the skeletal structure have been fully described by Cope.

Periptychus carinidens *Cope.*

Periptychus carinidens COPE, Am. Nat. 1881, 337; Proc. Am. Phil. Soc. 1881, 484; 1882-3, 561; Tert. Vert. 403, Pl. xxv*a*, fig. 16, xxiii*d*, figs. 14-15, xxiv*g*, fig. 5.
P. brabensis OSBORN & EARLE, Bull. Am. Mus. Nat. Hist. 1895, 55. Not *P. brabensis* of Cope.

This species appears to be good, although not very well defined. It differs from *P. rhabdodon* in its smaller size, narrower molars with longer heel on the third, and less robust premolars. Strictly intermediate specimens are known, but are less common than the extreme types. The species is common but not nearly as abundant as the larger form.

Subfamily ANISONCHINÆ.

The teeth of this group relate them to *Periptychus*, although the build and habits of the two seem to have been widely different. The astragalus is flat and wide, with short neck and wide head bearing a considerable cuboid facet; but the trochlea is not so flat as in *Periptychus*, nor the neck so short. The flange (for the support of the fibula) on the outer side of the astragalus is also prominent and sharp-pointed, as in *Euprotogonia*.

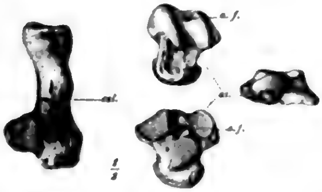

Fig. 11.—*Hemithlæus kowalevskianus* Cope. Calcaneum, superior view; and superior, inferior and anterior views of astragalus, No. 3503. Natural size.

Osborn and Earle have already described the skeletal characters of *Haploconus lineatus* of the Torrejon. I figure an unusually perfect calcaneum and astragalus which were found in the lower beds associated with jaws and parts of the skeletons of two individuals; the larger one is *Conacodon entoconus*, the smaller probably *Hemithlæus kowalevskianus*, though in the absence of the premolars we are not able to distinguish it with certainty from *Anisonchus gillianus*. The figured specimens belong to the smaller individual; to it belongs also a slender tibia with very high cnemial crest and small head with a rather large semilunar fibular facet perpendicular to the axis of the bone. To the larger specimen belong the distal ends of a tibia and fibula much like those of *Periptychus*, except that the fibula is larger, has a prominent external process just above the outside of the facet, and the tibia has a facet less oblique antero-posteriorly, and with sharper and more prominent internal hook.

Osborn and Earle consider that the primary division in this subfamily should be made rather on the shape than on the complexity of the premolars. Cope's separation is nevertheless an entirely constant one for the Puerco-Torrejon species, which fail to show any evidence of evolution in cusp-building. We may therefore make a second division based on the complexity of the premolars. This gives four well-defined types, which should rank as distinct genera. They may be classified thus:

A.—With flat premolar cusps.
- 1. Third upper premolar with internal cusp—*Anisonchus* Cope. Two species—*A. sectorius* Cope, *A. gillianus* Cope.
- 2. Third upper premolar simple—*Haploconus* Cope. Two species—*H. lineatus* Cope, *H. corniculatus* Cope.

B.—With round premolar cusps.
- 1. Third upper premolar with internal cusp—*Hemithlæus* Cope. One species—*H. kowalevskianus* Cope.
- 2. Third upper premolar simple—*Conacodon*, gen. nov. Two species, *C. entoconus* Cope, *C. cophater* Cope.

A number of other species are described by Cope, but all appear to be synonyms of the above, except *Anisonchus agapetillus*, which we remove from the Anisonchinæ and place under the genus *Oxyacodon* O. & E., of doubtful affinities. The species considered invalid are:

1. *Haploconus xiphodon* Cope. Founded on the milk dentition of *H. lineatus*, the fourth milk premolar being taken for the first molar. By cutting into the jaw of specimens referred by Cope to this species, I have exposed the third molar, proving the dentition to be temporary.

2. *Haploconus angustus* Cope. The type and one other individual are considerably smaller than *H. lineatus*; the other specimens are intermediate in size, and as there is no other constant distinction, the species may best be considered as an individual variation of *H. lineatus*.

3. ***Anisonchus coniferus*** Cope. The type is a worn upper jaw fragment of *Conacodon entoconus*, the third premolar so worn as to produce a false appearance of an internal cusp. A careful comparison with *C. entoconus* shows that this cusp was probably not present. The remaining specimens referred to the species belong mostly to *Hemithlæus kowalevskianus* Cope.

4. ***Hemithlæus apiculatus*** Cope. The species is indistinguishable from *Anisonchus gillianus* Cope, and comes from the same level, being the only species with flat premolar cusps found in the lower beds. The species with round premolar cusps, on the other hand, are entirely confined to the lower beds.

5. ***Anisonchus mandibularis*** Cope. As re-defined by Cope in his last article on the Puerco, this species is represented by two individuals, one being a single fourth lower premolar, the other, parts of both jaws not well preserved. I am unable to see in it more than an unusually large individual of *A. sectorius*, which is an abundant species, varying considerably in size.

6. ***Zetodon gracilis*** Cope. The two specimens representing this species are suspiciously like crushed jaws of small *Anisonchi*, such as *A. gillianus*. In the absence of an uncrushed specimen, the existence of this extraordinary type of tooth can hardly be considered as proven.

Family PHENACODONTIDÆ *Cope*.

The three genera of this group, *Protogonodon* of the Puerco, *Euprotogonia* of the Torrejon, and *Phenacodus* of the Wasatch and Wind River, appear to stand in direct ancestral relationship. Unfortunately we have no skeletal material of *Protogonodon*; it is probable that it would show a synthetic type, Creodont by definition, Ungulate in relationship.

The advance noted in the family is especially in the following characters: The *manus* and *pes* developed from a plantigrade pentadactyl unguiculate to a digitigrade functionally tridactyl ungulate type. Preceding the reduction of the digits we find alternation in the podials, the lunar reaching over on the unciform, and the scaphoid probably on the magnum, and the astragalus very slightly on the cuboid. This was not continued and tended to disappear in *Phenacodus*, for reasons noted later. A characteristic feature found in both *Euprotogonia* and *Phenacodus* is the depression of the cuboid with reference to the navicular and ectocuneiform, and of the fourth metatarsal with reference to the third,[1] an inheritance probably from unguiculate ancestors whose paws were used for grasping and striking. The character is found in the Cats and in some of the Primates. The *teeth* developed from simple molars and premolars of the primitive creodont type to sexitubercular molars above and quadritubercular below, the premolars tending to become molariform, and the molars developing additional cusps (multicuspid). In short the family passed through the same changes which we suppose to have occurred in the earliest unknown stages of development of the Perissodactyla, but with certain limitations and retention of ancestral features. They were not able to change the molar tubercles into crests; and they did not develop alternating podials. This is true, however, only for the known members of the family; a *tendency* towards both of these changes is seen, and it may have been stronger in species as yet unknown or insufficiently known. While we are unable to consider *Euprotogonia* as the direct ancestor of the Perissodactyla, yet it had many characters approximating it to them. It is probable that the common ancestor of the typical Ungulata was thoroughly an unguiculate, and that the first separation into the phyla of Phenacodonts, Perissodactyls and Artiodactyls accompanied or preceded the development of hoofs from claws.

[1] *I. e.*, the navicular, ectocuneiform and Mt.III overlap the cuboid and Mt.IV.

Family PHENACODONTIDÆ.

		Puerco. *Protogonodon.* Two species.	Torrejon. *Euprotogonia.* One very variable species.	Wasatch. *Phenacodus.* Several well-defined species.	Wind River. *Ectocion.*[1] One species.
Skeleton		Small.	Small, variable.	Large and small.	Small.
		Unknown.	Slender, semi-plantigrade.	Stout, digitigrade.	? Slender.
			Astragalus flat.	Astragalus more keeled.	Astrag.? strongly keeled.
			Astrag. foramen present.	Astrag. foramen absent.	
			Tarsus nearly serial.	Tarsus serial.	
			Carpus interlocking.	Carpus nearly serial.	
Upper teeth.	hy. on m^{1-2}	Small.	Equal to pr., fixed.	Equal to pr., fixed.	Equal to pr.
	" " m^3	None.	Variable, small or none.	Well developed.	
	ms. on m^{1-3}	None.	Variable, minute or none.	" "	Well developed.
	tr. on p^4	? Absent.	Small, variable.	Equal to pr., fixed.	Equal to pr., crescentic.
	" " p^3		" "	Smaller than pr.	
Lower teeth.	pa^d on m_{1-3}	Well developed, fixed.	Small, variable.	Small, variable.	Minute.
	basin-heel	Open.	Contracted.	Contracted.	Crescent heel.
	de^d on p_4	Variable, minute or absent.	Variable, strong.	Stronger and fixed.	Fully molariform.
	heel of p_4	Simple cingular cusp.	One or two small cusps.	Two strong cusps.	
	pa^d on p_4	Small cingular cusp.	Small, position variable.	Strong, far forward.	
	de^d on p_3	None.	None.	Strong.	

[1] See Bull. Am. Mus. Nat. Hist., 1896, 83.

Protogonodon *Scott.*

Earle has suggested[1] this genus as an ancestor of the Artiodactyla, and in the Puerco paper of 1895 attention is called to the incipient selenodontism observed in a specimen of upper teeth referred to it. I believe, however, that its relations were rather with *Euprotogonia*, and that the Puerco ancestor of the Artiodactyls should be a form with teeth like those of the smaller species of *Mioclænus* or *Protoselene*. The points connecting *Protogonodon* with *Euprotogonia* are: the presence in most specimens of an incipient deuteroconid on the fourth lower premolar, the short stout premolars, whose proportionate size and shape do not differ much from the Torrejon genus, the presence of a small hypocone on the upper molars, and especially the general shape of these teeth, which recalls strongly that of *Euprotogonia*. The described species, *P. pentacus* Cope, is rather larger than *E. puercensis*, and shows but small range of variation. There is a smaller undescribed form, indicated on labels by Prof. Cope as *P. stenognathus*, which fulfills more nearly the requirements for the direct ancestor of *E. puercensis*.

Protogonodon stenognathus, n. sp. (Cope, MSS. name only.)

The type No. 3198 consists of fragments of the lower jaw with the three true molars, which are smaller than in *P. pentacus* and somewhat narrower. The third is much narrower, with compressed heel. The cingula are obsolete on all the molars. With the type I associate No. 761, an upper jaw with the last four molar teeth and the root of p^3. The fourth premolar has a very strong internal cusp but apparently no trittocone. The molars have well developed intermediates, large protocone, small but distinct hypocone on m^1 and m^2, and strong cingula encircling three sides of the tooth. The transverse width of the teeth is greater than that of *Euprotogonia*, but their outline otherwise much resembles it.

Nos. 822 and 3566*a* probably belongs to this species.

[1] Am. Nat., 1893, 377.

		No. 3198.		No. 761.
Dimensions . .	m_{1-3}	= .029	p^3-m^3	= .040
	m_3 longit.	=.0101	m^{1-2}	= .025
	" transv.	=.0064	m^2 longit.	=.0102
	m_1 longit.	=.0093	m^2 transv.	=.0069
	" transv.	=.0076	m^3 "	=.0111

Euprotogonia *Cope.*

A number of species have been described as belonging to this genus, but after a careful review of all the known material I am unable to recognize more than two distinct forms, a larger one, very abundant, and a smaller represented by three specimens only. The species have been founded solely on characters of the teeth, and mainly on progressive characters, which naturally are extremely variable. As all the material comes from a single level we cannot recognize in these any stages of evolution, and they are too inconstant to denote more than individual difference. The distinction from *Phenacodus* is based on the fourth upper premolar which in *Phenacodus* has two subequal external cusps, while in *Euprotogonia* the posterior external cusp or trittocone is rudimentary or absent.

Euprotogonia puercensis (*Cope*).

Phenacodus puercensis Cope, Proc. Am. Phil. Soc. 1881, 492 ; Am. Nat. 1884, 900, fig. 22 ; Tert. Vert. p. 488, Pl. xxv*e*, figs. 12 and 13, lvii*f*, figs. 8 and 9 ; (*Protogonia*) Cope, Trans. Am. Phil. Soc. 1888, 359 ; Schlosser, Morph. Jahrb. Bd. XII, 1887, p. 11 ; (*Euprotogonia*) Cope, Am. Nat. 1893, 378 ; Osborn & Earle, Bull. Am. Mus. Nat. Hist. 1895, p. 64, fig. 19 ; Wortman, Bull. Am. Mus. Nat. Hist. 1896, p. 106, fig. 16.

Phenacodus calceolatus Cope, Proc. Am. Phil. Soc. 1883, 561 ; Tert. Vert. p. 487 ; (*Protogonia*) Cope, Trans. Am. Phil. Soc. 1888, 359.

Protogonia subquadrata Cope, Proc. Am. Phil. Soc. 1881, 492 ; Tert. Vert. p. 426, Pl. lvii*f*, figs. 11 and 12 ; (? *Mioclænus*) Osborn & Earle, Bull. Am. Mus. Nat. Hist. 1895, 64.

Protogonia plicifera Cope, Am. Nat. 1882, 833 ; Tert. Vert. p. 424, Pl. xxv*f*, figs. 2 and 3 ; Trans. Am. Phil. Soc. 1888, p. 359 ; (*Euprotogonia*) Wortman, Bull. Am. Mus. Nat. Hist. 1896, p. 106, fig. 17.

Mioclænus floverianus Cope, Trans. Am. Phil. Soc. 1888, 330 ; (*Tetraclænodon*) Scott, Proc. Phila. Acad. 1892, p. 299.

The collections in the Museum contain nearly two hundred specimens now referred to this species. Although a rather wide range of variation is thus included within its limits, it does not seem practicable to make any separation. The variation in size is: $m_{\overline{1-3}}$ = .024 to .030 m. The mesostyle is usually present though small, on the first molar, and frequently appears on the second, sometimes on the third. The fourth premolar has usually an antero-intermediate cusp (paraconule) and sometimes a postero-intermediate (metaconule). The postero-external cusp on p^4 (trittocone) is small or absent. Other very variable characters are the size and shape of the last upper and lower molar and of the heel of the third lower premolar, and the prominence of the paraconid, which is usually almost obsolete on $m_{\overline{2}}$ and $m_{\overline{3}}$, but sometimes rather clearly marked. The trittoconid is developed to a variable extent on $p_{\overline{4}}$, sometimes being as far separated from the other cusps as in *P. primævus*. The deuteroconid on p^1 is occasionally present though very small. None of these variations show any degree of constancy or any association one with another.

Protogonia calceolata. This species was founded on a single fragmentary individual, differing from *puercensis* only in that a lower premolar, the third or fourth according to Cope, has a flattened heel. The premolar in question is very like the third premolar of *puercensis*, with which the remaining teeth and the skeletal fragments agree entirely, and in view of the variability in this character the species must be discarded till better evidence of its distinctness appears.

Protogonia subquadrata. In his last reference to this species, in 1888, Cope makes it a synonym of *puercensis*. Osborn and Earle have revived it, placing it nearer to *Mioclænus* than to *Euprotogonia*. It does not appear to the present writer to be a valid species.

Protogonia plicifera. The main distinction between this form and *puercensis* is the prominence of the paraconid on the last two molars. Cope in 1888 considers the species as doubtfully valid, as "specific difference cannot be predicated on the presence or absence of this cusp." Additional material fails to confirm the separation; most specimens of *puercensis* have some trace of the paraconid on all three molars, and a smaller number exhibit it more prominently in varying degree.

Mioclænus (Tetraclænodon) floverianus. This species was founded on jaw fragments and skeletal bones of an old individual of

E. puercensis, in which the fourth lower premolar was mistaken for the first molar. The position of the mental foramen just in front of the supposed first molar shows the actual position of the tooth in the jaw. The fragments of jaw are accompanied by a nearly complete humerus, most of one side of the pelvis, and fragmentary vertebræ, all which are fully described by Prof. Cope.

Skeleton of Euprotogonia.

A skeleton of *E. puercensis*, found by Mr. Granger of the American Museum Expedition of 1896, contains both hind limbs and feet complete, the greater part of the pelvis, the centre of nearly all the vertebræ, most of the right fore-limb and parts of the left, the lower jaws and upper teeth. This important discovery enables us to fix definitely the position and relations of this most primitive Ungulate.

The animal was slender, long-limbed, of proportions nearer those of *Protorohippus* than *Phenacodus*, but smaller and proportionately lower at the shoulders. It had a very long and heavy tail.

The right hind limb and foot are absolutely complete, down to the sesamoids. The facets on the bones are very perfect, so that their exact relations can be clearly seen. The foot was semi-plantigrade, five-toed, with extremely narrow hoofs very like claws. The side toes are reduced, but not as much as in *Phenacodus*. The astragalus differs considerably from that of *Phenacodus* ; it is much wider and flatter, less keeled, with longer neck and flattened head. The astragalar foramen is present and clearly cut, surrounded by a depressed area, and the trochlea is situate mainly in front of this, not extending as far back as in *Phenacodus*.

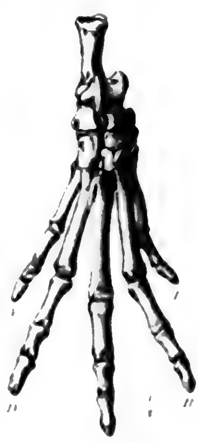

Fig. 12.—*Euprotogonia puercensis* Cope. Hind foot, one-half natural size. No. 2468.

The calcaneum is longer than in *Phenacodus*, the end of the tuber calcis less oblique. The calcaneal side of the tarsus and metatarsus is depressed below the level of the astragalar side, the third metatarsal overlapping the fourth. This is likewise the case in

Phenacodus, in some specimens if not all, and is apparently an inheritance from unguiculate ancestry. The second cuneiform is shortened and Mt.II pushed up between the first and third. The entocuneiform is larger than in *Phenacodus*. The first and fifth digits are much less reduced, the metatarsals being about three-fifths the length of Mt.III, the first somewhat slenderer and considerably curved, having a large proximal facet which allows considerable lateral play of the digit, and a smaller internal facet for Mt.II. The fifth metatarsal is slightly curved, and has a flattened head with strong external hook projecting under the calcaneum; it has two small facets for the cuboid and Mt.IV. These two lateral digits appear to have been somewhat separate from the rest, and were evidently undergoing a rapid reduction.

The distal end of the *fibula* has its plane at right angles to the distal tibial facet; the proximal end is widely flared, the shaft quite slender. The *tibia* is slender, with a prominent sharp crest; the proximal end of the bone is bent backwards and the plane of the cotyli is at an angle of about 60° to the axis of the shaft. The patella is ovate, not high, rather small. The *femur* is slender but with well-developed trochanters; the sides of the rotular groove do not project above the plane of the shaft;[1] the distal end is less enlarged than in *Phenacodus*, and is bent backward so that the plane of the middle of the condyles is not far from being parallel to the axis of the shaft. This, in connection with the position of the tibial cotyli, I believe indicates customary great flexure of the knee; crushing of the bones might account for part, but not for all of it. The great trochanter is higher than the head of the femur, wide and truncate, enclosing a deep fossa; the lesser trochanter is rather sharp and thin, the third somewhat larger and placed about two-fifths of the length from the proximal end.

The *pelvis* is of the same general type as that of *Phenacodus* but longer and slenderer; it is not sufficiently well preserved for exact comparison.

