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

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

The present volume is the thirty-fourth of this series.

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

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

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

Richard Rathbun,
Assistant Secretary, Smithsonian Institution,
In charge of the United States National Museum.

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SCHIZOPOD CRUSTACEANS IN THE U. S. NATIONAL MUSEUM: SCHIZOPODS FROM ALASKA.

By Arnold E. Ortmann,

The present paper treats of a collection of Schizopods made during the investigations by the Alaska Salmon Commission in 1903. The collection, although small, contains a number of interesting forms. One of them represents a new genus the systematic position of which was ascertained with difficulty, and to which finally a position could be assigned only by altering the definition of one of the established subfamilies of the family Mysidae.

The paper was originally to be published by the Bureau of Fisheries, but was turned over to the U. S. National Museum, and it forms here the second instalment of a series of publications intended to describe the Schizopods of the national collections.

Order MYSIDACEA Boas.

Family LOPHOGASTRIDE G. O. Sars.

Genus GNATHOPHAUSIA Willemoes-Suhm.

GNATHOPHAUSIA GIGAS Willemoes-Suhm.


Station No. 4267.—1 male (?), jun.—Off Sitka Sound, 922 fathoms. (Color, dark crimson).

Previous records.—Atlantic: West of Azores, 2,200 fathoms (Challenger); between Cape Charles and Long Island, 852 fathoms (Albatross); Pacific: Hawaiian Islands, 856–767 fathoms; Bering Sea, 399 fathoms; between Unalaska and Kadiak, 695 fathoms; between Sitka and Columbia River, 876 fathoms (Albatross).


Proc. N. M. vol. xxxiv—08—1
The present specimen agrees well with the one mentioned by the writer among the Hawaiian Schizopods. Its length (difficult to measure, since the specimen is doubled up) is about 55 mm. It differs from the typical (adult) Gnathophanais gigas in the stronger development of the branchiostegal, infero-lateral, and postero-dorsal spines; the branchiostegal spines are even stronger than in the Hawaiian specimen. Besides, the supraocular is distinctly larger than the antennal. The outer margin of the antennal scale has five distinct teeth, while the type has only four, and the Hawaiian specimen has also four, of which the last one is very small. The rostrum is longer than in the Hawaiian individual; in the present specimen the part in front of the ocular spines is distinctly longer than the rest of the carapace, including the posterior spine, while in the one from Hawaii it is about as long as the rest of the carapace without the posterior spine. All these minor differences apparently are due to age.

Family MYSID. E Dana.

Subfamily LEPTOMYSINAE Norman, 1892.

The division of the family Mysidae into subfamilies seems quite necessary on account of the large number of genera of various type contained in it. The subfamilies created by Norman are chiefly framed with reference to the British forms, and thus it is sometimes hard to assign foreign genera and species to their proper place.

According to Norman, the following features are characteristic for this subfamily:

Outer uropods one-jointed, their outer margin setose. Gnathopods (= second maxillipeds or second cormopods) conforming in general character of the endopodite to the maxillipeds (= first maxillipeds or first cormopods). First true legs (= third cormopods) similar to the following in general character, and not very greatly developed and larger than the latter. Male with all pleopods greatly developed and adapted for swimming, second to fifth pair biramous, all branches multiarticulate and setose, the outer branch of fourth, and sometimes also of third modified for sexual purposes, but the modification only extending to a slight lengthening of the limb and a change in the character of the sete of the terminal joint.

This diagnosis does not exactly apply to some forms, not treated by Norman, which clearly ought to be placed here, while it apparently fits others, which are more widely different in other characters.

Borromysis G. O. Sars, for instance, although answering fairly well to the above diagnosis, differs at once in the presence of seven

---

pairs of marsupial lamellae, and should be placed in a distinct subfamily.

The genera *Amblyops* G. O. Sars\(^a\) and *Pseudomma* G. O. Sars\(^b\) probably belong in this subfamily, but differ from all other genera in the rudimentary condition of the eyes, which are lamelliform. The male pleopods are here very uniform in shape, the first with the inner branch rudimentary, the four others with subequal branches. The telson resembles rather that of the typical *Leptomysis*, being not cleft.

The genera *Erythrops*, *Parerythrops*, and *Enachatomera* seem to form a natural group, differing from the typical *Leptomysis* in the shape of the telson, which always is remarkably short, and mostly has no lateral spines. In this group the male pleopods, as in the *Amblyops* group, are also very uniform, the second to fifth having subequal branches.