The *vertebræ* preserved are the centra probably of seventeen cervicals and dorsals, seven lumbars and eighteen caudals, the sacrum being weathered into fragments. The cervicals are short

[1] Other individuals show that there was considerable variation in this respect.

and obliquely procœlous ; the dorsals, probably the eleven posterior ones, are small, the anterior ones having triangular sections, the posterior transversely oval. The lumbars are much longer and wider, with flattened oval section and a hypapophysial keel developing on the posterior ones. Six or seven are preserved ; there is no indication of any more, and the lumbar formula was probably the same as in *P. primævus.* The caudals appear to be all present except a few posterior ones. Eighteen are preserved, the length regularly increasing in the first few and not sensibly diminished till the eighteenth. The neural arches are complete to about the eighth and then break up into open grooves. The total length of the part of the tail preserved is about fourteen inches; to this must be added two or three inches for the tip. The extreme length therefore was not less than sixteen or seventeen inches, although the animal stood only a foot high at the rump.

The humerus is slender, with tuberosities less developed than in either species of *Phenacodus ;* the deltoid ridge extends far down on the shaft ; the condylar surface is wide transversely but not deep ; the entepicondylar foramen is well marked, the epicondyles not prominent.[1] The *ulna* has a large truncate olecranon, not bent backward as in the Ungulata, but its axis continuous with that of the shaft. The shaft is moderately slender, much flattened. The *radius* is smaller proximally than the ulna, somewhat larger at the distal end; the distal facets are like those of *Phenacodus.*

Only two bones of the *carpus* are preserved, the right magnum and left unciform. The unciform shows a considerable lunar facet at an angle to that for the cuneiform. The facets for the fourth and fifth metacarpals are of equal size, indicating a less reduction of the fifth digit than in *Phenacodus.* The magnum has a comparatively small upper surface, and is extended proximally into a keel separating two nearly equal facets, one for the lunar, the other supporting the scaphoid, or as may be suspected, a centrale, or both (the surface is not well enough preserved to be certain on this point). The trapezoid facet is small, and does not reach the upper surface of the magnum.

[1] Described by Cope from a somewhat less crushed bone, Trans. Am. Phil. Soc., 1888, 311

The trapezium, cuneiform and unciform are preserved in another specimen (No. 2547*a*); the trapezium is rather large, fits closely to the carpus, has two equal external facets for Mc.II and the trapezoid, a somewhat larger proximal facet for the scaphoid, and a distal facet for Mc.I, not much smaller than the facets for Mc.III and Mc.IV and V on the magnum and unciform. The first digit was therefore not greatly reduced, nor did it project out from the rest of the foot as a dew-claw.

Position of Euprotogonia.

In every detail of its skeletal structure, *Euprotogonia* shows a most striking resemblance to the Creodonts. The customary bend of the knee and elbow, the long heavy tail, the semi-plantigrade five-toed foot are general points of likeness, and when we compare the separate limb-bones, the close relationship becomes apparent, especially close to the more primitive types. As in *Pachyæna*,[1] the fore-limbs were comparatively short, so that the animal seems to have been higher at the rump than at the shoulder—how far this might have been modified by the flexure of the limb it is not possible to say.

The carpus is much like that of *Dissacus* in several respects. The carpals, it will be observed, are *alternating*, not serial. The keeled magnum with small upper surface, the trapezoid small and nearly crowded away from the magnum, and the alternation of the two rows of podials, are characters shown by all of the four Basal Eocene forms in which the carpus is known (*Dissacus*, *Clænodon*, *Pantolambda* and *Euprotogonia*, *Psittacotherium* being here excluded from consideration). The centrale was certainly present in *Dissacus*, quite probably in *Euprotogonia*, and perhaps in *Pantolambda*. It should be observed that the displacement is greater in the short-footed plantigrade *Pantolambda*, *Clænodon* and *Dissacus* than in the more digitigrade, long-toed *Euprotogonia*. This evidence, though not conclusive, points unmistakably towards an alternating carpus as the primitive one. In *Phenacodus* the carpus is more nearly serial, although it varies

[1] Cope, Tert. Vert., p. 366. The humerus figured by Prof. Cope (Pl. XXVIII*c*, fig. 1), probably belongs to *Phenacodus nunienus*.

in different individuals, and there is always a lunar-unciform contact. But if *Phenacodus* is a direct descendant of *Euprotogonia*, this serialism must be secondary. As to *Meniscotherium*, not enough is known of its ancestry to say whether its carpus, serial as figured by Marsh, is primitive or not.

For these reasons I do not consider the interlocking carpus of *Euprotogonia* as a bar to its being ancestral to *Phenacodus*, although it involves some breaking away from the generally accepted view on this point.

The humerus and other skeletal bones of *Euprotogonia* (in the type of *Mioclænus floverianus*) were described by Cope as those of a Creodont, and as "not presenting any but specific differences from" *Clænodon* and *Triisodon*.[1] The pelvis is distinctively Creodont rather than Ungulate in type, as is that of *Phenacodus*, being long and slender with ilia narrow and curved, not expanded anteriorly. These characters are primitive, their possession by both Creodonts and Condylarths serving to show how closely we are approaching the common origin of the two groups.

In every point where *Euprotogonia* differs from *Phenacodus*, it approaches the Creodonts—or rather approaches that hypothetical group from which descended both Creodonts and Condylarths. It stands therefore in a strictly intermediate position, and warrants us in believing that its Puerco ancestor, *Protogonodon*, was in all respects a true Creodont, of generalized type, except as to the teeth, which had already started on their development towards the Ungulata.

Euprotogonia stands nearer to the early Horses than does *Phenacodus*, but I do not think that it can be considered the direct ancestor of *Hyracotherium*. It has the distinctive cusps of *Phenacodus* in a rudimentary stage; it does not exhibit any tendency to form crests; the last molar is small with no hypocone, and the skeleton exhibits no indications of an advance from the primitive type towards *Hyracotherium* in particular, while it has many points of resemblance to *Phenacodus*. We must go somewhat lower down than the Torrejon to find the junction of the Equine and Phenacodont phylæ. And it must be supposed that their common ancestor was a clawed animal, for *Euprotogonia* is in the first stage

[1] Trans. Am. Phil. Soc., 1888, p. 320.

of development as a hoofed mammal, and shows very little else of the ungulate type of skeleton. In the Torrejon representatives of the horse family, one would expect to find the molars showing some trace of approaching lophodonty, the last one of full size, and the astragalus with some indications of a perissodactyl development. In most other respects it might well approximate *Euprotogonia*.

Euprotogonia minor, n. sp.

Protogonia zuniensis COPE, Trans. Am. Phil. Soc. 1888, 305, name only, part. Not on p. 359 *loc. cit.;* nor *Phenacodus zuniensis* COPE, Proc. Am. Phil. Soc. 1881, 492; 1882-3 (1881) 180, and Tert. Vert. p. 491, pl. lvii*f*, fig. 10.

The type and all the specimens originally referred to *E. zuniensis* Cope are identical with *Tricentes subtrigonus*, and are certainly not *Euprotogonia*. They are all lower jaws. Two specimens containing fragments of both upper and lower jaws, Nos. 3896 and 3897, were subsequently referred by Prof. Cope to the same species. These two seem to indicate a small species of *Euprotogonia*, though they cannot be determined with certainty in the absence of the fourth premolar. They are very distinct from the type of *E. zuniensis*, being larger and with a different style of lower molar. In 1888 Prof. Cope referred "three individuals" to this species, presumably the type and Nos. 3896 and 3897. This original type is, however, *T. subtrigonus*, and the species represented by Nos. 3896 and 3897 must be re-named. No. 3896, which contains upper and lower molars of the permanent dentition, may be taken as type. No. 3897 is a young individual with milk dentition. To these may be added No. 3904. The definition of the species will be:

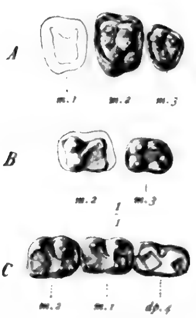

Fig. 13.—*Euprotogonia minor* Matt. *A* and *B*, upper and lower molars of type specimen No. 3896. *C*, lower molars and fourth milk molar of another individual, No. 3897. All crown views, natural size.

Upper true molars sextubercular, differing from those of *E. puercensis* in the smaller size, the series measuring .0191 as against .0222 to .0255. Last upper and lower molar disproportionately small, the upper (.0048 × .0062) more rounded than in *E. puercensis*, and not appressed against the second molar. (The shape of m^2 in the common species is quite variable, so that this is not a very good distinction.) The paraconid is well developed in the three specimens referred to *E. zuniensis*. Fourth permanent premolar unknown, the last lower milk premolar (No. 3897) is like that of the larger species except in size. The trigon is large, the paraconid strong, not quite equalling the proto- and metaconid, and placed far forward. The tooth is in this respect not unlike the *permanent* fourth premolar of *Phenacodus*. The proto- and metaconid are well separated, and all three cusps strongly trihedral, with a crest curving forward and inward from proto- to paraconid. The heel is like that of the first molar but considerably narrower. Dimensions of the tooth in this species: Length, .0073, width of trigon, .0039, of heel, .0042. The corresponding measurements in *E. puercensis* (No. 3833) are, .0100, .0057, .0063.

Family MIOCLÆNIDÆ *O. & E.*

It is with much hesitation that the following species are grouped under the Condylarthra. They are known almost exclusively by the characters of the teeth, and these are very unsatisfactory. The dental series is complete, without diastema, the canines hardly larger than the adjoining teeth, the grinding teeth mostly low-cusped, and well-worn in old individuals, the premolars simple with cusps inflated to a varying extent. Such evidence as we have indicates a skeleton little specialized, not very different from *Euprotogonia*, and where differing, approaching the smaller Periptychidæ so far as these last are known. The teeth are tritubercular, but not persistently so as in the Periptychidæ and Amblypoda, for when the hypocone appears in the upper molars it is in a position to develop quadrituberculy.[1] They differ likewise from the Periptychidæ in having a basin-like heel on the lower molars opening inward instead of being closed internally as in all that family by the entoconid. The premolars are more or less inflated and sometimes enlarged, but this is not constant even specifically, and cannot be relied on as evidence of their relationship to the Periptychidæ. The upper premolars have a deuterocone on the third and fourth, while the lower ones are simple with small heels.

The group may not be homogeneous; the teeth of some of its members have a vague resemblance to the Wasatch Monkeys,

[1] That is, the position of the hypocone is more posterior, less internal than in the Periptychidæ, and the primitive molar cusps are not approximated to the centre of the tooth

Hyopsodus and *Pelycodus*, some to the Artiodactyl *Pantolestes*. Neither of these likenesses is supported by skeletal characters.

Under the type genus *Mioclænus* I place, besides *M. turgidus*, several small species of less aberrant form, but whose characters are not very well known. *M. opisthacus* Cope is so far different from the others that it must be separated generically.

Mioclænus *Cope.*

Premolars inflated more or less strongly. Third and fourth upper premolar similar, each with internal cone. Lower premolars with small heels. Last molar reduced. No entoconid on lower molars.

Prof. Cope referred a large number of the Basal Eocene species to this genus, and regarded it as a Creodont of generalized type, a starting point to which the various groups of flesh-eaters might be traced back. Prof. Scott in 1892 restricted the name *Mioclænus* to the type and other species with low massive premolars equalling or exceeding the molars in size, and speaks apparently with favor of Schlosser's suggestion[1] that *Mioclænus* is a Condylarth. Osborn and Earle in 1895 quote the history more fully than I have done, and propose the Mioclænidæ as a fourth family of Condylarths with the single genus and species *Mioclænus turgidus* Cope. The relations of the species now added are :

A. Premolars and molars very much inflated.
  1. Last molar reduced. $M_{\overline{1}-\overline{3}}=.019$ .... *M. turgidus* Cope.
  2. Last molar unreduced.... .... *M. lydekkerianus* Cope.

B. Smaller species with premolars less inflated.
  1. Last molar somewhat reduced. $M_{\overline{1}-\overline{3}}=.013$........ *M. lemuroides*.
  2. Last molar somewhat reduced, molar cusps much higher than in the preceding species. $M_{\overline{1}-\overline{3}}=.0118$..*M. turgidunculus* Cope.
  3. Last molar greatly reduced. Cusps low. $M_{\overline{1}-\overline{3}}=.0113$.... *M. inæquidens* Cope.
  4. Last molar scarcely reduced. Cusps rounded. $M_{\overline{1}-\overline{3}}=.0105$. *M. acolytus* Cope.

Mioclænus turgidus *Cope.*

Mioclænus turgidus Cope, Am. Nat. 1881, 830 ; Tert. Vert. 325, pl. lvii*f*, figs. 3–4, xxv*e*, figs. 19–20 ; Trans. Am. Phil. Soc. 1888, 321 ; Scott, Proc. Phila. Acad. 1892, 321 ; Osborn & Earle, Bull. Am. Mus. Nat. Hist. 1895, 50.

Mioclænus zittelianus Cope, Trans. Am. Phil. Soc. 1888, 334.

[1] Morph. Jahrb., Vol. XII (1886), p. 37, foot-note.

Although this is an abundant species, we have almost no knowledge of the skeleton. A sacrum asociated with teeth of *M. turgidus* is described by Osborn and Earle as of ungulate rather than carnivore type. A calcaneum is associated with No. 3157, determined as *M. turgidus* by Prof. Cope. This is more like the calcaneum of the Anisonchinæ than that of *Euprotogonia*, but all three are closely similar. It is much less like *Periptychus* or *Pantolambda*. A radius, with part of the shaft missing, is associated with a few teeth in No. 4058*a*. This is considerably different from *Euprotogonia*, the head being rounder and less expanded, the shaft more curved and probably shorter, the distal end less flattened, while the distal facets are quite different in shape, the scaphoid facet being apparently quite small, though not well separated from the lunar facet. The distal end of a tibia with No. 3157 shows that the astragalus was flat and oblique about as in *Hemithlæus*. Altogether, as far as it goes, the skeletal material with this species tends to place it as intermediate between Periptychidæ and Phenacodontidæ, while its teeth are more primitive than either, the premolars reminding one of *Thlæodon* of the Laramie. The outline of the jaw is Condylarth, very like that of *Euprotogonia*, less like any Periptychid.

Removal of the matrix from the type specimen of *M. zittelianus* shows that, like *M. turgidus*, it had internal cusps on the third and fourth upper premolars. It does not show any other important differences from the common species.

A single specimen appears to indicate a species of size equal to *M. turgidus*, but with the last molar unreduced. This is the type of *M. lydekkerianus* Cope.[1] The other specimens referred to that species are *Tricentes* and *Protochriacus*.

Mioclænus turgidunculus *Cope.*

Mioclænus turgidunculus COPE, Trans. Am. Phil. Soc. 1888, 334, type specimen only.
M. acolytus COPE, *loc. cit.*, one specimen doubtfully referred.

The additional material now at hand shows that the Torrejon specimens referred by Prof. Cope to *M. turgidunculus* belong to

[1] Trans. Am. Phil. Soc., 1888, 328.

an allied but distinct species, and that the true ***turgidunculus*** is a Puerco species only. To it I refer specimen No. 3212, a Puerco specimen which Prof. Cope referred doubtfully to ***M. acolytus.*** This specimen shows p_{1-4} and m_1, and part of the upper molar series. The upper molars are not well exposed, and I am unable to distinguish them from the Torrejon species except that they were somewhat smaller and the last molar slightly less reduced. The cusps were probably higher. The lower incisors and canine must have been very small and without diastema; the first premolar is small, probably one-rooted, the second is two-rooted, larger than p_1, the third and fourth are much larger, moderately inflated. All four are recurved and heeled, the heel of the fourth larger than the others. The first molar has a small but well-defined paraconid, rather high rounded cusps, heel scarcely lower than trigon and somewhat constricted off from it. Hypoconid strong, well-defined, the internal shelf of the heel breaking up into small cusps without a distinct entoconid, basin deep, opening forward and inward. Differs from the species described below in its smaller size, smaller pms_{1-2}, molar smaller and much less turgid, with higher cusps and more rectangular outline.

Fig. 14. — *Mioclænus turgidunculus* Cope. Four lower premolars and one molar, from the inside. No. 3212. Natural size.

The above description is from specimen No. 3212. The type, No. 3291, shows the fourth premolar and first two molars of the upper jaw, and can be distinguished from the Torrejon form only by the somewhat smaller size and higher cusps and a little difference in the shape of p^4. In specimen No. 3314, p^2 or p^3 is seen to be simple, without internal cusp, and m_3 reduced to nearly the same extent as *M. lemuroides.* Nos. 3300 and 3474*a* are also probably this species.

Mioclænus lemuroides, sp. nov.

Mioclænus turgidunculus Cope, Trans. Am. Phil. Soc. 1888, 334, part.

The type of this species is No. 2421, a nearly complete pair of lower jaws, showing p_2–m_3 and alveoli of all the front teeth. It is represented by fifteen other specimens, all from the Torrejon beds, including two referred by Prof. Cope to ***M. turgidunculus.***

There were three small incisors; the canine was somewhat larger, about the size of the first premolar; the first premolar was one-rooted, the second is two-rooted, larger, recurved, and minute-heeled. The third and fourth are still larger, stouter, recurved and moderately inflated, the heel of the fourth larger than the others. The molars are very simple, broad and short and considerably inflated, with more or less oval outline, the cusps low, no paraconid, no entoconid, and a simple shallow basin in the heel. Length from i_1-m_3 = .0343; p_{4-1} = .0135; m_{1-3} = .0129. The shape of the jaw is that of *Euprotogonia* and of *M. turgidus*; the teeth are much less inflated than in *M. turgidus*, but more so than in the preceding species. The type is from the Rio Torrejon, San Juan Basin, New Mexico.

Fig. 15.

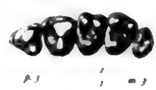

Fig. 16.

Fig. 15.—*Mioclænus lemuroides* Matt. Lower jaw, crown and outside views. Type specimen No. 2421. Natural size.

Fig. 16.—*Mioclænus lemuroides* Matt. Upper teeth, crown view. No. 4025. Natural size.

Another specimen (No. 4025) shows the upper teeth with part of the lower jaw containing the last premolar. The third upper premolar is subtriangular with a well-separated internal cusp; the fourth is wider transversely, more nearly oval, the internal cusp almost as large as the protocone. The first and second molars are slightly larger than p^4, with rudimentary hypocone and minute intermediates. The third molar is but two-thirds the diameter of the second. All the teeth have low rounded cusps, and external cingula obsolete except on m^1 and m^2. Length, p^3m^3 = .019; m^{1-3} = .011.

Mioclænus inæquidens (*Cope*).

Tricentes inæquidens Cope, Proc. Am. Phil. Soc. 1883-4, 317; Trans. Am. Phil. Soc. 1888, 336, fig. 8; (*Ellipsodon*) Scott, Proc. Phila. Acad. 1892, 298.

Mioclænus minimus Cope, Trans. Am. Phil. Soc. 1888, 335. Not *M. minimus* Cope of Proc. Am. Phil. Soc. 1882-3, 468, and Tert. Vert. 327, pl. xxv*e*, figs. 22–24.

The type specimen (No. 3095) is a palate partly buried in very hard matrix. The front teeth are very vaguely indicated and might be interpreted in at least two ways. Either the first premolar is minute or absent, as Prof. Cope believed, and the canine moderately large, or the first premolar is spaced (displaced probably) and the canine unknown. The latter view brings the front

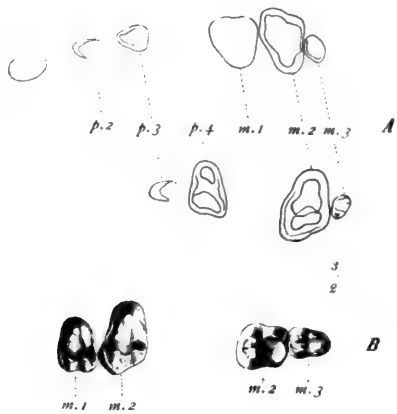

Fig. 17.—*Mioclænus inæquidens* (Cope). *A*. Outline of upper teeth. Type, No. 3095. *B*. Upper and lower molars, crown view, No. 3298.

teeth into harmony with the other Mioclæni. The upper molars and last two premolars are quite of the type of *M. lemuroides* but more simple, the molars trituberculate with no internal cingulum and obsolete external one, intermediates minute or absent, no hypocone. Third and fourth premolar with strong internal cusp, others apparently simple. Last molar minute, transversely oval. Lower molars very simple, paraconid absent, protoconid and metaconid approximated, opposite, blunted ; small hypoconid on heel, basin very much depressed internally, no entoconid. Last molar much reduced, oval, cusps low and flattened, basin shallow and nearly as high as the cusps. The characters of the lower molars are taken from No. 3298. Nos. 3096, 3296 and 3299 also belong to this species.

Mioclænus acolytus (*Cope*).

Hyopsodus acolytus Cope, Proc. Am. Phil. Soc. 1882–3, 462. Tert. Vert. p. 282, pl. xxiii*d*, figs. 5–6; (*Mioclænus*) Cope, Trans. Am. Phil. Soc. 1888, 335.
Mioclænus minimus Cope, Proc. Am. Phil. Soc, 1882–3, 468; Tert. Vert. p. 327, pl. xxv*e*, figs. 22–24. Not *M. minimus* Cope, Trans. Am. Phil. Soc. 1888, 335. See also Scott, Proc. Phila. Acad. 1892, 323.

This is the smallest of the Torrejon species, the three lower molars measuring only ten and a half millimetres in length. The shape of the molar cusps is like those of *Hyopsodus*, but the cusps are lower and the internal crest lacking; the postero-internal cusp (entoconid) is not present, and the anterior cusps are opposite, not alternating. The premolars are quite different, being entirely simple with small heels and moderately inflated. Upper teeth scarcely known; an upper jaw (the type specimen, No. 3208) with two premolars partly exposed indicates that these teeth were rather large with obsolete external cingula, the fourth with a large interior cusp, the third with a small one or simple.

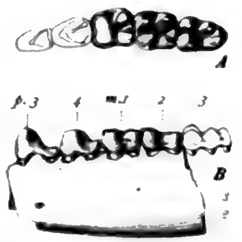

Fig. 18.—*Mioclænus acolytus* (Cope). *A*. Lower teeth, crown view, No. 3292*a*. *B*. Lower jaw, outside view, No 3294.

Cope's original type of *Mioclænus minimus* appears to be identical with this species; the specimens on which the revised description of 1888 was based are a larger form, quite distinct from this one and belong to *M*. ("*Tricentes*") *inæquidens* Cope.

Protoselene, gen. nov.

Premolars not much inflated, lower ones trenchant. Fourth upper premolar with strong internal cusp (deuterocone) and distinct postero-external cusp (trittocone). Third premolar nearly simple. Last lower premolar with strong heel, anterior ones simpler. Entoconid well developed on lower molars.

Protoselene opisthacus (*Cope*).

Mioclænus opisthacus Cope, Am. Nat. 1882, 833; Proc. Am. Phil. Soc. 1883–4, 312; Trans. Am. Phil. Soc. 1888, 332, fig. 5; Scott, Proc. Phila. Acad. 1892, 321; (*Hemithlæus*) Cope, Tert. Vert. 407, pl. xxv*f*, figs. 8 and 9.
Hemithlæus baldwini Cope, Am. Nat. 1882, 833; Tert. Vert. 328, pl. xxv*f*, fig. 16.

This species has rather advanced molars combined with premolars of the simple type found in *Mioclænus*, but more trenchant. The molar cusps show a departure from the rounded form in the direction apparently of selenodontism. The type of selenodontism, if such it be, does not appear to be one that led up into any later form, for it was tritubercular in the upper molars, the protocone combining with the intermediates while the hypocone is left outside. This is not marked, however. The lower molars have the outer cusps quite strongly crescentic, the inner ones still rounded. The last molar is long with a strong hypoconulid projecting backward medially. The paraconid is present on all the molars, although small, entoconid strong and hypoconulid distinct. Lower premolars rather compressed, trenchant, their width varying; in some specimens they are moderately inflated. A rudimentary heel on $p_{\overline{2}}$, a rudimentary anterior cusp and small heel on $p_{\overline{3}}$, and small anterior cusp and strong two-cusped heel on $p_{\overline{4}}$. Upper molars with distinct, though very small, parastyle and mesostyle, small intermediates tending to fuse with the protocone into a crescent, and small hypocone.


Fig. 19. — *Prostoselene opisthacus* (Cope). *A*. Lower teeth, crown view, No. 3278. *B*. Lower jaw, outside view, No. 2435. Both natural size.

Specimen No. 2435, from which the above description is taken, has some skeleton fragments preserved, as well as upper and lower jaws. A calcaneum is in general proportions like that of *Euprotogonia*, but the shape of the sustentacular is different, being less sharply triangular and projecting less internally — in this the bone resembles the Anisonchinæ. There is no roll facet for the fibula, but facing quite externally is a small concave oval facet, whose peculiar shape and position I cannot explain — it may be some accidental peculiarity. The calcaneum has an oblique ectal astragalar facet, and thus forbids any near relationship to the Artiodactyla. The proximal part of a humerus shows a moderately well developed greater tuberosity, the lesser one being small. The head is somewhat rounder and more elongated anteroposteriorly than in *Euprotogonia*. The deltoid ridge is flattopped and continued well down on the shaft but not prominent. A median metacarpal is rather long and slender and has a small, nearly lateral facet for the unciform and a small nearly proximal facet for the overlapping second metacarpal. Fragments of the femur, pelvis and of several vertebræ are preserved, but I recognize nothing characteristic about them.

This skeleton is slightly smaller than that of *Indrodon malaris*, No. 823, described in this Bulletin (1895), although the teeth are one-half larger. There is not much doubt about the correctness of the association. As far as it goes, it indicates a Condylarth, but the evidence is far from convincing. The heel of the calcaneum is compressed laterally, instead of rounded as in *Indrodon*, or angulate or flattened as in some modern Primates. The tuberosities are unequal as in *Euprotogonia*, not sub-equal as in *Indrodon*. The low deltoid crest is a distinction from such Rodents as *Plesiarctomys*, in which it is a high compressed flange. The ridge was probably low in *Indrodon*, but is not preserved in No. 823.

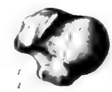

Fig. 20.—*Protoselene opisthacus* (Cope). Head of humerus, proximal view, natural size, No. 2435.

Considerable variation occurs in premolars of this species, as to their size and stoutness, but I cannot detect any constancy in this character. The type specimen is a large individual; the rest of the specimens referred to this species by Prof. Cope are smaller and less robust, as is also the type of *Mioclænus baldwini*. One individual is recorded as coming from the lower beds, but shows no difference from the rest.

AMBLYPODA *Cope*.

Family PANTOLAMBDIDÆ *Cope*.

Pantolambda *Cope*.

The collections of the Museum Party of 1896 contain a number of fine specimens of both species of this interesting genus, but their description is reserved for the present, and will be included in a forthcoming paper by Prof. Osborn. As already observed, *Pantolambda* comes very near to being a Condylarth, under the definition given in this paper, but on account of its undoubted connection with the Amblypoda it is better to remove it from the group of undifferentiated Ungulates.

EDENTATA.

Suborder GANODONTA *Wortman.*

The Basal Eocene members of this group have been fully discussed and illustrated by Dr. Wortman in previous papers,[1] and call for no further mention here.

Foot Structure of Basal Eocene Mammals.

On theoretical grounds it has been generally expected that the feet of the Puerco Ungulates and Creodonts would show for the most part a serial podium, perhaps a serial metapodium. This expectation has not been realized, as is shown by a list of Basal Eocene species in which the foot is more or less known :

		CARPUS.	TARSUS.
Primates	Indrodon malaris	Unknown	Serial.
Creodonta	Triisodon heilprinianus	"	Non-serial.
	Dissacus navajovius	"	"
	" saurognathus	Non-serial	"
	Clænodon ferox	"	"
	" corrugatus	"	"
Condylarthra	Euprotogonia puercensis	"	Serial (approx'ly).
	Periptychus rhabdodon	Unknown	Non-serial.
	Ectoconus ditrigonus	"	"
	Anisonchinæ	"	"
Amblypoda	Pantolambda bathmodon	Non-serial	"
	" cavirictus	"	"
Edentata	Psittacotherium multifragum.	"	Unknown.

All these species have much in common about foot structure, and the rest of the skeleton offers but few characteristic points of distinction. In all the known forms the magnum is very small, keeled and facetted for lunar and scaphoid or centrale, the lunar of moderate size, keeled and facetted for magnum and unciform, the trapezoid small and trapezium large. Metacarpals II and III

[1] Bull. Am. Mus. Nat. Hist., 1896, 259, and 1897, 59. Also 'Science,' Dec. 11, 1896, p. 865.

have facets for the magnum and unciform respectively, as well as their proper facets for trapezoid and magnum. The centrale is separate in one Creodont, fused in another ; in the Condylarths and Amblypods its presence may be suspected, but it was probably not large if it had not already disappeared (by absorption, not by fusion). In the hind foot the astragalus is but little keeled, with round head, and neck of varying length. The calcaneum has only two astragalar facets, the ectal being oblique to the axis of the bone and convex internally, the sustentacular of about equal size slightly concave. The heel is straight and long. Except in *Euprotogonia*, the most progressive Condylarth, and in the ? Primate *Indrodon*, the cuboid has a considerable astragalar facet. The presence of a tibiale has not been shown, although an apparent internal facet is more or less distinguishable on the head of the astragalus in several species; but that this really indicates a bone I am by no means certain. The three cuneiforms are present, the second being quite short, with the second metatarsal pushed up between the first and third cuneiforms.

The conclusion to which the study of these feet leads, apart from any theoretical considerations, seems to me to be as follows:

The primitive condition of the carpus was alternating, with the centrale present. By *absorption* of the centrale a serial carpus, except for the lunar-unciform contact, was produced. By *fusion* of the centrale with the scaphoid the alternating type of carpus would be maintained. That this primitive alternating carpus was preceded by an entirely serial carpus of the type of *Meniscotherium* is quite possible, but there is no evidence of it.

In the tarsus we find no evidence to support the theory of primitive serialism. Only in *Euprotogonia*, the most progressive of the group, do we find an approximately serial tarsus, and this is accompanied by a slender foot adapted for running, and by reduced side toes. The drift of all the evidence is towards relegating the primitive serial carpus and tarsus back into the unknown Cretaceous.

Note on the Use of the Term Condylarthra.

Cope proposed the term Condylarthra (1881) with *Phenacodus* as the type genus, as a suborder of Perissodactyla distinguished by (1) astragalus with convex head, (2) astragalus articulating with navicular only, (3) a third trochanter on the femur. In this group he placed the Phenacodonts, Periptychids and (later) *Meniscotherium*. Subsequently (1885) he altered the arrangement making a new Order Taxæopoda, to include the Condylarths and *Hyrax*, defining it as with serial carpus and tarsus, *Hyrax* being placed in a separate suborder distinguished by the blunt hoofs and peculiar astragalo-fibular articulation. Rütimeyer, Osborn and others have shown that this later conception is by no means strictly applicable, and our present knowledge enables us to state definitely that none of the forms referred to the Condylarthra have an entirely serial carpus, except perhaps *Meniscotherium*, of which the carpus is figured by Marsh as serial. *Phenacodus* has a serial tarsus and a carpus which, though not entirely serial, is not interlocking. But this condition is secondary, for in *Euprotogonia*, its direct ancestor, the carpus is partly interlocking, and the tarsus is not quite serial. In *Pantolambda* the carpus is interlocking, and the tarsus strongly displaced; in *Periptychus* the carpus is not known, but the tarsus is extremely close to *Pantolambda*, and from this and many other resemblances I believe it safe to consider that the carpus was also interlocking. In *Haploconus* the carpus is unknown, the tarsus moderately displaced. We may note that the short-toed plantigrade *Pantolambda* shows the greatest departure from the serial type, while the longer-toed semi-digitigrade *Phenacodus* and *Euprotogonia* show the closest approach. In fact, whatever may be the force of the theoretic arguments in favor of the serial foot being the primitive ungulate type, it receives no support from what we know of the foot-structure of the Condylarths. If it was the primitive structure, the first departure from it must have long antedated the separation of Creodonts and Ungulates.

It is convenient, however, to use a term which will include these primitive Ungulates, some of which gave rise to the later orders, while the great majority have left no descendants. The earlier conceptions of Kowalevsky and other European scientists do not furnish any satisfactory basis for a clear definition of the *Protungulata* (Urungulaten), as the group must now be understood. Marsh's re-definition (1884) is more complete, and recognizes more nearly their proper position—but it is hypothetical, is inapplicable to the forms here considered in several respects, notably in ascribing to the group a serial tarsus and carpus with centrale present, and is antedated by Cope's Condylarthra.[1] The latter was based on actual skeletons, and its first distinction, the round-headed astragalus, is the one most characteristic of all the forms of the group. Osborn's modification of Cope's original classification (Trans. Am. Phil. Soc., 1889, 559) is likewise inapplicable to most of the forms here included.

I would re-define it, then, as including primitive Ungulates retaining many unguiculate characters, among which the most characteristic is the convex-headed astragalus with distinct neck. Other characters found in the known members of the group are :

2. Dental series complete, usually without diastemata, teeth short-crowned, canines not large.

3. Skull low, brain small and smooth.

4. Radius and ulna separate, subequal, toes five, with narrow hoofs. Humerus with entepicondylar foramen, and condyles wide but not deep.

5. Femur with third trochanter.

6. Fibula complete, articulating with astragalus and barely touching calcaneum.

7. Tarsus not far from serial, toes five, the side ones sometimes reduced.

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[1] Am. Nat., 1881, 1018

Article XXIII.—THREE NEW SPECIES OF HETEROCERA FROM SIERRA LEONE, AFRICA.

By W. Schaus.

Metanastria clementsi, sp. nov.

Head and collar sordid white, the latter with some yellow scales posteriorly. Thorax mottled white and yellow. Abdomen white. Primaries with the base and outer margin pale brown; the median space gray; the postmedial space whitish; the basal space crossed by two reddish brown bands, the inner band very broad and more in the nature of a spot; an antemedial and a postmedial fine wavy brown line, the latter followed by a series of large brown spots between the veins from 2 to 8; a brown discal spot; the postmedial space crossed by a grayish shade, and separated from the pale brown outer margin by the subterminal line, which is white, lunular, and very irregular, receding from the outer margin between veins 4 and 6. Secondaries grayish, becoming white along the inner margin; the outer margin pale brown, limited by an angular subterminal white line; a large brown median spot below the costa. Expanse, ♂, 57 mm.; ♀, 78 mm.

Habitat: Sierra Leone.

Types, in Coll. Am. Mus. Nat. Hist.

The costa of secondaries is excised as in *Lebeda*.

Taragama postalbida, sp. nov.

♀. Palpi and body below golden brown. Head and collar gray with a central brown line. Thorax streaked brown and gray. Abdomen above whitish, shaded laterally and subdorsally with brownish yellow. Primaries reddish brown, the veins luteous; from the middle of the costa a very dentate gray band, margined on either side with black, forms a curve towards the apex and then recedes to the inner margin at the base; a wavy subterminal dark line extends from the apex to the middle of the inner margin, this line followed by a broad whitish shade, divided towards the apex by a brown line, and towards the inner margin largely suffused with brown. Secondaries white with the outer margin broadly reddish brown; fringe brown with a yellow spot at the end of each vein.

The ♂ has the abdomen dorsally reddish brown, and the secondaries of the same color.

Expanse, ♂, 50 mm.; ♀, 82 mm.

Habitat: Sierra Leone.

Types, in Coll. Am. Mus. Nat. Hist.

In this species the antennæ are more evenly pectinated, and veins 9 and 10 are on a shorter stalk than in the typical species of the genus.

Trabaloides citrina, sp. nov.

♂. Olivaceous yellow; head and thorax yellowish brown. Primaries with a small white spot near the base; a straight brown antemedial line, touching on the inner margin a postmedial brown line which is angled below the costa; an indistinct discal line; a subterminal irregular whitish band inwardly shaded with grayish. Secondaries with the basal half yellow, the outer half tinged with olivaceous.

♀. Bright yellow; the primaries with the two lines wavy, indistinct, reddish; a large red discal spot; a subterminal row of red spots. Secondaries with the commencement of a subterminal row of red spots near the apex.

Expanse, ♂, 49 mm.; ♀, 80 mm.

Habitat: Sierra Leone.

Types, in Coll. Am. Mus. Nat. Hist.

Article XXIV.—NOTES UPON NEW YORK FISHES RECEIVED AT THE NEW YORK AQUARIUM, 1895–1897.

By Tarleton H. Bean.

Since May 1, 1895, the Aquarium has received 165 species of the fishes of New York, of which 124 species are marine or anadromous, and the rest fresh-water forms. The marine fishes have been collected chiefly in Gravesend Bay, Long Island, in the traps and other fishing apparatus belonging to John B. De Nyse, a veteran fisherman, whose knowledge of the migrations of coast fishes and of the history of the fishery in that bay is extensive and accurate. Many rare species that would escape the notice of the average observer are recognized and sent to the Aquarium, usually alive, by Mr. De Nyse and his sons.

The writer has made occasional excursions to Shinnecock and Peconic Bays, Sandy Hook and the ocean beach at Southampton, Long Island, the Bronx River, and to several lakes in Central Park and Prospect Park, Brooklyn. The New York Commission of Fisheries, Game and Forest, has contributed many species, both living and dead, for exhibition or identification, and additional materials have come from the South Side Sportsmen's Club of Long Island, and from James Annin, Jr., of Caledonia, N. Y.

It is well known that systematic seining along the shores in the vicinity of New York City would add many species to this list, but the present exhibit will serve to indicate the wealth of the marine fish fauna at least, and, at the same time, introduce a number of species of rare occurrence or new to the region. The Short-nosed Sturgeon (*Acipenser brevirostris*) has been living in one of the pools since May, 1896, and has taken hard clams (*Venus mercenaria*) regularly for food.

A species of *Harengula* was caught at Gravesend Bay in 1895. No species of the genus has been known to occur north of the Gulf of Mexico before. Hoy's Whitefish (*Argyrosomus hoyi*) has been taken only in Lake Michigan until Mr. Annin found it in

Canandaigua Lake, N. Y., where it is abundant. The Fresh-water Silverside (*Menidia beryllina*), previously known and rather rare in the Potomac River, is common in a little stream at Water Mill, Long Island. The Thread-fin (*Polydactylus octonemus*), which has not been observed in our waters for thirty years, was secured in Gravesend Bay, Sept. 24, 1896. Three examples were obtained. The Surmullet (*Mullus auratus*), an occasional visitor from southern waters, ranging north to Cape Cod, was reported abundant at Sandy Hook in September and October, 1897, by fishermen. Three individuals were seined for the Aquarium Oct. 8, and, at the time of writing, one of them is alive.

A large Amber-fish (*Seriola* sp.) was captured in August, 1896, at Gravesend Bay, Long Island, and brought in for identification; its measurements are given in the proper place. The Runner (*Elagatis bipinnulatus*), belonging to the West Indian fauna, was once before recorded from Long Island; a single example was taken in Gravesend Bay, in August, 1895. The Banded Larimus (*Larimus fasciatus*), which is not a common species, has been reported from Chesapeake Bay to the Gulf of Mexico. Two individuals were brought alive from Gravesend Bay in August, 1895, and lived in the Aquarium until December, when they succumbed to the cold water at a temperature of 43° Fahr. They fed freely upon shrimp. The Parche (*Chætodon ocellatus*), a West Indian species, occasionally found in summer in Rhode Island and New Jersey waters, was obtained in Gravesend Bay.