Of the other genera, *Leptomysis*, *Mysidopsis*, *Mysidecis*, and the new genus *Holmesiella* described herein, again form a natural group, characterized by a peculiar development of the male pleopods, which are not so uniform as in the genera mentioned above; in the fourth pair one of the branches develops the tendency to become longer than the other, bearing at the same time a peculiar armature at the apex. The telson in all these forms is distinctly longer than in the *Erythrops* group, and invariably possesses marginal spines. This group, which may be called the typical one of the *Leptomysis*ae, since it conforms best to the original diagnosis of the subfamily, forms a transition to the subfamily *Mysinae*; in fact, the latter differs only in a greater accentuation of the differentiation of the male pleopods, not only the first pair, but also the second, and generally also the fifth showing distinct reductions, bearing only one ramus as in the female. Sometimes this reduction even affects the third pair. The difference of the two branches of the fourth pair has become very strongly pronounced in the *Mysinae*, one branch being rudimentary, the other greatly developed.

The genus *Callomysis* Holmes\(^c\) differs from all other genera in the subfamily *Leptomysisinae* in the shape of the pleopods of both, male and female. Here, according to Holmes' account, the pleopods of the female are rudimentary, but biramous, while they are uniramous in all other genera; and also the male pleopods are small and rudimentary, although all distinctly biramous; and further, differing from all other genera, here it is the *third* pair in the male, in which the outer ramus is elongated, much after the style in certain *Mysinae*.

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\(^a\) Monogr. Mysid., II, 1872, p. 3.
\(^b\) Idem, I, 1870, p. 48.
If we want to include Callomysis as well as the Amblyops and Erythrops groups into this subfamily, we are to alter slightly the above diagnosis of the Leptomysinae as given by Norman, and put it the following way:

Subfamily: Leptomysinae.

Outer uropods one-jointed, their outer margin setose. Gnathopods (second cormopods) conforming in general character of the endopodite to the maxillipeds (first cormopods). First true legs (third cormopods) similar to the following in general character, and not very greatly developed and longer than the latter. Male with all the pleopods well developed, and adapted for swimming; second to fifth pair biramous, and never resembling those of the female. Sometimes one of the branches of the fourth (rarely the third) pair modified for sexual purposes, in being slightly lengthened and possessing peculiar seta on the terminal joints.

The following key of the genera of Leptomysinae mentioned above may be convenient for their identification. No complete revision of the subfamily is intended.

KEY TO GENERA.

a'. Eyes rudimentary, lamelliform. Male pleopods very uniform, the first with inner branch rudimentary, the second to fifth with two subequal branches.  
\[ Amblyops \text{ Sars and } Pseudomma \text{ Sars.} \]

a'''. Eyes not lamelliform, more or less globular.

b'. Telson short, sometimes hardly longer than wide, always much less than twice as long as wide. Outer margin not spinous (or rarely so, in Euchatontoma). Apex not cleft. Male pleopods very uniform, the second to fifth with two subequal branches.  
\[ Erythrops \text{ Sars,}^a \text{ Pererythrops Sars,}^b \text{ Euchatontoma Sars,}^c \]

b'''. Telson longer, generally at least twice as long as wide. Outer margin always spinous. Apex entire or cleft. Male pleopods less uniform; one branch of third or fourth pair generally longer than the other (the prolongation sometimes only caused by the presence of a terminal spine).

c'. Pleopods of female rudimentary, simple. Outer or inner branch of fourth pleopods of male with tendency to become lengthened.

d'. Outer margin of antennal scale setose, without distal spine. Outer branch of fourth pleopods of male with tendency to become lengthened, its terminal joints only slowly increasing in length, if at all.

c''. Telson elongated, linguiform, apex pointed or rounded, not cleft. Three last joints of outer branch of fourth pleopods of male without seta, but with three strong spines. Antennal scale very long, narrow, pointed.  
\[ Leptomysis \text{ Sars,}^d \]

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\text{a Sars, Monogr. Mysid., I, 1870, p. 11; Norman, in Ann. Nat. Hist. (6), X, 1892, p. 150.}

\text{b Sars, Idem, p. 40.}


Schizopods from Alaska—Ortmann.

c. Telson more or less triangular, apex truncate or eleft. Terminal joint of outer branch of fourth pleopod of male with a single stout terminal spine. Antennal scale lanceolate or ovate.

d. Outer branch of fourth pleopod of male projecting only with the terminal spine beyond inner branch; distal joints not at all increasing in length. Telson triangular, apex truncate or eleft.