A young Surgeon-fish (*Teuthis hepatus*) was captured in Gravesend Bay, Oct. 20, 1897; this occurs in the West Indies and Gulf of Mexico; it was previously known as far north as Charleston. Young Trunk-fish (*Lactophrys trigonus*), belonging to the West Indian fauna, are carried occasionally by the Gulf Stream northward as far as Massachusetts. An example was found in Gravesend Bay, Aug. 28, 1897; it could not be kept alive long in a balanced jar, but it fed regularly for about ten days on minced clam. The Spotted Codling (*Phycis regius*) is not an uncommon fish in Gravesend Bay in October; several individuals were obtained this year. The species often lies upon its side very much like the Tautog and many Flounders.

Pterophryne histrio was found floating in New York Bay in August, 1897; it occurs occasionally in summer as far north as Cape Cod, but belongs to the tropical parts of the Atlantic.

In this paper the species are arranged in the order in which they are given in 'A Check-list of the Fishes and Fish-like Vertebrates of North and Middle America,' by David Starr Jordan and Barton Warren Evermann. The names, almost without exception, are written as they stand in that work. The notes were made from time to time during the entire period mentioned in the title whenever suitable dead fishes became available for observation; and additional data were secured by a study of living individuals. I am under obligations to Mr. L. B. Spencer and Mr. W. I. De Nyse for many important notes upon the feeding habits. Most of the species here recorded have been presented to the American Museum of Natural History.

1. **Petromyzon marinus** *Linnæus.* Sea Lamprey; Lamprey Eel.—The Lamprey has been obtained in Gravesend Bay in March, April and June in small numbers. It has never been kept alive long in the Aquarium because of the impracticability of furnishing it with proper food.

2. **Mustelus canis** (*Mitchill*). Smooth Dogfish.—The species has been brought alive from Gravesend Bay in August, September and October. In the Aquarium it is restless and delicate, often coming to the surface and struggling as if trying to escape from the pool.

3. **Sphyrna zygæna** (*Linnæus*). Hammer-headed Shark.—Not common in Gravesend Bay; occasionally taken in August and September, but never brought alive to the Aquarium because of its great liability to injuries of the eyes.

4. **Carcharias littoralis** (*Mitchill*). Sand Shark.—A young male received from Gravesend Bay, Long Island, on June 26, 1895, died in the Aquarium Dec. 19, 1895, when the temperature of the water in the pool containing it was 53° Fahr. The following notes were made upon the specimen in the fresh condition:

Color, bronze gray with light brown blotches, the largest about as long as the eye. Belly and other lower parts white. Eye yellowish. Tips of pectorals, ventrals, dorsals, anal and caudal above and below with a narrow black streak. Numerous minute dark specks on the under surface of snout and suborbital region, extending back to angle of mouth.

Two rows of teeth in function above and three below. Length of longest tooth in lower jaw, ½ inch ; in upper jaw, ⅜ inch.

Measurements.

Length	3 ft. 6 in.
Depth of body	6½ in.
Least depth of caudal peduncle	1⅝ in.
Tip of snout to perpendicular through last gill-opening	10 in.
From first to last gill-opening	2½ in.
Depth of gill-openings	2 in.
Snout	2½ in.
Eye to spiracle	1½ in.
Eye	½ in. long, ⅜ in. deep.
Snout to nostril	1¼ in.
Width of nostril	⅝ in.
Distance between nostrils	1¼ in.
Nostril to front of mouth	½ in.
Length of mouth opening	2⅝ in.
Width of mouth, including labial folds	4 in.
Length of labial fold	1 in.
Labial fold to first gill-opening	3¾ in.
Snout to first dorsal	16 in.
First dorsal base	3½ in.
Middle of dorsal base to top of fin	3 in.
Length of posterior margin of dorsal	1¼ in.
From first to second dorsal	5 in.
Length of second dorsal base	2¾ in.
Middle of second dorsal base to top of fin	2½ in.
Posterior margin of second dorsal	1⅛ in.
Second dorsal to caudal pit	3 in.
Caudal from pit	12 in.
Lower caudal lobe	9⅜ in.
Terminal caudal lobe	3 in.
Snout to pectoral, obliquely	10½ in.
Length of pectoral	5 in.
Lower margin of pectoral	2¼ in.
Extended pectoral not quite reaching to perpendicular through front of dorsal.	
Ventral origin slightly behind end of first dorsal base.	
Length of ventral	3⅛ in.
Inner margin of ventral	1¾ in.
Vent to tip of clasper	1½ in.
End of ventral base to origin of anal	3¾ in.
Anal base	3 in.
Hind margin of anal	1 in.
Depth of anal	2 in.
Anal base to origin of lower caudal lobe	1¾ in.

5. **Squalus acanthias** *Linnæus.* Horned Dogfish.—The Spined Dogfish has been brought from Gravesend Bay in October only ; it is common on the fishing banks off the New Jersey coast. The species is not hardy in captivity.

6. Squatina squatina (*Linnæus*). SHARK RAY; MONKFISH.—The Shark Ray has not been received alive, and is to be found only in the bays adjacent to the Atlantic. It appears occasionally in Gravesend Bay in summer.

7. Raia erinacea *Mitchill.* COMMON SKATE.—The Prickly Skate was received from Gravesend Bay in November, 1897, and the eggs came from there in March, 1896. The species has deposited eggs in the Aquarium in winter. It will not live in the tanks in summer, but endures the spring, fall, and part of the winter.

8. Raia lævis *Mitchill.* BARNDOOR SKATE.—This Skate has come to the Aquarium from Gravesend Bay in October, 1896 and 1897. It is short lived in captivity because of the want of sand and mud, and the difficulty of providing suitable food. Individuals have been kept alive three or four months.

9. Dasyatis centrura (*Mitchill*). STING RAY.—The Sting Ray is rare now in Gravesend Bay, where hundreds were formerly taken every year. It will live in the Aquarium several months in the spring and summer.

10. Pteroplatea maclura (*Le Sueur*). BUTTERFLY RAY.—A very rare species in Gravesend Bay, and does not endure a captive life.

11. Rhinoptera bonasus (*Mitchill*). COW-NOSE RAY.—Rarely seen now in Gravesend Bay.

12. Acipenser sturio *Linnæus.* STURGEON.—A female eight feet long was brought from the mouth of the Delaware River and placed alive in a pool on May 20, 1897. At this time (Dec. 7) it is still apparently in good condition. Rock crabs, soft clams and opened hard clams have been used for its food, but it seems to have eaten little or nothing until December first, when it began to feed freely upon opened hard clams. The species appears every spring in Gravesend Bay, and sometimes in the fall. It is hardy in the Aquarium.

13. Acipenser brevirostris *Le Sueur*. SHORT-NOSED STURGEON.—The species was obtained in Gravesend Bay May 14, 1894, and a single example was brought alive to the Aquarium on May 13, 1896. It has taken food regularly, and is now living (Dec. 7, 1897). It came in company with five young individuals of *A. sturio*. The species has proved to be well adapted to aquarium life. It is rarely seen in Gravesend Bay.

14. Ameiurus nebulosus (*Le Sueur*). BULLHEAD.—The young were seined in the Bronx in August, 1897. Larger examples were forwarded by the New York Commission of Fisheries, Game and Forest, from Canandaigua Lake in November, 1896, and November, 1897; also from Saranac Lake in November, 1897. The fish feed freely upon hard clams and earth-worms; liver is given to them occasionally. Several albinos were obtained from Hackensack Meadows, N. J., in August, 1897. They are now (Dec. 7) six inches long, and have grown to that length from three inches in three months.

15. Catostomus commersonii (*Lacépède*). SUCKER.—This Sucker was obtained from Canandaigua Lake in November, 1896, and November, 1897; from the Bronx young individuals were received in August, 1897; from Saranac Lake the New York Commission forwarded the small mountain form, distinguished by its size and red color, in November, 1897. The Canandaigua Lake Suckers thrived in the Aquarium until July, 1897, when they were all killed by warm water. The food is chiefly hard clams, with earth-worms occasionally.

16. Erimyzon sucetta (*Lacépède*). CHUB SUCKER.—The Chub Sucker was seined in the Bronx in August, 1897, and Prof. Ulric Dahlgren sent one example from near Princeton, N. J., in September, 1897. The latter, when it arrived, had the broad, longitudinal, median band well developed and the vertical bands obsolete; but soon after it was placed in the Aquarium it obscured the longitudinal band entirely and developed the vertical bands.

17. Cyprinus carpio *Linnæus.* CARP.—In November, 1896, a number of Carp, none of them above two pounds in weight, were presented by the U. S. Fish Commission. During the last summer two female Leather Carp died as a result of retention of the eggs. In October, 1897, several large examples were seined in the lake at Prospect Park, Brooklyn. The food of this species is hard clam, earth-worms, wheat, corn, lettuce and cabbage. Their growth is remarkable. A Leather Carp has fully doubled its weight in one year.

18. Carassius auratus (*Linnæus*). GOLDFISH.—Goldfish have been obtained from lakes in Central and Prospect Parks, and from fountains in Gramercy Park and Bryant Park. A specimen was kept in a fountain at the Old Reservoir (42d Street and 5th Avenue, New York) by Patrick Walsh nine years, and was then presented to the Aquarium. The triple-tail variety was a gift from Mr. E. G. Blackford. From the Cold Spring Harbor hatchery of the New York Fish Commission a number of remarkably large goldfish were obtained. One was a typical fan-tail; another resembling this in color had the form of the regular goldfish; still another was so deep-bodied that he could scarcely swim in equilibrium—all of these were from the same lot of eggs. This fish has never been troubled by fungus or parasites.

19. Semotilus atromaculatus (*Mitchill*). CHUB; FALLFISH; DACE.—A number of large Chub were sent by Mr. Annin from the Fish Commission station at Canandaigua Lake in November, 1896, and again, in the same month, in 1897. Some of the first lot were 14 inches long in July, 1897. All of the first shipment died in July, 1897, from the effects of warm water. They fed freely on hard clam and earth-worms and, occasionally, live killifish.

20. Abramis crysoleucas (*Mitchill*). ROACH; GOLDEN SHINER.—Abundant in the lakes of Central Park and in the Bronx; not found in the large lake of Prospect Park, Brooklyn, in seven hauls with a large seine. They feed freely upon chopped hard clam, and do not like earth-worms. The species spawned in their tank in May, 1897, and their young are now 1½ inches long.

21. Abramis crysoleucas, variety. Irish Roach.—About the end of June, 1896, two females and one male were found to be ready to spawn. The females cast their eggs, but they were immediately eaten by the fish. The fish is always extremely shy. It takes hard clam readily, and does not care for earth-worms. This variety is distinguished by its short and deep body, uniform size of scales and permanent vermilion color of the pectorals, ventrals and anal. The example studied has D. i, 7 ; A. i, 12 ; V. i, 8 ; scales 10–48–4 ; teeth 5–5, hooked, crenate, and with grinding surface. It is found in Central Park.

22. Anguilla chrysypa *Rafinesque.* Eel.—The Eel is particularly liable to attacks of fungus, which do not always yield to the treatment with salt or brackish water. By placing the Eel in a poorly-lighted tank the parasite can be more safely and surely overcome.

23. Leptocephalus conger (*Linnæus*). Conger Eel.—This species has never thrived in the Aquarium, but the individuals received were generally caught with hooks and badly injured. The fish suffers greatly from fungus attacks which cannot be relieved by changing to fresh water. It is sometimes caught in summer in Gravesend Bay.

24. Elops saurus (*Linnæus*). Big-eyed Herring.—An adult example was caught in Gravesend Bay Oct. 5, 1896. It is known to the fishermen as the '*seering*' and '*sisco.*'

25. Etrumeus sadina (*Mitchill*). Round Herring.—Young individuals were taken in Gravesend Bay July 30, 1896, varying in total length from 4½ to 4¾ inches. They were associated with young Mackerel of slightly larger size in bunches and schools. John B. De Nyse saw some schools that he estimated to contain 25,000 fish.

26. Clupea harengus (*Linnæus*). Sea Herring.—On April 30, 1896, Mr. John B. De Nyse brought to the Aquarium from Gravesend Bay some small Clupeids known as 'shad bait,' which are believed to be Sea Herring. The following notes were made from fresh specimens :

Many young transparent fish of the genus *Clupea*, a little under two inches long, are seen in the shad fykes and pounds, and are known as 'shad bait,' because they are said to be taken frequently from shad stomachs.

D. 18 ; A. 17. Muscular impressions along side of body about 60. The ventral very slightly in advance of the origin of dorsal. Intestinal tract full of minute orange-colored substances resembling Entomostraca. A row of black dots on sides, low down, from pectoral to anal. Iris silvery ; top of eye very dark.

Large Sea Herring, according to Mr. W. I. De Nyse, occur rarely in Gravesend Bay. Only about one hundred or two hundred are obtained during fall and winter. On Nov. 23, 1897, an individual 13½ inches long, and 2¾ inches deep, and a number of young from 4¾ to 6 inches long were secured.

27. Pomolobus mediocris (*Mitchill*). Hickory Shad.—The Hickory Shad is caught in Gravesend Bay during September, October and November, but not in such numbers as were found some years ago.

The Hickory Shad arriving in Fulton Market Oct. 30, 1896, each contained in the stomach from 15 to 20 Sand Launce, from 3½ to 5 inches long. The Shad are large, weighing from ½ pound to 2½ pounds. They were shipped from nearby waters.

28. Pomolobus pseudoharengus (*Wilson*). Branch Herring.—This Alewife is the first to make its appearance in Gravesend Bay. It comes with the Shad. No attempt has yet been made to keep it in captivity here, but there is no reason to doubt that it would do as well as the Shad, Menhaden and Herring now (Dec. 7, 1897) living in the central pool. On Nov. 30, 1897, examples above 7 inches long were brought from Gravesend Bay.

29. Pomolobus æstivalis (*Mitchill*). Glut Herring.—On Nov. 23, 1897, Mr. De Nyse sent from Gravesend Bay a Glut Herring 6¾ inches long and 1⅜ inches deep, evidently the young of the year. It is known in the Bay as Shad Herring. On Nov. 30 two individuals, evidently fish of the year, measuring about 7 inches, were brought in from the same bay.

30. Alosa sapidissima (*Wilson*). SHAD.—Mr. W. I. De Nyse says it is a common thing in the fall of the year to take large quantities of young Shad in nets set off shore in Gravesend Bay—sometimes a ton and a half in a haul; that is during the migration seaward. They are usually about 6 to 8 inches long. In John B. De Nyse's pound sixty or seventy were caught Oct. 17, 1895. A male 11 inches long and 2¾ inches deep, and a female 12 inches long and 3 inches deep were brought to the Aquarium. None were taken after Oct. 31 in 1895; but on that date a male 13 inches long and 3½ inches deep, and a female 13½ inches long and 3⅛ inches deep, were secured. The male had two lernæan parasites on its back just below the dorsal fin. Mr. W. I. De Nyse states that this parasite is always found along the backbone.

On Oct. 8, 1896, a Shad about 4½ inches long and one about 9 inches were taken in Gravesend Bay. Apparently the Shad do not all remain at sea after their first migration until they are sexually mature.

Mr. John B. De Nyse informs me that in the first spring run of small Shad, fully ninety per cent. are males.

31. Harengula sp.—An individual about 9 inches long was brought in dead from Gravesend Bay in 1895. This was the only one observed in that locality, and it is the only record known of the occurrence of this genus north of Florida. The specimen is not now available for study.

32. Opisthonema oglinum (*Le Sueur*). THREAD HERRING.—Known as 'Sprat Herring' in Gravesend Bay. Appears there in July and August, and is sometimes so abundant as to fill the nets. The great run lasts two weeks, beginning towards the end of July.

33. Brevoortia tyrannus (*Latrobe*). MENHADEN.—The species comes into Gravesend Bay in May and through the summer; occasional individuals are seen in the fall as late as November. At the end of November, 1897, some examples are alive and feeding well in the great pool of the Aquarium.

34. Stolephorus mitchilli (*Cuv. & Val.*). ANCHOVY; WHITE BAIT.—This Anchovy appears in Gravesend Bay in May and remains until October. It is frequently shipped to the market as 'White Bait.' The fish is too frail for a captive life.

35. Stolephorus argyrophanus (*Cuv. & Val.*). ANCHOVY.—This species is uncommon in Gravesend Bay, but occurs more frequently in bays communicating directly with the Atlantic.

36. Coregonus quadrilateralis *Richardson.* FROST-FISH; ROUND WHITEFISH.—This small Whitefish is one of the characteristic species of the Adirondack lakes. Mr. James Annin, Jr., sent specimens for identification from Hoel Pond and Big Clear Lake, in Franklin County, N. Y., and from the third lake of the Fulton Chain. He states that the fish spawns in the little inlets or upon the sand beaches. It never appears until about the time the water begins to chill and freeze about the edges. On the Fulton Chain of lakes the spawning season of 1895 was practically closed about Nov. 20.

The Frost-fish, according to Mr. Annin, is "a delicious morsel."

The following notes were made upon fresh examples received from the third lake of the Fulton Chain, Nov. 26, 1895:

A male $11\frac{3}{4}$ inches long to end of caudal fin had the middle caudal rays, from end of scales, $\frac{5}{8}$ inches long; upper caudal lobe, measured horizontally, $1\frac{7}{8}$ inches; head, $1\frac{13}{32}$ inches; maxilla, $\frac{3}{8}$ inch; eye, $\frac{3}{8}$ inch; gill-rakers, 5 plus 10, the longest $\frac{1}{4}$ as long as the eye; scales, 8–84–8. A female $11\frac{7}{8}$ inches to tip of caudal has upper caudal lobe 2 inches, measured horizontally; middle caudal rays from end of scales, $\frac{9}{16}$ inch; depth of body, $2\frac{1}{4}$ inches; head, $1\frac{7}{8}$ inches; maxilla and eye, each $\frac{3}{8}$ inch; gill-rakers, 5 plus 10, the longest $\frac{1}{4}$ as long as the eye; scales, 8–79–8.

Three males received Dec. 11, 1895, showed the following colors:

In the male, $13\frac{3}{8}$ inches long, from Hoel Pond, the back and sides were dark steel gray; the belly white; pectoral, ventral and anal orange; dorsal and caudal chiefly yellow. A male 12 inches long, from Big Clear Lake, had the back and sides silvery gray, darker between the lines of scales; the lower fins orange; the dorsal and caudal with traces of yellow. A male 11 1/8 inches long, from Big Clear Lake, showed the same colors as the last. The following measurements in inches and notes were taken :

	Hoel Pond. ♂	Big Clear Lake. ♂	Big Clear Lake. ♂
Length	13 3/8	12	11 1/8
Caudal lobe, horizontally	2 3/16	1 7/8	1 7/8
Middle caudal rays	3/4	5/8	9/16
Depth of body	2 1/2	2 3/8	2 3/16
Least depth of caudal peduncle	7/8	3/4	11/16
Head	2	1 3/4	1 5/8
Snout	1/2	..	..
Eye	7/16	7/16	3/8
Maxilla	7/16	3/8	3/8

In all, the gill-rakers are minute, and number: 5 plus 10, 5 plus 10, and 5 plus 9. The scales are: 10–86–9, 10–76–9, and 9–86–8.

An example sent by the New York Commission of Fisheries, Game and Forest, from Saranac Lake, Nov. 23, 1897, showed the following characters :

Measurements.

Length, including caudal	13 in.
Length to end of scales	11 1/2 in.
Length of middle caudal rays (from end of scales)	7/8 in.
Length of upper caudal lobe (obliquely)	2 1/8 in.
Depth of body at dorsal	2 3/8 in.
Least depth of caudal peduncle	13/16 in.
Length of head	2 1/8 in.
Diameter of eye	9/16 in.
Length of maxilla (does not reach orbit)	9/16 in.
Length of mandible	3/4 in.
Distance from snout to dorsal origin	5 1/8 in.
Length of dorsal base	1 7/16 in.
Length of longest dorsal ray	1 5/8 in.
Length of last dorsal ray	13/16 in.
Distance from snout to ventral origin	5 5/8 in.
Length of ventral	1 9/16 in.
Length of ventral appendage	1/2 in.
Distance from snout to anal origin	8 3/4 in.
Length of anal base	1 3/16 in.
Length of longest anal ray	1 7/16 in.
Length of last anal ray	1/2 in.
Length of pectoral	2 in.
Distance from snout to adipose fin	9 1/4 in.
Length of base of adipose fin	7/16 in.
Width of adipose fin	3/8 in.
Length of adipose fin	3/8 in.
Length of longest gill-raker	1/8 in.

D. 11; A. 11; V. i, 10; P. i, 14. Scales, 10–84–8. Gill-rakers, 6 + 10, the longest 1/8 inch.

Purplish gray ; lower parts whitish. Pectorals, ventrals and anal vermilion. Eye pale golden. Head, especially behind the eyes, iridescent gold and purple tints. Caudal was chiefly vermilion in life.

The fish is a male with ripe milt. There are numerous small tubercles on the scales of the sides above and below the lateral line.

37. Coregonus clupeiformis (*Mitchill*). WHITEFISH.—A single young individual, caught in a gill-net at Wilson, Niagara Co., N. Y., in Lake Ontario, was forwarded by Mr. James Annin, Jr., for identification.

38. Coregonus labradoricus *Richardson.* LABRADOR WHITEFISH.—This species is frequently confused with the common Whitefish of the Great Lakes (*C. clupeiformis*), especially in waters into which fry of the latter fish have been introduced. It is also mistaken sometimes for the Blackfin Whitefish (*Argyrosomus nigripinnis*); but a glance at the jaws should correct that error speedily. From the common Whitefish it may readily be distinguished by the lingual teeth (unfortunately not always present) and its compressed back, as well as its small size.

A male and a female were received through Mr. Jas. Annin, Jr., from Upper Saranac Lake on Nov. 16, 1895. Both fish were nearly spent. They were supposed to be the common Whitefish. A male from Chazy Lake arrived through the same source on Nov. 22, 1895. It was doubtfully called 'Blackfin Whitefish.' At that time the fish had left the spawning beds and were in deep water. On June 17, 1896, a female 19$\frac{5}{8}$ inches long was shipped by Mr. Annin from Canandaigua Lake. Its stomach is pear-shaped with walls more than $\frac{1}{4}$ inch thick ; it contained numerous small shells of several genera, not yet identified.

The species is reported by fishermen to be very abundant in that lake, and to be destructive of eggs of other fish. They say it comes in great numbers into shallow water near the shore in early summer when the water is roily, and can be caught on set lines. Mr. Annin saw men baiting their set lines with small Minnows on Canandaigua Lake, and when they were taken up in the morning the Labrador Whitefish was found on the hooks. It is claimed that one of them so taken weighed 6 pounds. Superintendent O. H. Daniels, of the New Hampshire Fish Commission forwarded a specimen from Lake Winnesquam, at Laconia, 19⅞ inches long, weighing 46 ounces, and he wrote that individuals weighing 7½ pounds had recently been taken. The species was called 'Blue-fin' and 'Whitefish.'

The fish-eating habit of the Labrador Whitefish was fully verified in the Aquarium upon examples obtained in Canandaigua Lake in November, 1896, by Mr. Annin. Knowing that the species usually subsists upon small mollusks and crustaceans, efforts were made to provide the fish with *Physa* and *Gammarus;* but this became difficult in winter, and an experiment was made with small Killifish (*Fundulus heteroclitus* and *majalis*), which proved satisfactory during the cold months. In summer, however, it was found necessary to return to the use of *Gammarus.* The Whitefish at first took the Killifish without any eagerness, but they soon learned to chase their prey and take it much as trout do.

A female received from Canandaigua Lake on June 17, 1896, in a fresh state, showed the following colors: Membrane of pectoral fins dusky; that of the pectorals tinged with lemon yellow; ventrals dusky at the tip; anal pale; caudal pale except a narrow dusky portion of the middle rays; eyes pearly with golden iridescence. The maxilla reaches about to front of eye. The adipose dorsal extends straight backward, and its base is covered with a sheath of small scales $\frac{3}{16}$ of an inch wide. The gill-rakers are 9 plus 17, the longest ⅜ of an inch. Very small teeth are present on the tongue. The eggs are minute.

In a male example, 17¼ inches long, received Nov. 16, 1895, from upper Saranac Lake and nearly spent, no tubercles could be seen upon the scales; but several of the males from Canandaigua Lake had them well developed. There is a great difference in the development of the lingual teeth, some of our individuals showing only a trace of them, and it seems as if there may be some relation between their condition and the sexual maturity of the fish. For example, in a male 14 inches long, sent from the fourth lake of the Fulton Chain, Nov. 9, 1897, the lingual teeth were present in a large patch; in three males, only a little smaller but sexually immature, from Saranac Lake, Nov. 11, 1897, the teeth on the tongue could be perceived by the touch only. The following measurements, in inches, and additional notes, were made from the fresh fish :

	Canandaigua Lake, June 17, 1896. ♀	Upper Saranac L., Nov. 16, 1895. ♂	Chazy Lake, Nov. 22, 1895. ♂
Length, including caudal	19 5/8	17 1/4	15 1/2
Length of middle caudal rays (from end of scales)	1	15/16	7/8
Length of upper caudal lobe (horizontally)	3	3 1/2	..
Length of longest caudal ray	3 1/4	..	..
Depth of body at dorsal	4 3/4	3 1/2	..
Least depth of caudal peduncle	1 1/2	..	1 1/8
Length of head	3 3/8	2 3/4	2 1/2
Diameter of eye	5/8	5/8	1/2
Length of maxilla	1	3/4	5/8
Distance from snout to dorsal origin	8	..	..
Length of dorsal base	2 1/8	..	
Length of longest dorsal ray	2 1/2	..	..
Length of last " "	3/4	..	..
Distance from snout to ventral origin	9	..	..
Length of ventral	2 3/4	..	..
Length of ventral appendage	7/8	..	..
Distance from snout to anal origin	13	..	..
Length of anal base	2	..	..
Length of longest anal ray	1 3/4	..	..
Length of last anal ray	5/8	..	..
Length of pectoral	3	..	..
Distance from snout to adipose fin	14	..	..
Length of base of adipose fin	1		..
Length of adipose fin	3/4	..	..
Width of base of adipose fin	1/2	..	..
Length of longest gill-raker	3/8	3/8	5/16

Taking the fish in the order above given, the gill-rakers are : 9 plus 17, 10 plus 16, and 9 plus 17. The scales are : 10-76-8, 10-87-9, and 11-81-10. The branchiostegals in various specimens examined are 9 to 10 ; divided dorsal rays, 10 to 11 ; anal rays, 10 to 11.

39. Argyrosomus artedi (*Le Sueur*). CISCO ; LAKE HERRING.—A male was received from Mr. Annin Nov. 22, 1895, and a female on Nov. 25 of the same year. The male had spermaries moderately developed. The female agrees very well with the variety *cisco*. Both are from Three-mile Bay, Lake Ontario. The following measurements, in inches, and notes, were made upon the fresh examples :

	3-mile Bay. ♂	3-mile Bay. ♀
Length, including caudal	13 1/2	13
Length of middle caudal rays	3/4	..
Least depth of caudal peduncle	1	..
Depth of body at dorsal	3	2 1/2
Length of head	2 1/4	2 1/4
Length of maxilla	3/4	3/4
Diameter of eye	1/2	1/2
Length of longest gill-raker	5/8	..
Number of gill-rakers	17 + 31	47
Scales	8-74-8	76

In the female above mentioned, the maxilla reaches to the front of pupil; the lower jaw projects a little; the dorsal and anal each have ten divided rays; the dorsal has a black tip; the pectoral is dusky above; the ventral and anal are pale; the caudal is dusky towards the margin. According to Mr. Annin it lives in deep waters and spawns in brooks in December.

40. Argyrosomus hoyi *Gill.* LAKE SHINER; MOON-EYE CISCO.—This species is recorded with certainty from Lake Michigan only. It is taken in gill-nets in deep water and, notwithstanding its small size, has become commercially important. It is here for the first time announced as a member of the New York fauna, and the description following below leaves no doubt of the correctness of the identification. The fish examined, a female with ripe eggs, was taken in Canandaigua Lake, Dec. 19, 1896, by Mr. Annin's men. It was the only one caught, and was captured by becoming gilled in the funnel of the net. Mr. Annin is satisfied that this is the Lake Shiner of the fishermen, which they sometimes see in immense schools at the surface, and kill for trolling bait by shooting them.

Description.—Head, 4; depth, $4\frac{4}{7}$; eye, 5 (nearly); snout, $3\frac{1}{2}$; maxillary, nearly 3 in head, reaching to vertical through front of pupil. D. 10; A. 11; scales, 8–70–9. Gill-rakers, 14 + 28, left side, 40 on right side, longest about $\frac{1}{4}$ inch, about 2 in eye. Branchiostegals, 8. Body rather elongate, compressed, the back little elevated. Mouth rather large, terminal, the lower jaw slightly longer than upper when the mouth is closed; tip of muzzle conical as in *A. artedi;* mandible nearly reaching vertical through posterior edge of eye, nearly 2 in head. Head rather long and slender, with pointed snout; interorbital width equal to eye. Supraorbital and preorbital long and narrow. Distance from tip of snout to occiput, 2 in distance from occiput to origin of dorsal fin; dorsal rays much longer anteriorly than posteriorly, the longest ray nearly equal to distance from front of pupil to end of head, the last ray only $\frac{1}{3}$ as long; longest anal ray $2\frac{1}{2}$ in head, last anal ray $\frac{2}{5}$ as long as the longest Pseudobranchiæ well developed; tongue with evident teeth.

Color in spirits silvery, with purplish iridescence on back; scales without punctulations; belly whitish; dorsal and caudal fins dark on terminal half, pale at base; other fins all pale.

Length, without caudal, 8 inches; total length, $9\frac{1}{2}$ inches; depth, $1\frac{3}{4}$ inches; head, $2\frac{1}{8}$ inches; eye, $\frac{7}{16}$ inch; maxilla, $\frac{11}{16}$ inch; interorbital width equal to diameter of eye.

Mr. Annin wrote me that the people at Canandaigua Lake told him that there were large quantities of small Lake Shiners, as they are called, in the lake. A fisherman said that they are seen in immense schools at the top of the water occasionally, and by firing a gun loaded with shot into them they can stun them so that they can pick up quite a number. They are eagerly sought after for trolling bait for the salmon trout found in that lake.

41. Argyrosomus tullibee *Richardson.* TULLIBEE.—The Tullibee occurs in Onondaga Lake. A female was sent from there by Mr. Annin Nov. 18, 1895, and another of the same sex Nov. 25, 1896. Mr. Annin wrote that the fish commenced running onto the shoals about Nov. 15, and were spawning in the lake Nov. 25. They come up to the banks or gravelly shoals and deposit their eggs in from three feet to seven feet of water. The species has never been caught with the hook in that lake, although almost every kind of bait, the finest and smallest hooks, baited with *Gammarus* and other natural foods, were tried.

The following notes relate to the female obtained Nov. 18, 1895:

Length to end of caudal	$18\frac{1}{2}$ in.
Length of upper caudal lobe	$2\frac{5}{8}$ in.
Length of middle caudal rays	1 in.
Least depth of caudal peduncle	$1\frac{3}{8}$ in.
Depth of body at dorsal origin	$4\frac{5}{8}$ in.
Length of head	$3\frac{1}{4}$ in.
Length of maxilla	$\frac{7}{8}$ in.
Diameter of eye	$\frac{5}{8}$ in.
Length of longest gill-raker	$\frac{9}{16}$ in.

The mandible projects slightly. B. 8; D. 11; A. 11; V. 11; scales, 8–75–8; gill-rakers, 17 + 27.

The female received Nov. 25, 1896, is 15 inches long.

New York is well supplied with Coregonidæ, having eight of the sixteen North American species. *C. quadrilateralis* is the Frostfish of the Adirondacks and the Great Lakes. *C. clupeiformis*, the common Whitefish, inhabits the Great Lakes and Lake Champlain. *C. labradoricus*, the Labrador Whitefish, is very abundant in the Adirondacks, and is found also in the Great Lakes. *Argyrosomus osmeriformis* is a shapely little Herring of Seneca and Skaneateles Lakes. *A. artedi* is the common Lake Herring or Cisco of the Great Lakes and Lake Champlain. *A. hoyi*, the Lake Shiner, or Hoy's Whitefish, is above recorded from Canandaigua Lake. *A. prognathus*, the Long-jaw, the only summer spawning Whitefish so far as known, lives in Lake Ontario, and, finally, *A. tullibee*, is the fine Whitefish of Onondaga Lake.

42. Salmo salar *Linnæus.* ATLANTIC SALMON.—Although this is again a New York fish, it is represented in the Aquarium by the young hatched here from eggs taken from the Restigouche River, Canada. Eggs just on the point of hatching were received about May 1, 1897, from Mr. Percy Baker, and in a few days several hundred healthy fry were set free. These were reared almost without loss until June 18, when the temperature of the water had reached 76 degrees Fahrenheit. The refrigerating plant was not completed until July 7, and then only three of the young survived. One of these was subsequently lost by the displacement of a strainer. The larger of the two is now (Nov. 27) 3⅜ inches long. Liver has been the principal food of these Salmon.

43. Salmo salar sebago *Girard.* LAND-LOCKED SALMON.—This Salmon has been introduced into our waters from Maine, and appears to have become established in several localities. A very fine example was obtained from the South Side Sportsmen's Club of Long Island, but it was injured in transportation and never recovered. In April, 1896, several individuals from Maine were presented by Mr. Eugene G. Blackford. One of these lived in a tank on the salt-water side for nineteen months, and was then frightened by visitors when the water was drawn low for cleaning, and injured itself so badly that it died after a few hours of struggling. The following measurements were obtained from the fresh fish :

Length	24 in.
Middle caudal rays from end of scales	1⅝ in.
Depth	4 in.
Least depth of caudal peduncle	1⅝ in.
Head	4¾ in.
Snout	1¼ in.
Eye	$\frac{11}{16}$ in.
Orbit	¾ in.
Snout to dorsal	9½ in.
Dorsal base	2¾ in.
Longest dorsal ray	2⅜ in.
Last dorsal ray	1¼ in.
Snout to ventral	11¼ in.
Length of ventral	2¼ in.
Snout to anal	16⅜ in.
Anal base	1⅞ in.
Longest anal ray	1⅞ in.
Last anal ray	1⅛ in.
Snout to adipose dorsal	17⅝ in.
Width of adipose dorsal	½ in.
Length of adipose dorsal	¾ in.
Length of pectoral	3¼ in.
Upper jaw	2¼ in.
Maxilla	2 in.

The head has about 28 dark spots, the largest on the gill-cover, oblong, $\frac{5}{8}$ inch long. Body with many large and small black spots, a few with a pale ring around them, and some as large as the largest on the gill-cover; one on the caudal peduncle of one side distincly X-shaped. General color dark bluish gray; belly and lower parts iridescent silvery. Fins all dusky: the dorsal with many black spots. Eye pale lemon, the upper part dusky.

Gill-rakers, 9 + 11, the longest $\frac{5}{16}$ inch. B. 11; D. 10; Scales, 21–123–20.

44. Salmo mykiss *Walbaum.* Black-spotted Trout; Red-throat Trout.—The Lake Tahoe, California, Trout, form *S. mykiss henshawi* (Gill & Jordan), was obtained by Mr. James Annin, Jr., and reared at his establishment. Young individuals were sent by him in November, 1896, and thrived in the Aquarium until the latter part of June, 1897, when they were overcome by the warm water. They would not endure the transfer to salt water.

45. Salmo gairdneri *Richardson.* Steelhead Trout.—From information furnished by Mr. Annin it appears evident that some of the eggs of trout received at Caledonia, N. Y., many years ago from the McLeod River, California, as Rainbows, really included both Rainbows and Steelheads. He finds certain females producing deep salmon-colored eggs, while in the same pond and receiving the same food as other females which furnished very light-colored, almost white, eggs. Some of the females also differ in going to the spawning beds nearly two months in advance of others. It is now known also that the McLeod contains a small-scaled form of the Rainbow, known to the Indians as the No-Shee, and this also may easily have been sent to the East under the name of Rainbow. Striking differences in the appearance and habits of so-called Rainbows introduced into the various States, lend color to this supposition.

The Steelheads now in the Aquarium were obtained in November, 1896, from the U. S. Fish Commission. They were hatched from eggs shipped from Fort Gaston to the Craig Brook station in Maine. The length of the Trout ranged from four to four and one-half inches; they are now ten inches long on the average, and weigh many times as much as they did a year ago. None of them have at any time yet shown a red lateral band such as is present in the Rainbow, and they are further distinguished by the presence of white tips on the ventral and anal fins; the dorsal also has a small white tip. They have been kept almost from their arrival in salt water, and could not have been kept in the warm Croton water in June. The salt water never rose above 71½ degrees Fahrenheit, and continued at this high temperature only ten days.

46. **Salmo irideus** *Gibbons.* RAINBOW TROUT.—Trout of this species have been received from the South Side Sportsmen's Club at Oakdale, Long Island, the New York Hatchery at Cold Spring Harbor, Long Island, and the Caledonia station of the New York Fish Commission. The large fish never stand transportation well when ice is used to cool the water. They frequently injure their eyes so that they become blind soon after the end of the trip. They are inveterate fighters, and the strongest invariably rules the rest. Contrary to what has been stated heretofore, they will not endure high temperatures as well as brook trout.

47. **Salmo fario** *Linnæus.* BROWN TROUT.—This is one of the earliest species of trout to be placed in the Aquarium, and has shown remarkable hardiness in captivity. A large female was received from Mr. E. G. Blackford in April, 1896, and placed in a salt water tank where it remains now (Nov. 27, 1897), and gives every indication of perfect health. During most of the time the fish has been in salt water, but at certain intervals fresh water is substituted for a short time, especially when symptoms of fungus make their appearance. Liver and live Killifish have been used for her food. Last November she excavated a shallow depression in the gravel bottom and deposited a lot of eggs. The species is extremely shy, and never seems to lose its fear of the attendants.

48. **Salmo** (HYBRID = **fario + fontinalis**). HYBRID TROUT. —In a paper published seven years ago the writer stated, as a result of his studies, that when a large-scaled trout is crossed with a small-scaled one, the hybrid will be large-scaled whichever way the cross be made. The hybrid between the Brown Trout and the Brook is a large-scaled form, and it is sterile as

far as reported. The Aquarium has had this hybrid from the South Side Sportsmen's Club, and from the New York Hatcheries at Cold Spring Harbor, Long Island, and Caledonia. It is always a strikingly handsome fish, and grows to a large size; but it is far less hardy than either of its parents. The cross has always been artificially made, and never occurs naturally. Two specimens studied gave the following measurements in inches:

	Caledonia, N.Y. June 10, 1896. Jas. Annin, Jr.	Oakdale, N.Y. Mar. 23, 1897. Geo. P. Slade.
Extreme length	$9\frac{1}{4}$	$14\frac{1}{4}$
Length of middle caudal rays from end of scales	$\frac{3}{4}$	..
Depth of body	$1\frac{7}{8}$	$3\frac{1}{8}$
Least depth of caudal peduncle	$\frac{7}{8}$	..
Length of head	2	$3\frac{1}{4}$
Length of snout	$\frac{1}{2}$	$1\frac{1}{8}$
Length of upper jaw	$1\frac{1}{4}$	..
Length of lower jaw	$1\frac{3}{8}$	..
Diameter of eye	$\frac{5}{16}$	$\frac{7}{16}$
Distance from snout to dorsal origin	$3\frac{3}{4}$	..
Length of dorsal base	$1\frac{3}{16}$	..
Length of longest dorsal ray	$1\frac{5}{16}$	..
Length of last dorsal ray	$\frac{3}{4}$	..
Distance from snout to ventral origin	$4\frac{1}{2}$	..
Length of ventral	$1\frac{1}{8}$	..
Distance from snout to anal origin	6	..
Length of anal base	$\frac{7}{8}$	..
Length of longest anal ray	$1\frac{1}{4}$	..
Length of last anal ray	$\frac{1}{2}$	..

The Caledonian specimen has no hyoid teeth; the vomerines are in a very small patch on the head of the bone only. The gill-rakers are 4 plus 10, the longest about one-half diameter of the eye. It has about 124 tubes in the lateral line. Branchiostegals, 10. The following color-notes were taken from the fresh fish:

Dorsal fin with numerous dark blotches resembling those of young Rainbow. Adipose long and slender, amber color with two obscure dusky blotches, one of these very indistinct. Lower half of sides pink; ventral, anal and caudal pink; ventral and anal with a milk-white front margin, that in the anal limited behind by a dark line as in Brook Trout. Sides reticulated with large meshes of lemon yellow interspersed with darker purplish or olive. Dorsal blotches are mingled with pale lemon. Pectoral pale vermilion. Eye silvery white with yellowish reflections.

The specimen from Oakdale, Long Island, weighed 20 ounces. It has a triangular patch of vomerine teeth, as found in *fontinalis*, but continued behind by several teeth in a single row, the entire length of the vomerine series being seven-sixteenths of an inch.

49. Cristivomer namaycush (*Walbaum*). LAKE TROUT; SALMON TROUT.—The only New York examples of Lake Trout were received from Mr. James Annin, Jr., Caledonia, in the fall of 1896. They lived and grew rapidly until the warm water killed them in June, 1897. They could not endure transfer to salt water of a lower temperature, as so many other Trout will do, and nothing else could be utilized to tide them over until the completion of the refrigerating plant.

Owing to the extensive individual and race variation among Trout referred to this species, it seems desirable here to give some notes and measurements made from individuals obtained from New Hampshire and Vermont. Two Lake Trout weighing about 4¾ pounds each were shipped in a can, only a few inches longer than the fish, from Roxbury, Vermont, on Nov. 17, and after an express journey of 20 hours without an attendant one of them survives in good condition, while the other was nearly dead upon arrival and died within one hour. The latter was a female, and appears to have injured itself severely by jumping in the can; it was not in good condition when it left Vermont. Twelve large Brook Trout shipped with the Lake Trout in two cans arrived without injury; these and the Lake Trout were presented by Mr. John W. Titcomb, Fish and Game Commissioner.

Commissioner N. Wentworth, of Hudson Center, N. H., forwarded the New Hampshire Lake Trout, one from Newfound Lake, the other from Lake Winnepesaukee. They were sent to determine whether the trout of the two lakes, which the fishermen claim are different species, really are distinct. The Commissioner wrote that "The Newfound Trout has darker flesh, more like the Sea Salmon. This is not caused by their food, as both lakes are alive with Smelt. The Winnepesaukee Lake Trout are better biters; tons of them are caught through the ice every winter. The Newfound Trout are hardly ever caught through the ice. A few were caught last winter for the first time to my knowledge. I am sure there is but one variety of Lake Trout in Newfound Lake. We had one in our tanks this fall that would weigh 25 pounds." The only differences to be found upon examination were such as relate to the depths at which the two races habitually live; one is the slim, dark-colored *tuladi*, and the other the common Lake Trout of the Great Lakes region.

It is necessary, however, to call attention to the Lake Trout from Northern Vermont which furnished one of the series of measurements given below. The gill-rakers in that example are few in number and unusually short, four or five on each side being reduced to mere spiny tubercles.

Measurements in Inches.

	Newfound Lake.	Winnepesaukee Lake.	Roxbury, Vt.
	♂	♂	♀
Length, including caudal	24½	27⅛	22
Length to base of middle caudal rays	21	23⅝	19½
Least depth of caudal peduncle	1⅝	1⅞	..
Greatest depth of body	4⅝	6⅜	4½
Thickness of body	2¾	2⅝	2¾
Length of head	5⅝	6½	4¼
Length of snout	1¼	1¾	1⅛
Length of postorbital part of head	3¼	3⅛	2½
Length of upper jaw	2¾	3⅞	2⅜
Length of maxilla	2¼	3	2
Diameter of eye	¾	¾	⅝
Interorbital width	1⅝	2⅜	1⅛
Distance from snout to dorsal	10¾	12⅝	10
Length of dorsal base	2⅝	2½	2⅛
Length of longest dorsal ray	3	2¾	2⅜
Length of last dorsal ray	1½	1⅜	1⅛
From end of dorsal to adipose fin	4½	5	4¼
Length of adipose fin	¾	1	¾
Width of base of adipose fin	⅜	9/16	⅜
Distance from snout to ventral	12¼	14⅜	11⅝
Length of longest ventral ray	2⅝	2⅞	2⅜
Length of last ventral ray	1⅜	1½	..
Length of ventral appendage	¾	⅜	⅝
Distance from snout to anal	16	18⅝	15½
Length of anal base	2	2⅝	1⅞
Length of longest anal ray	2¾	2½	2½
Length of last anal ray	1	1	¾
Length of pectoral	3½	3½	3¼
Length of upper caudal lobe	3¾	3¾	..
Length of lower caudal lobe	3½	3⅞	..
Length of longest gill-raker	7/16	7/16	5/16

In the Newfound Lake fish we have :

B. 11 ; D. 11 ; A. 10 (counting divided rays only) ; V. i, 8 ; P. i, 12 ; scales, 26–195–34 (about 150 tubes) ; gill-rakers, 9 + 13, the longest a little more than one-half length of eye, the one in the angle club-shaped at the tip. It is a male with spermaries moderately small but soft. The body is gray, darker on the back. The outer edge of the pectoral and ventral and the front margin of the anal are white as in *fontinalis*. A white tip to the lower caudal lobe and a very small one at the top of the dorsal. Otherwise the coloration is like that of ordinary lake trout which have the pectoral, ventral and anal chiefly vermilion in the breeding season.

The male from Winnepesaukee Lake has:

B. 12 to 13; D. 10; A. 10; V. i, 8; P. 12; gill-rakers 8 + 12, the longest about one-half as long as the eye The ground color is a little lighter than in the Newfound Lake trout, and the vermilion of the pectorals, ventrals and anal is less intense. The spermaries are larger than in the specimen from Newfound, and in about the same stage of development; the body is considerably stouter.

The female from Roxbury, Vermont, shows the following additional characters:

B. 12; D. 10; A. 10; V. i, 8; gill-rakers, 8+12, the longest exactly one-half as long as the eye. The eggs and ovaries are small as in young females. The pectorals, ventrals and anal are chiefly vermilion as in the male from Newfound Lake. The body is silvery gray with numerous small, whitish spots, these present also upon the dorsal.

50. Salvelinus fontinalis (*Mitchill*). Brook Trout; Speckled Trout.—Brook Trout have been received from New York Fish Commission stations at Caledonia and Cold Spring Harbor, from the private establishment of Jas. Annin, Jr., the preserve at Oakdale, Long Island, of the South Side Sportsmen's Club, the Maine Fish Commission, from Mr. John W. Titcomb, President, Vermont Fish and Game Commission, Mr. E. G. Blackford, New York, and Mr. A. N. Cheney, State Fish Culturist of New York. The only Brook Trout that endured the high temperature (76°) of the Croton water in June, 1897, was one young individual from Caledonia. The Vermont Trout were saved by sending them to Cold Spring Harbor in May.

The food of the Trout in the Aquarium consists almost entirely of chopped hard clams and liver for the young, and hard clams, live killifish, and occasionally earth worms for the larger ones. Their increase in weight has been remarkable; an individual from Caledonia, for example, received in November, 1896, as a fingerling not above 3½ inches long, is now (Dec. 10, 1897) 12¼ inches long, and 3½ inches deep. This species will live indifferently in the fresh and salt water of the Aquarium. When attacked by fungus in fresh water the parasite is easily killed by keeping the fish in salt water, and the Trout is not at all injured or inconvenienced by this treatment if the transfer be made gradually, that is, from fresh to brackish, and finally salt water of the salinity here found (about 1.017). A Trout so treated and cured has practical immunity from fungus attacks thereafter. The Brook Trout is well adapted to domestication in tanks; it soon overcomes its fear of moving objects, takes its food regularly, and is always attractive because of its beauty and its grace of movement.

51. Osmerus mordax (*Mitchill*). SMELT.—The Smelt is found in Gravesend Bay in winter, beginning to run in December, and remaining during cold weather. In the spring it ascends rivers to spawn. The eggs are small and adhesive. The fry are hardy in transportation. In the Aquarium the adults live until about the end of June, when the water becomes too warm and they die. Their food consists mainly of shrimps and other small crustaceans.

52. Umbra limi (*Kirtland*). MUD MINNOW.—A number of Mud Minnows were shipped in wet moss from Caledonia, N. Y., April 10, 1896, by James Annin, Jr., and nearly all were alive at the end of the twelve hours' journey. The species has not proved hardy, either in balanced tanks or in running water, notwithstanding its reputation as a fish that can endure alternate freezing and thawing without permanent injury.

53. Lucius americanus (*Gmelin*). BANDED PICKEREL.—On Dec. 30, 1895, Mr. James Annin, Jr., sent from Rockland, N. Y., a small Pickerel which had attracted his attention on account of its colors and markings. It was taken in a small spring brook, tributary to the Beaverkill, which, about ten or fifteen miles below, unites with the Delaware. Subsequently two examples were forwarded alive from the same place, and one of them is still living in the Aquarium. The following notes and measure ments, in inches, relate to the first individual of undetermined sex, the organs being undeveloped :

Length, including caudal fin	$7\frac{3}{4}$ in.
External caudal lobe (horizontally)	$1\frac{1}{8}$ in.
Middle caudal rays (from end of scales)	$\frac{1}{2}$ in.
Length of head	$1\frac{3}{4}$ in.
Greatest depth of body	$1\frac{1}{8}$ in.
Least depth of caudal peduncle	$\frac{1}{3}$ in.
Length of snout	$\frac{5}{8}$ in.
Length of maxilla	$\frac{11}{16}$ in.
Length of mandible	$1\frac{3}{16}$ in.
Diameter of eye	$\frac{5}{16}$ in.
Distance from snout to dorsal	$5\frac{3}{16}$ in.
Length of dorsal base	$\frac{7}{8}$ in.
Length of longest dorsal ray	$\frac{3}{4}$ in.
From end of dorsal to caudal origin	$\frac{7}{8}$ in.
Distance from snout to pectoral	$1\frac{5}{8}$ in.
Length of pectoral	$\frac{13}{16}$ in.
Distance from snout to ventral	$3\frac{5}{8}$ in.
Length of ventral	$\frac{3}{4}$ in.
Distance from snout to anal	$5\frac{1}{4}$ in.
Length of anal base	$\frac{3}{4}$ in.
Length of longest anal ray	$\frac{11}{16}$ in.
From end of anal base to origin of lower caudal lobe	$\frac{3}{4}$ in.

B. 12; D. 12; A. 11; V. 9; scales, 24–110.

The maxilla reaches to below the middle of the pupil. The mandible projects $\frac{1}{16}$ of an inch when the mouth is closed. The diameter of the eye is contained $5\frac{2}{5}$ times in length of head. The stomach was empty, but insect remains were voided from the vent.

Colors.—About 20 oblique, interrupted, dark bands on the body. A narrow oblique dark band under the eye and four rather large dark blotches on the cheek and opercle. Pectorals, ventrals and anal orange. A tinge of orange on the dorsal and caudal. General color olivaceous gray, with golden reflections; lower parts creamy white. Iris lemon mingled with pale brown. Peritoneum silvery.

All the Pickerels are liable to fungus attacks without apparent cause, but, as a rule, they can be cured by the salt water treatment. Their food consists of small live killifish, which they approach slowly and deliberately until within five or six inches, when they rush, seize, and stop as abruptly as if stopped by an obstruction.

54. **Lucius reticulatus** (*Le Sueur*). Chain Pickerel.—Living Pickerel were sent from Canandaigua Lake by Mr. James Annin, Jr., and small examples were seined in the Bronx. Others were given to the Aquarium by Charles A. Shriner, Chief Game and Fish Protector of New Jersey, and Prof. Ulric Dahlgren of

Princeton University. The Chain Pickerel is always hard to keep in good condition in captivity, but the losses here have been very small owing to the success of the salt water treatment for fungus. The fish spawned in their tank in June, 1897, and young were hatched naturally, but they died when about $\frac{3}{4}$ inch long because they could not be induced to feed. The feeding habits of this Pickerel are the same as stated concerning *L. americanus.*

55. **Lucius lucius** (*Linnæus*). PIKE.—About July 1, 1896, a fresh specimen was sent for identification by Mr. Annin from Silver Lake, Wyoming Co., N. Y. He says the Pike is not found in Canandaigua Lake. Curiously enough, the Aquarium has never yet had a living example.

56. **Lucius lucius immaculatus** (*Garrard*). UNSPOTTED MASCALONGE.—The examples of Unspotted Mascalonge received at the Aquarium were from Chautauqua Lake, N. Y., which belongs to the Ohio River drainage system. It appears that the typical spotted form also inhabits the Ohio basin, but occurs rarely. Mr. Annin sent one individual Dec. 4, 1895, and two on May 4, 1896; from these three were obtained the following notes and measurements in inches:

	Dec. 4, 1895.	May 4, 1896. ♂	May 4, 1896. ♀
Length, including caudal fin	$23\frac{1}{2}$	$27\frac{1}{8}$	$25\frac{7}{8}$
Length to end of scales	..	$23\frac{7}{8}$	23
Length of caudal lobe (horizontally)	$3\frac{5}{8}$	..	.
Length of middle caudal rays	$1\frac{1}{2}$	..	..
Depth of body	$3\frac{5}{8}$	4	$3\frac{7}{8}$
Least depth of caudal peduncle	$1\frac{1}{2}$	$1\frac{3}{4}$	$1\frac{5}{8}$
Length of head	$5\frac{3}{4}$	$6\frac{5}{8}$	$6\frac{1}{8}$
Length of snout	$2\frac{3}{8}$	$2\frac{3}{4}$	$2\frac{1}{2}$
Length of maxilla	$2\frac{1}{2}$	$2\frac{3}{8}$	$2\frac{1}{8}$
Length of mandible	$3\frac{3}{4}$	$4\frac{1}{4}$	$3\frac{3}{4}$
Diameter of eye	$\frac{1}{2}$	$\frac{9}{16}$	$\frac{9}{16}$
Distance from snout to dorsal	..	$18\frac{1}{8}$	$16\frac{3}{4}$
Length of dorsal base	..	$2\frac{3}{4}$	$2\frac{7}{8}$
Length of longest dorsal ray	..	$2\frac{7}{8}$	$2\frac{5}{8}$
Distance from snout to ventral	..	$13\frac{1}{2}$	$12\frac{3}{4}$
Length of ventral	..	$2\frac{1}{2}$	$2\frac{3}{8}$
Length of anal base	..	$2\frac{1}{4}$	$2\frac{5}{16}$
Length of longest anal ray	..	$2\frac{3}{4}$	$2\frac{9}{16}$
Length of pectoral	..	$2\frac{1}{4}$	$2\frac{9}{16}$
Branchiostegals	19	18	19
Dorsal rays (developed)	18	16	17
Anal rays (developed)	16	15	15
Rows of scales	ca. 153	..	..
Gill-rakers	13 + 28	..	..

In all the specimens the maxilla extends to below the front edge of the pupil. The gill-rakers are mere clumps of spiny tubercles. In the two males the diameter of the eye is contained from 4⅓ to 5 times in the length of the snout, and from 10 to 11 times in the length of the head.

In the individual of Dec 4, 1895, the lateral line tubes are distributed over various parts of the sides without much regularity except in the median line. There are no black spots. About twenty entire, blotch-like, irregular cross bands and several parts of bands and blotches intervening. The lower third of the pectoral is pink. The dorsal, caudal and anal with dark blotches making pseudo bands. Iris lemon yellow overlaying silvery white. The general color is olive green with golden tints.

The two males of May 4, 1896, furnished the following color-notes :

> Olive green tinged with golden bronze. Sides with about 23 irregular dusky blotches resembling interrupted bands. Dorsal, caudal and anal with numerous large dusky blotches, those on dorsal and anal almost forming bands. Iris lemon yellow and silvery in the larger ; almost vermilion and orange in smaller. A dark blotch at upper edge of opercle.

The Chautauqua Lake Mascalonge, according to Mr. James Annin, Jr., who sent the specimens, is a very fine food and game fish, and attains to the weight of fifty pounds. In the spring of 1895 it was not unusual to capture individuals weighing from 40 to 50 pounds, and 20 to 30 pounds was a very common weight. In winter the fish frequent nearly the same localities as in summer, being found in the vicinity of water-plants. When the lake becomes very clear in February, they go into deep water, but they live in deep water more or less all the year.

For the fish-cultural operations the nets are set as soon after the first of April as the ice leaves the lake. The fish begin to spawn a few days after and continue until the latter part of April. They go into shallower water for spawning ; most of them spawn in from ten to fifteen feet of water. They do not resort to the gravel like many other fish, but to mud, generally going into bays. The eggs are placed in boxes, all of which are provided with screens at top and bottom. The bottom has an extra screen, to prevent minnows from injuring the eggs. The boxes are sunk from one foot to two feet under the surface of the water. Every day or two they are drawn up, the covers removed, and all bad eggs and sediment cleaned out.

57. **Fundulus majalis** (*Walbaum*). BASS MINNOW; KILLIFISH.—This large Killifish is found all the year in Gravesend Bay. It has proved less vigorous in captivity than all the other marine killifishes. In the winter it is found in deep, muddy holes at the mouths of creeks.

58. **Fundulus heteroclitus** (*Linnæus*). KILLIFISH.—A permanent resident in Gravesend Bay, going into deep, muddy holes near the mouths of creeks in winter. This species forms the principal supply of live food for the larger fishes in the Aquarium.

59. **Fundulus diaphanus** (*Le Sueur*). FRESH-WATER KILLIFISH.—This is usually a most difficult species to keep in health. The individuals now in the gallery were seined in the lake at 110th Street and 5th Avenue, Central Park, in August, 1897. As a rule the fish is attacked and killed by fungus before the salt-water treatment can take effect. Its food is chopped hard clams chiefly. Occasionally it takes liver. It cannot be considered hardy in captivity.

60. **Lucania parva** (*Baird & Girard*). RAINWATER-FISH.—This Killifish is abundant in Peconic, Shinnecock and Great South Bays, and in a fresh-water stream at Water Mill, Long Island. Although small it is always interesting because of its translucent body and its graceful movements; it is hardy and takes chopped clams very freely. The fish does not exceed 1½ inches in length.

61. **Cyprinodon variegatus** *Lacépède*. LEBIAS; SHORT KILLIFISH.—Mr. Spencer has kept a male and two females in a balanced jar nearly two years. They have bred at least once, and the young were reared to a length of ⅝ inch when they disappeared suddenly, and it is probable that they were eaten by the adults. This is one of the best of the Cyprinodonts for aquarium purposes.

62. Tylosurus marinus (*Walbaum*). SILVER GAR; NEEDLE-FISH.—The Silver Gar is to be found in Gravesend Bay from June to September. It never stands transportation, and cannot be kept long in captivity.

63. Eucalia inconstans (*Kirtland*). BROOK STICKLEBACK.—Living examples were obtained from Mr. James Annin, Jr., at Caledonia, N. Y., April 10, 1896. For some unexplained reason it is difficult to keep the fish alive either in balanced or circulating tanks; it does better in the former. One individual of the lot above mentioned is now alive in a balanced tank. It has always been shy, but feeds readily upon hard clams and *Gammarus*.

64. Pygosteus pungitius (*Linnæus*). NINE-SPINED STICKLEBACK.—Less abundant in Gravesend Bay than the following two species. In the Aquarium it is not difficult to keep alive.

65. Gasterosteus bispinosus *Walbaum*. STICKLEBACK.—The adults have been kept in a balanced marine tank many months, and young were obtained and reared to the length of about ½ inch, but they were then eaten by the adults. All of this species were killed by warm water in the summer of 1896.

66. Apeltes quadracus (*Mitchill*). THREE-SPINED STICKLEBACK.—A hardy species in circulating tanks; but none have ever been known to breed in captivity. Their food consists of chopped hard clams, and broken shrimps.

67. Siphostoma fuscum (*Storer*). PIPE-FISH.—The Pipe-fish is moderately common in summer in eelgrass and sea lettuce in Gravesend Bay. It is difficult to find suitable food for it in the Aquarium, and, as a consequence, it is short-lived. The species likes shrimp with eggs and small *Gammarus*. Several examples taken at Sandy Hook, Oct. 8, 1897, are still alive in a slightly circulating tank in the Aquarium, in a temperature of 54° Fahrenheit. They feed well upon *Gammarus*, and seem to be in good condition.

68. Hippocampus hudsonius *De Kay.* SEA-HORSE.—The Sea-horse is sometimes found in large numbers in the nets at Gravesend Bay, but has not been abundant since 1895. It endures captivity for a few months only; individuals have been kept eight months in a 'balanced' tank, where they thrive best. The food consists of *Unciola* and shrimp eggs.

69. Aphredoderus sayanus (*Gilliams*). PIRATE PERCH.—Common in a lake at Patchogue, Long Island, where it has sometimes been mistaken for young Carp. The individuals in the Aquarium were sent by Prof. Ulric Dahlgren from Princeton, N. J., in October, 1897. They have never been observed to feed, and do not look well.

70. Menidia beryllina (*Cope*). FRESH-WATER SILVERSIDE.—This small Silverside, heretofore found only in the Potomac River, is abundant in a little mill stream at Water Mill, Long Island, where the writer seined it, Sept. 14, 1897, in company with *Fundulus diaphanus*, *Lucania parva*, *Eupomotis gibbosus*, and *Lucius reticulatus*. The largest of the individuals are 2⅜ inches long. Owing to high temperature the shipment to New York was unsuccessful, none of the fish having lived in the Aquarium longer than a few days. Following are some of the characters:

D. V, I, 10; A. I, 16–17; scales, 8–40.

71. Menidia notata (*Mitchill*). SILVERSIDE; SPEARING.—This species is found in Gravesend Bay almost all the year, inhabiting spring holes in winter. Individuals brought into the Aquarium in the winter of 1895 are still living (Nov. 28, 1897). They endure the summer temperature, which has sometimes reached 71½ degrees Fahrenheit in the salt-water tanks. They feed here upon hard clams and shrimp.

72. Labidesthes sicculus (*Cope*). BROOK SILVERSIDE; SKIPJACK; GLASS-FISH.—The name Glass-fish is used for the species on Chautauqua Lake. Mr. Annin sent some living examples April 22, 1897, but they were in a very weak condition after the twelve hours' journey by rail, and soon died.

73. Mugil cephalus *Linnæus.* STRIPED MULLET.—The young Mullet are abundant in Gravesend Bay in midsummer;

larger ones appear in September and October. One winter, some years ago, they hibernated in the mud in Sheepshead Bay and were taken with eel-spears. It feeds and thrives most of the year, but cannot survive the heat of summer. Food in the Aquarium consists of hard clam and shrimp.

74. **Mugil curema** *Cuv. & Val.* White Mullet.—This appears with the foregoing, but is less abundant in Gravesend Bay.

75. **Sphyræna borealis** *De Kay.* Barracuda.—Several young individuals were captured in Gravesend Bay in September, 1896. The species is not common in that locality. An individual 5½ inches long was seined at Sandy Hook Oct. 8, 1897; it lived only until Oct. 31, and was never observed to take food. The species never has been successfully reared in the Aquarium.

76. **Polydactylus octonemus** (*Girard*). Threadfin.—On Sept. 24, 1896, three specimens were obtained by Mr. John B. De Nyse in Gravesend Bay and sent to the Aquarium dead, as they would not endure captivity. The fish agrees in coloration and in every other respect with *P. octofilis* Gill, and is believed to be the adult form of *P. octonemus* Girard. This is probably the first record of its occurrence in New York waters for more than thirty years.

Measurements.

Length, including caudal	$8\frac{3}{4}$ in.
Length to end of middle caudal rays	$7\frac{1}{2}$ in.
Length to origin of middle caudal rays	$6\frac{5}{8}$ in.
Greatest depth of body	2 in.
Least depth of caudal peduncle	$\frac{15}{16}$ in.
Length of head	$1\frac{3}{4}$ in.
Length of snout	$\frac{5}{16}$ in.
Diameter of eye	$\frac{5}{16}$ in.
Length of upper jaw	$\frac{3}{4}$ in.
Length of mandible	$\frac{3}{4}$ in.
Length of longest pectoral filament	$2\frac{3}{8}$ in.
Length of upper and lower caudal lobes	$2\frac{1}{4}$ in.
Length of pectoral	$1\frac{1}{2}$ in.
Length of longest (third) dorsal spine	$1\frac{1}{4}$ in.
Length of second dorsal ray	$1\frac{1}{4}$ in.
Length of ventral	$\frac{15}{16}$ in.
Length of longest anal ray	1 in.
Length of anal base	$1\frac{7}{16}$ in.
Length of base of first dorsal	$\frac{3}{4}$ in.
Length of base of second dorsal	$1\frac{1}{8}$ in.

The longest pectoral filament reaches to below the interspace between the two dorsals and slightly past the vent. The diameter of the eye equals the length of the snout and one-fifth the length of the head.

77. **Ammodytes americanus** *De Kay.* SAND LAUNCE; SAND EEL; LANT.—The species appears in Gravesend Bay in July, but is more plentiful in winter. In the Aquarium it will not thrive for want of sand and proper food. It swims continually and soon dies. The fish buries itself in sand and sometimes, when alarmed, will leap four inches above the sand.

78. **Mullus auratus** *Jordan & Gilbert.* RED MULLET; GOAT FISH.—Three individuals of a *Mullus* were captured in a seine at Sandy Hook, N. J., Oct. 8, 1897, and brought alive to the Aquarium, where they are now (Nov. 30, 1897) in good condition and feed freely upon shrimp. As the fish are living it is uncertain whether or not they are *M. auratus;* but they agree in the main with the description of that species. Their endurance of water at a temperature of 50 degrees Fahrenheit is unexpected. *M. auratus* is recorded upon our East Coast from Cape Cod to Florida, but it is rare as a rule in the north. Fishermen at Sandy Hook reported that large numbers were seen there in September and October, 1897.

79. **Scomber scombrus** *Linnæus.* MACKEREL.—Two young, 3¼ to 5½ inches long, were taken in Gravesend Bay, L. I., May 23, 1896, in John B. De Nyse's shad pound. No more were seen, and these were the first for the year. They come about the time of the appearance of Anchovy and Weakfish. They are often seen swimming at the surface of the bay in small bunches of 18 or 20, occasionally 100, in the latter part of May or early in June. They are always split up into small bunches, probably by the attacks of weakfish and other predaceous species which are present at the time. Flukes attack them also in shallow water; flukes are very destructive to young fish. A fluke will often have 8 or 10 little tautogs in its stomach. They frequent the flats for the purpose of feeding on little fishes.

80. Scomber colias *Gmelin.* THIMBLE-EYE MACKEREL; CHUB MACKEREL.—This species was not found in large numbers in Gravesend Bay in 1897, but in 1896 it abounded in all the little creeks, and in some instances the fish could be dipped up by the boat loads with scoop-nets. The fish reached ten inches in length before the end of the summer.

81. Sarda sarda (*Bloch*). BONITO.—The fish is generally scarce in Gravesend Bay. Five were taken in one day in a pound net in October, 1897, an unusual number for that species. The fish will not live in captivity.

82. Trichiurus lepturus *Linnæus.* SCABBARD-FISH.—One young example was caught in John B. De Nyse's pound, Gravesend Bay, in August, 1897. It had been captured by another fish while in the pound, but was rescued in good condition. The species is rarely seen in that bay.

83. Oligoplites saurus (*Bloch & Schneider*). LEATHER JACKET.—An example 9¾ inches long and 2½ inches deep was secured in De Nyse's pound in Gravesend Bay in the summer of 1896. It is rarely seen there.

84. Seriola zonata (*Mitchill*). BANDED PILOT.—The species does not endure close confinement, but thrives in the great pool of the Aquarium. Two examples, taken in September in Gravesend Bay, are living at the end of November, 1897. They feed on small killifish, which they take with a rush much the same as the brook trout.

85. Seriola lalandi *Cuv. & Val.* (?). AMBER-FISH.—A large Amber-fish was captured by Mr. De Nyse in Gravesend Bay, July 15, 1896, and was brought alive to the Aquarium Aug. 8, but it never recovered from the effects of the journey. The large *Seriolas* are too active and shy to stand transportation, and they rarely live in captivity, but a species received from Bermuda early in July, 1897, is alive in the Aquarium (Dec. 10), and still feeds regularly upon pieces of herring and live killifish.

A description and measurements in inches of the Gravesend Bay specimen may help to verify or correct the identification :

Length, including caudal	$33\frac{1}{2}$ in.
Length to end of middle caudal rays	$30\frac{1}{2}$ in.
Length of external caudal lobes from pit	7 in.
Length of middle caudal rays	2 in.
Greatest depth of body	$6\frac{3}{4}$ in.
Least depth of caudal peduncle	$1\frac{1}{8}$ in.
Greatest thickness of body	4 in.
Length of head	8 in.
Length of upper jaw	$3\frac{1}{2}$ in.
Width across end of maxilla	$1\frac{1}{2}$ in.
Length of mandible	$4\frac{1}{8}$ in.
Length of snout	$2\frac{3}{4}$ in.
Diameter of eye	$1\frac{1}{4}$ in.
Diameter of pupil	$\frac{5}{8}$ in.
Distance from snout to vertical from first dorsal origin	$10\frac{1}{4}$ in.
Length of first dorsal base	$3\frac{1}{2}$ in.
Length of first spine	$\frac{5}{8}$ in.
Length of second spine	$1\frac{1}{4}$ in.
Length of third (longest) spine	$1\frac{7}{8}$ in.
Length of seventh spine	$\frac{1}{4}$ in.
Distance from snout to second dorsal (obliquely)	$14\frac{1}{4}$ in.
Length of second dorsal base	$11\frac{3}{4}$ in.
Length of second ray of second dorsal	$3\frac{3}{4}$ in
Length of first ray	$1\frac{7}{8}$ in.
Length of last ray	$1\frac{3}{8}$ in.
Length of pectoral	$3\frac{7}{8}$ in.
Length of ventral	$4\frac{5}{8}$ in.
Distance from ventral origin to anal origin	$10\frac{1}{8}$ in.
Distance from vent to anal origin	2 in.

The jaws are equal. The maxilla reaches to below the middle of the pupil. The pectoral and ventral origins are in the same vertical.

D. VII, 26 ; A. I, 24 ; V. 6 ; P. 21 ; scales, about 24-160-30 ; gill-rakers, 4 + 10, the longest $1\frac{1}{8}$ inches, very thin, much wider at base, and tapering gradually to a small, rounded point, very finely toothed on inner margin.

Teeth in broad, villiform bands in both jaws ; an arrow-shaped patch with long, slender backward process on vomer. Similar bands on palate and pharynx.

The ground color is gray with purplish iridescence. A golden bronze stripe beginning on the snout and continued behind the eye to the caudal in a nearly straight line, slightly above the median line. Another bronze stripe begins above the eye and extends to the first dorsal. In life, two dark bands showed between the eyes and extended to the first dorsal. Sides and lower parts much mingled with silvery white. Iris gray overlaid with golden yellow. Pupil bluish black. All the fins colored like the body except the ventrals, which are whitish underneath, and gray mingled with white above.

The weight of the fish was 13 pounds, $1\frac{1}{2}$ ounces.

86. Elagatis bipinnulatus (*Quoy & Gaimard*). RUNNER.—On Aug. 2, 1895, a fresh dead specimen of the Runner was brought from Mr. De Nyse's pound in Gravesend Bay. This tropical species has once before been recorded from Long Island.

87. **Decapterus punctatus** (*Agassiz*). SCAD; ROUND ROBIN.—The Spotted Scad is not recognized in Gravesend Bay. It was found abundant, Aug. 31, 1897, in the ocean at Southampton, Long Island.

88. **Decapterus macarellus** (*Cuv. & Val.*). MACKEREL SCAD.—The Mackerel Scad has not yet been recorded in Gravesend Bay, but was found common at Southampton, Long Island, in the Atlantic, Aug. 31, 1897, associated with the preceding species and young *Scomber*, *Pomatomus*, *Rhombus*, *Clupea*, *Etrumeus*, *Clupea*, two species of *Stolephorus* and *Paralichthys*.

89. **Trachurops crumenophthalmus** (*Bloch*). BIG-EYED SCAD.—This is taken in the fall in Gravesend Bay. It is another fish that soon dies when closely confined, but will live within suitable ranges of temperature in the large pool. The food is small killifish, chopped clams and shrimp. Found Aug. 31, 1897, in the surf at Southampton, Long Island.

90. **Caranx hippos** (*Linnæus*). YELLOW MACKEREL; CREVALLÉ.—The remarks made concerning the Big-eyed Scad will apply to the two species of Crevallé.

91. **Caranx crysos** (*Mitchill*). CREVALLÉ.—At the end of November, 1897, several Crevallés of this and the preceding species are living and feeding in the large pool. Occasionally they school together under the Sand Shark and follow it about.

92. **Alectis ciliaris** (*Bloch*). THREAD-FISH.—This species is occasional in summer in Gravesend Bay. In the Aquarium it usually lives about three months, dying when the temperature falls much below 60 degrees.

93. **Vomer setipinnis** (*Mitchill*). HORSE-FISH; SHINER.—An example was brought from Gravesend Bay, Oct. 21, 1896. The young, called 'Dollar-fish' here, was brought from the bay Oct. 22, 1896, for examination.

94. Selene vomer (*Linnæus*). MOON-FISH.—On Sept. 8 and 29, 1897, three examples of the Moon-fish were taken in Gravesend Bay. In November these were transferred to a tropical tank, in which the water is kept at a temperature of 68 to 70 degrees Fahrenheit, and they are taking their food regularly.

95. Trachinotus carolinus (*Linnæus*). POMPANO.—The young are summer and fall visitors in Gravesend Bay. Twenty-two individuals were placed in the Aquarium in August, 1897, and thrived until the temperature of the water fell below 60 degrees Fahrenheit, in November, during which month all of them died.

96. Trachinotus falcatus (*Linnæus*). ROUND POMPANO.—The young are occasionally taken in summer in Gravesend Bay. Early in September, 1897, a small individual was placed in the Aquarium and lived more than two months; it died in November on account of the low temperature of the water. As long as the temperature was suitable it fed and grew rapidly.

97. Pomatomus saltatrix (*Linnæus*). BLUEFISH; SNAPPER.—This is usually regarded as a difficult species to keep in the Aquarium. On Oct. 8, 1897, five young were brought from Gravesend Bay and Sandy Hook, and three of them are now living (Nov. 30) and feeding freely.

98. Coryphæna hippurus *Linnæus*. DOLPHIN.—A fine example, 17 inches long and 2¾ inches deep, was brought in from off Sandy Hook late in August, 1897. It was caught by a trolling line while fishing for bluefish, and so badly injured in one of the eyes that it could not be kept alive.

99. Palinurichthys perciformis (*Mitchill*). RUDDER-FISH.—Rare in Gravesend Bay. Some years none are seen, but usually one or two will appear during the summer.

100. Rhombus triacanthus (*Peck*). HARVEST-FISH; BUTTER-FISH.—This is found in Gravesend Bay from April to November. It is not a hardy fish in the Aquarium.

101. Rhombus paru (*Linnæus*). HARVEST-FISH; PAPPY-FISH.—A summer visitor in Gravesend Bay and sometimes rare, but formerly abundant. Not well adapted to Aquarium life.

102. Eupomotis gibbosus (*Linnæus*). SUNFISH.—The common Sunfish abounds in the parks, and living individuals have been received also from Canandaigua Lake, the Adirondack lakes and elsewhere. It is hardy but subject to fungus attacks, which yield readily to treatment with brackish water.

103. Micropterus dolomieu *Lacépède*. SMALL-MOUTHED BLACK BASS.—Fourteen young of the year were received from James Annin, Jr., Caledonia, N. Y., on Oct. 6, 1896. On the approach of cold weather they remained nearly dormant and took almost no food during the winter, but when the spring was advanced they fed eagerly and grew rapidly.

104. Micropterus salmoides (*Lacépède*). LARGE-MOUTHED BLACK BASS.—Three individuals, about 4 inches in length, were received from Mr. Annin, at Caledonia, Oct. 6, 1896. They hibernated and almost always refused food in the winter, but fed ravenously in spring, summer and fall. Young fish from 1½ to 2 inches long were seined in Bronx River in August, and they prove hardy in captivity.

105. Stizostedion vitreum (*Mitchill*). PIKE PERCH; WALL-EYED PIKE; PIKE.—Mr. James Annin, Jr., of Caledonia, sent two individuals, April 23, 1896, for identification. They furnished the following notes and measurements in inches:

	♀	♂
Length, including caudal	18¾	18
Length to end of middle caudal rays	18	17⅛
Depth of body	3½	3½
Least depth of caudal peduncle	1⅛	1¼
Length of head	4¾	4⅜
Length of snout	1¼	1⅛
Diameter of eye	13/16	13/16
Length of maxilla	2	1⅞
Length of mandible	2¾	2½
Dorsal	XIV, I, 21	XIV, I, 20.
Anal	III, 11.	III, 11.
Scales	92	93

The pyloric cœca are long and loaded with fat. The male is brassy; the female gray and whitish.

In November, 1896, and again in the same month of 1897, Mr. Annin had living adult Pike Perch shipped by express from Canandaigua Lake, and a fish was seldom lost in transportation.

106. Perca flavescens (*Mitchill*). Yellow Perch.—The species is abundant in the parks of New York and Brooklyn. It is a fairly good aquarium fish, somewhat susceptible to fungus attacks but easily treated with salt water. Its food is chiefly hard clam ; sometimes live killies are used.

107. Boleosoma olmstedi (*Storer*). Tessellated Darter. —The species was found sparingly in Bronx River in August, 1897. A number of individuals were placed in a balanced tank and are still living at the end of November. They are fed principally on hard clam, *Gammarus*, and, occasionally, earth-worms.

108. Roccus chrysops (*Rafinesque*). White Bass.—Mr. Annin obtained a specimen in Oneida Lake Sept. 4, 1896, and sent it for identification. Its length is 12¼ inches, and its weight 16½ ounces. The following additional measurements in inches were taken :

Length to end of middle caudal rays	11½ in.
Length to end of scales	10 in.
Depth of body	4 in.
Least depth of caudal peduncle	1⅜ in.
Length of head	3 in.
Length of snout	⅝ in.
Diameter of eye	9/16 in.
Length of fourth dorsal spine	1⅜ in.
Length of second dorsal ray	1¾ in.
Length of second anal ray	1¾ in.

109. Roccus lineatus (*Bloch*). Striped Bass; Rockfish. —A permanent resident, but the height of the fishery in Gravesend Bay occurs from Oct. 10 to Nov. 10. Large fish, up to 45 pounds, are caught in May, but the fall fish will range from 9 to 24 inches in length. In the Aquarium the species is hardy and grows rapidly. Its food consists of killifish, pieces of herring, shrimp and, occasionally, chopped clam. Many examples have been kept here 3½ years, and are still alive.

110. Morone americana (*Gmelin*). WHITE PERCH.—This species is never plentiful in Gravesend Bay; it is abundant in fresh-water lakes of Central Park, New York, and Prospect Park, Brooklyn. Near Montauk, Long Island, individuals weighing two to three pounds and more are reported. In the Aquarium the White Perch is very susceptible to fungus attacks, but the parasite is readily killed by changing the water supply from salt to fresh, or *vice versa*.

111. Centropristes striatus (*Linnæus*). SEA BASS.—The Sea Bass makes its appearance in Gravesend Bay in May. It is not abundant. The young in October are found in the eel grass, measuring from 1½ to 2 inches in length. The species is well adapted to life in the tanks during all but the coldest months.

112. Orthopristis chrysopterus (*Linnæus*). PIG-FISH.—Several examples were taken in Gravesend Bay, Oct. 24, 1894.

113. Stenotomus chrysops (*Linnæus*). SCUP; PORGY.—The Scup comes into Gravesend Bay in May, and is taken as late as November. In the Aquarium it lives until December, and in warmed water can be kept indefinitely. It is thrifty, and is seldom out of condition.

114. Lagodon rhomboides (*Linnæus*). SAILOR'S CHOICE.—Not a common fish in Gravesend Bay; it is found occasionally in summer.

115. Archosargus probatocephalus (*Walbaum*).—SHEEPSHEAD.—Very unusual in Gravesend Bay. A large example, weighing 13 pounds, was caught Sept. 16, 1897, at Coney Island, and brought to the Aquarium, but was badly injured and never recovered. The species is well adapted to Aquarium life.

116. Kyphosus sectatrix (*Linnæus*). BERMUDA CHUB.—This rare species was taken in Gravesend Bay in October, 1896, and again in September, 1897. It is hardy in the Aquarium, but cannot endure the winter temperature.

117. Cynoscion regalis (*Bloch & Schneider*). WEAKFISH; SQUETEAGUE.—An adult example, now living in the Aquarium, has been kept in good condition during two winters, and is now in winter quarters in the great central pool. At one time a white membrane covered both eyes, and the fish was supposed to be blind; but its eyes are now (Dec. 11, 1897) in perfect condition.

118. Larimus fasciatus *Holbrook.* BANDED LARIMUS.—An individual was captured in Gravesend Bay July 25, 1895, and another one Aug. 2 of the same year. These fed freely, and were kept in a healthy condition until Jan. 16, 1896, when the low temperature of the water killed them. The fish is not common anywhere, and has not before been recorded north of Chesapeake Bay.

119. Bairdiella chrysura (*Lacépède*). YELLOW-TAIL; SILVER PERCH.—The young of the Silver Perch are found every summer in Gravesend Bay, and adults are to be seen occasionally. On Sept. 8, 1896, Mr. De Nyse took an example 1¼ inches long with a shrimp net in eel grass back of the flats at extreme low tide. Pools containing two feet of water are common here, and many species of fish become imprisoned in them. In August Mr. W. I. De Nyse has captured a half-dozen adult *Hippocampus* in such localities. On Oct. 5, 1896, and again in the fall of 1897, the Silver Perch was obtained in the bay.

120. Sciænops ocellatus (*Linnæus*). RED DRUM; CHANNEL BASS.—A Red Drum, or Spotted Bass, weighing 14 pounds, was obtained by Mr. E. G. Blackford from New Jersey, and was purchased alive for the Aquarium. At the time of writing (Dec. 11, 1897) it is in the central pool, and is, apparently, in perfect health. It swims sometimes immediately under the sand shark. Its food consists of large pieces of herring, which it takes readily.

121. Leiostomus xanthurus *Lacépède.* SPOT; LAFAYETTE.—Rather common in Gravesend Bay from July to as late as December, and is well adapted to captive life. It is most abundant usually in September.

122. **Micropogon undulatus** (*Linnæus*). CROAKER.—A very uncommon species in Gravesend Bay.

123. **Menticirrhus saxatilis** (*Bloch & Schneider*). KINGFISH.—This was formerly abundant in Gravesend Bay, but it seldom makes its appearance there now.

124. **Pogonias cromis** (*Linnæus*). DRUM.—The Drum is an occasional summer visitor in Gravesend Bay. In the fall of 1896, fourteen young individuals, 8 inches long, were brought from there alive to the Aquarium, and lived until Feb. 10, 1897, when the low temperature (38°) overcame them. In the fall of 1897 none were seen in the bay.

125. **Tautogolabrus adspersus** (*Walbaum*). BERGALL; CUNNER.—Found throughout the year. Hardy in the Aquarium. Individuals have been kept three years or longer. The food is chiefly hard clam.

126. **Tautoga onitis** (*Linnæus*). BLACKFISH; TAUTOG.—Found during the entire year. An excellent aquarium fish. Examples now here have been kept longer than three years, and their growth in some cases is remarkable. They are fed upon chopped hard clams, live killifish, shrimp and, occasionally, fiddler-crabs.

127. **Chætodon ocellatus** *Bloch.*—Very rare in Gravesend Bay.

128. **Teuthis hepatus** *Linnæus.* SURGEON; DOCTOR-FISH.—A young individual, about three inches long, was caught in Mr. John B. De Nyse's pound, Oct. 22, 1897. It was injured when captured, and lived only a few days in the Aquarium. The species has not been known before north of Charleston.

129. **Balistes carolinensis** *Gmelin.* TRIGGER-FISH; TURBOT.—An uncommon species in Gravesend Bay, but seen occasionally in the bays opening into the Atlantic.

130. Monacanthus hispidus (*Linnæus*). FILEFISH.—This fish is taken in Gravesend Bay in moderate numbers occasionally in the fall. Individuals have been sent from there in September and November, 1897. Some are now (Dec. 11) living in a tropical tank and feeding freely.

131. Alutera schoepfii (*Walbaum*). ORANGE FILEFISH.—The young are rather common in Gravesend Bay in August, September, October, and sometimes as late as November. Adults are rarely seen. The species will not survive the winter except in warmed water. It feeds freely when the temperature is agreeable.

132. Lactophrys trigonus (*Linnæus*). TRUNK-FISH.—The only individual taken in Gravesend Bay was found in August, 1897; it was three-eighths of an inch long. The fish lived a very short time in a balanced jar, although it appeared to feed freely upon minced hard clam. It is seen oftener in Vineyard Sound and neighboring waters in the summer.

133. Lagocephalus lævigatus (*Linnæus*). RABBIT-FISH; SMOOTH PUFFER.—Occasionally taken in the fall in Gravesend Bay. Five young were obtained in October, 1897, but all of them died in November, notwithstanding that they had been taking food readily. The temperature could not be endured.

134. Spheroides maculatus (*Bloch & Schneider*). PUFFER; SWELL-FISH.—The species is found in Gravesend Bay at all times except the cold months. It is hardy, but cannot be kept with other fish because of its predatory habits.

135. Chilomyterus schoepfii (*Walbaum*). SPINY BOXFISH; BURRFISH.—The species is found occasionally in small numbers from May to October in Gravesend Bay, but no very small ones are seen. It lives in the Aquarium in winter only in water heated to a temperature of 68 to 70 degrees Fahrenheit.

136. Acanthocottus æneus (*Mitchill*). MITCHILL'S SCULPIN.—This little Sculpin spawns in winter. The eggs have a beautiful green color. The fish is practically a permanent resident of Gravesend Bay.

137. **Acanthocottus octodecimspinosus** (*Mitchill*). SCULPIN; HACKLEHEAD.—Taken only in winter and early spring in Gravesend Bay. It will not live in the warm water of summer in the Aquarium.

138. **Hemitripterus americanus** (*Gmelin*). SEA RAVEN.—The Sea Raven spawns in November. The eggs are amber or yellow.

The eggs of *Hemitripterus* in the Aquarium, Nov. 29, 1897, are in masses sticking tightly together. The egg is $\frac{5}{32}$ inch in diameter, and showing the form of the fish distinctly. The color of the egg is pale salmon, but is brighter when just deposited.

139. **Cyclopterus lumpus** *Linnæus*. LUMPFISH.—Found in Gravesend Bay in May. It never lives in the Aquarium longer than a few weeks.

140. **Rissola marginata** (*De Kay*). SLIPPERY DICK.—A rare fish in Gravesend Bay. A specimen was obtained there Oct. 24, 1894.

141. **Gobiosoma bosci** *Lacépède*. GOBY.—Taken in the oyster dredge at Eaton's Neck, Long Island, in the fall of 1896. The fish lived all winter in a balanced tank, and took food greedily; but on the approach of summer all perished. It seizes its food with a snap, and immediately rushes off to conceal itself in a rock crevice or behind plants.

142. **Astroscopus guttatus** *Abbott*. STAR-GAZER.—An example was caught in Gravesend Bay Oct. 24, 1894. It did not live longer than a month in captivity, and was killed by the cold water.

143. **Opsanus tau** (*Linnæus*). TOADFISH.—Not present in the hot summer months in Gravesend Bay, but can be kept in the Aquarium by careful treatment. Most of the individuals brought from there to the Aquarium have come in August, September and October.

144. **Pholis gunnellus** (*Linnæus*). ROCK-EEL; BUTTERFISH.—Taken in the oyster dredge at Eaton's Neck in the fall of

1896, and brought alive to the Aquarium. It did not live long in captivity.

145. Zoarces auguillaris (*Peck*). MUTTON-FISH; EEL-POUT.—Found in fall and winter on the fishing-banks. It never endures the warm water in summer.

146. Prionotus carolinus (*Linnæus*). SEA ROBIN.—This species appears in Gravesend Bay in May, and is caught in the shad fykes. It is the earliest of the Sea Robins to arrive.

147. Prionotus strigatus *Cuv. & Val.* RED-WINGED SEA ROBIN.—Makes its appearance later than *P. carolinus.*

148. Prionotus evolans (*Linnæus*). STRIPED SEA ROBIN.—This arrives in Gravesend Bay later than *P. carolinus.*

149. Cephalacanthus volitans (*Linnæus*). FLYING GURNARD.—An uncommon fish in Gravesend Bay. An example sent from there Oct. 30, 1897, lived only two days.

150. Echeneis naucrates *Linnæus.* REMORA; SUCKING-FISH.—The Remora is found in Gravesend Bay in summer only, attached to sharks, usually the sand shark, *Carcharias littoralis.* An example obtained July 28, 1897, lived and fed until Nov. 13, when it ceased feeding, and on Nov. 23 it died because of the low temperature of the water. In the Aquarium the fish is usually stationary on the bottom, but will often rise to the surface to take pieces of fish or clam.

151. Merluccius bilinearis (*Mitchill*). WHITING.—Found in Gravesend Bay in spring and fall A poor fish for the Aquarium. One individual lived in a large pool two months.

152. Pollachius virens (*Linnæus*). POLLACK.—The Pollack appears in the fall. It prefers cool water, and will not endure the summer temperature. It is a ravenous feeder.

153. Microgadus tomcod (*Walbaum*). TOMCOD.—A fall and winter species that does not live in captivity in summer.

154. Gadus morrhua *Linnæus.* COD.—The Cod is abundant in Gravesend Bay in November, 1897, and thrives in the tanks during the winter and spring, but cannot be kept later than June without refrigeration of the water.

155. Melanogrammus æglefinus (*Linnæus*). HADDOCK. —This species is not at all adapted to aquarium life.

156. Lota maculosa (*Le Sueur*). BURBOT; LING; LAWYER.—Perhaps one of the most difficult of the fresh-water fishes to transport. It is easily overcome by fungus. An individual obtained by Mr. Annin in Canandaigua Lake in November, 1897, is now alive, but may not recover from the effects of the journey.

157. Phycis regius (*Walbaum*). SPOTTED CODLING.—This fish is found in small numbers in Gravesend Bay in the fall. It lives in water below 60 degrees Fahrenheit, and is a good aquarium species, but cannot be kept in summer without artificial cold. Its habit of lying upon the side in imitation of the tautog, and other Labroids, is often observed here.

158. Phycis tenuis (*Mitchill*). HAKE.—As a rule, the common Hake does not live in water above 60 degrees Fahrenheit, but one example survived during last summer, and is now in plump condition. In the hot weather it was emaciated, and suffered greatly from attacks of fungus.

159. Phycis chuss (*Walbaum*). SQUIRREL HAKE.—Found only occasionally in Gravesend Bay; it lives in the deeper water off shore.

160. Paralichthys dentatus (*Linnæus*). FLUKE; FLOUNDER. —A summer visitor in Gravesend Bay, arriving in May or June, and leaving when cold weather sets in. It does not live in the Aquarium in winter.

161. Bothus maculatus (*Mitchill*). SPOTTED FLOUNDER.—The Spotted Flounder, or Window Pane, is not adapted to aquarium life; it delights in cold water.

162. Pseudopleuronectes americanus (*Walbaum*). FLAT-FISH.— A permanent resident, and a good aquarium fish. Individuals have lived two years or longer in captivity, and their growth has been remarkable.

163. Achirus fasciatus *Lacépède*. AMERICAN SOLE; HOG CHOKER.— This species has been brought from Gravesend Bay every month, except the first four, of the year. It is a hardy and interesting animal for the Aquarium. Its habit of clinging to the glass is remarkable.

164. Lophius piscatorius *Linnæus*. ANGLER; GOOSEFISH.— The Angler is moderately abundant on the fishing banks, and small ones are sometimes taken in Gravesend Bay. It has never lived in the Aquarium in summer, and no individual has survived longer than four months at any season. The species seems to need sand, which cannot be provided for it in our tanks.

165. Pterophryne histrio (*Linnæus*). MOUSE-FISH.— An individual caught off the Long Island shore in August, 1897, was brought to the Aquarium in a dying condition. It is not uncommon in the floating masses of gulf weed in the Gulf Stream.

As a supplement to the notes upon the fishes of the State, collected for exhibition and identification, a record of the shipments of living fish and occasional species intended for study only by W. I. De Nyse and John I. De Nyse from Gravesend Bay during 1895, 1896, and all of 1897, except December, is here given. This is not based upon exhaustive collections systematically made throughout the year, but upon the captures made in the pounds and fykes of John B. De Nyse, and in the small nets employed by the brothers for obtaining fish food, young fish and other marine animals for the Aquarium. The number of species included in the list is 87, which is far from the total of forms known to occur in that bay. Mr. De Nyse intended to include chiefly the species that were delivered alive at the Aquarium, and purposely omitted some species forwarded for examination dead. The statement is the only one now available for publication, and it will be found very useful as the beginning of a systematic record of the fish faunal conditions.

W. I. DE NYSE'S RECORD OF SHIPMENTS OF FISH FROM GRAVESEND BAY, LONG ISLAND, TO THE NEW YORK AQUARIUM, 1895–97, SHOWING THE MONTHS WHEN THE SPECIES WERE CAUGHT.[1]

	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Petromyzon marinus			X	XX		X						
Mustelus canis								XX	XX	XX		
Sphyrna zygæna								X	X			
Carcharias littoralis						X	X		X	X		
Squalis acanthias										XX		
Raia erinacea			eggs X								X	
Raia lævis										XX		
Acipenser sturio				X	X						X	X
Acipenser brevirostris					X							
Anguilla chrysypa			X			X	X					X
Leptocephalus conger												X
Elops saurus										X		
Clupea harengus	X							XX	XX	XX	XX	X
Pomolobus					XX	XX	XX	XX	XX	XX	XX	
Alosa sapidissima										X	X	
Brevoortia tyrannus							X	XX	XX	XX		
Osmerus mordax	X			X								X
Fundulus majalis	XXX	XXX	XXX	XX	XX	XX	XXX	XX	XX	XX	XXX	XX
Fundulus heteroclitus	XXX	XXX	XXX	XX	XX	XX	XXX	XX	XX	XX	XXX	XX
Cyprinodon variegatus	XXX	XXX	XXX	XX	XX	XX	XXX	XX	XX	XX	XXX	XX
Pygosteus pungitius												X
Gasterosteus bispinosus	X–X	X			X							
Apeltes quadracus	X–X	X										
Siphostoma fuscum							X			X		
Hippocampus hudsonius		X		X				X		X		
Menidia notata			X								X	X
Mugil cephalus										X–X		
Sphyræna borealis									X			
Polydactylus octonemus									X			
Ammodytes americanus					X							
Scomber scombrus					X							
Sarda sarda									X			
Seriola zonata									X–X			
Seriola lalandi (?)								X				
Elagatis bipinnulatus								X				
Trachurops crumenophthalmus									X	X		
Caranx hippos									XXX	X–X		
Caranx crysos									XXX	X–X		
Alectis ciliaris									XX			
Vomer setipinnis								X	X	X		
Selene vomer									X	X		
Trachinotus carolinus								X	X	XX		

Trachinotus rhomboides									x			
Pomatomus saltatrix									x	x		
Coryphæna hippurus									x			
Palinurichthys perciformis								x				
Rhombus triacanthus					x				x	xx		
Roccus lineatus				x		x			x-x		xx	x
Morone americana	x			x						xx	x	xx
Centropristes striatus				x	xx	x	x-x	x	xxx	x	x	x
Stenotomus chrysops				x	x-x	x		xx	xxx	x	xx	
Archosargus probatocephalus									x			
Kyphosus sectatrix									x	x		
Cynoscion regalis						x			x	xx	x	
Larimus fasciatus								x				
Bairdiella chrysura									xx	x	x	
Leiostomus xanthurus							x		xxx	xx	xx	x
Menticirrhus saxatilis					x			x		x		
Pogonias cromis					x					x	x	x
Tautogolabrus adspersus							x		x			
Tautoga onitis				xx	x		x	xx	x-x			x
Teuthis hepatus										x		
Balistes carolinensis									x			
Monacanthus hispidus									x		x	
Alutera schoepffi								xx	xx	xx	x	
Lactophrys trigonus								x				
Lagocephalus levigatus									x	x		
Spheroides maculatus					x-x		x	xx	x-x	x	x	
Chilomycterus schoepffi							x	xx		xx	x	
Acanthocottus æneus	x			xx	x				x		x	xx
Acanthocottus 18-spinosus				x							x	x
Hemitripterus americanus				x	xxx					xx	xx	xx
Cyclopterus lumpus				x	x							
Opsanus tau		x	x					xx	xx	xx		x
Prionotus carolinus					xxx	x		x	x	x-x		
Prionotus strigatus					xxx	x		x	x	x-x		
Cephalacanthus volitans										x-x		
Echeneis naucrates							x	x				
Merluccius bilinearis										x		
Microgadus tomcod	x		xx	xx	xx					x	x	xx
Gadus morrhua										xx	x	
Phycis regius										xx		x
Phycis tenuis				x	xx					x	x	xx
Phycis chuss										x		
Pseudopleuronectes americanus	x			x			x		x-x		x	x
Achirus fasciatus					x	x	x		x	x	x	x
Lophius piscatorius										x		

[1] The three xxx indicate that the species was sent in 1895, 1896, and 1897; two xx placed to the right of the column indicate the years 1896 and 1897, to the left, 1895 and 1896; two xx with a dash between (thus x-x) indicate not received in 1896.

INDEX TO VOLUME IX.

[The names of new genera, species and subspecies, are printed in heavy-faced type.]