Mysidopsis Sars. a

e. Outer branch of fourth pleopod of male distinctly projecting beyond the inner, distal joints slowly increasing in length. Telson triangular, apex with a short cleft. Mysidopsis Sars. b

f. Outer margin of antennal scale not setose, ending in a spine near the distal end. Terminal joints of inner branch of fourth pleopod of male increasing in length, especially the last one greatly elongate, and bearing a spine at its end. Telson elongate-triangular, apex truncate, not cleft. Holmesiella, new genus.

g. Pleopods of female biramous, although rudimentary. Outer branch of third pleopod of male much elongated. Outer margin of antennal scale not setose, with terminal spine. Telson subrectangular, 2-3 times as long as wide, outer margin spinous, spines remote proximally, but more close set distally; apex slightly emarginated, emargination spinous.

Callomysis Holmes. c

Genus HOLMESIELLA Ortmann, new genus. d

Diagnosis.—A genus of Mysidae, belonging to the subfamily Leptomysinæ. Body of the usual form. Eyes large. Third joint of peduncle of antennule in the male with a strong conical process on the lower side of the distal extremity. Legs slightly setose, with the propodite triarticulate, dactylopodite short, with a long, curved, terminal spine. Marsupial pouch of female consisting of three pairs of leaflets, the anterior small. Pleopods of female all rudimentary, short and simple. Pleopods of the male all biramous, but in the first pair the inner branch is short and simple; in the second, third, and fifth pair both branches are well developed, of about the same length, and multiarticulate; in the fourth pair it is the inner branch that is much elongated, about twice as long as the outer. The terminal joints increase in length, and especially the last one is much elongated, almost three times as long as the penultimate, and carries at the distal extremity a long and strong spine. The three last joints do not possess any setæ. Telson elongated, triangular, apex truncated, margins spinulose. Uropods narrow; otolith well developed.

d Named in honor of Prof. S. J. Holmes, in recognition of his work on Pacific Crustaceans.
The chief character of this genus is furnished by the development of the fourth pair of pleopods of the male (Plate I, fig. 11). Here it is the inner ramus (i.e., the one that carries a lobe-like process at the base) which is elongated beyond the outer one, while in all other genera with a tendency to increase the length of a branch of this appendage, it is always the outer branch that surpasses the inner. In shape, this elongated inner branch resembles to a degree that of the outer branch of Mysidopsis and Mysideis, being somewhat an exaggeration of the structure found in these two genera.

In the form of the antennal scale (Plate I, fig. 2) Holmesicella differs from all related genera (Leptomysis, Mysidopsis, Mysideis), and rather recalls Callomysis, or the genera of the Erythrops group. The shape of the telson does not differ much from the types known among the typical group of the Leptomysinæ. In all other respects, it possesses nothing that varies considerably from the characters assigned to the subfamily Leptomysinæ.

*Type of the genus.*—Holmesicella anomala.

**HOLMESIELLA ANOMALA** Ortmann, new species.

Plate I, figs. 1–13.

**Station No. 4192.**—12 young (male and female) (cotypes).—Gulf of Georgia, off Nanaimo, Vancouver Island, 89–97 fathoms.

**Station No. 4251.**—5 female adults (cotypes).—Stephens Passage, south of Juneau, 198 fathoms.

**Station No. 4257.**—1 male adult, type Cat. No. 31494, U.S.N.M.— Vicinity of Funter Bay, Lynn Canal (north of Juneau), 350 fathoms (estimated).

**Station No. 4264.**—2 female adults, cotypes Cat. No. 31492, U.S.N.M.—Off Freshwater Bay, Chatham Strait, south of Juneau, 293–282 fathoms.

**Description of adult male.**—Total length of largest specimen (type, from Station No. 4257), 37 mm. Body slender, but strong. Carapace with the frontal part projecting, not pointed, but broadly rounded. Eyes comparatively large, cornea globular, dark brown. Antennulae (Plate I, fig. 1).—Projecting beyond the eyes with the terminal joint of the peduncle; first joint subcylindrical, second joint very short, terminal joint swollen, thicker than the two preceding ones, about as long as thick, with the usual conical process at the distal end on the under side.

**Antennæ** (Plate I, fig. 2).—With the peduncle shorter than that of the antennulae. Antennal scale large, projecting far beyond the peduncle of the antennula, lanceolate, margins almost parallel in the middle part; outer margin almost straight, without setæ, terminating in a strong spine a short distance from the tip. Tip and inner margin setose.
True legs (Plate I, fig. 8) slender, sparsely setose. Propodite three-jointed; dactylopodite short, with a long curved terminal spine. Abdomen long and slender. Abdominal appendages greatly differentiated, but all biramous. First pair of pleopods (Plate I, fig. 9) with outer branch well developed and multiarticulate; inner branch short, about half as long as outer, uniarticulate, with a blunt process near base. Second and third pair (Plate I, fig. 10) with both branches nearly alike and multiarticulate, the inner one hardly longer than the outer, bearing a blunt process at the base. Fourth pair of pleopods (Plate I, fig. 11) with outer branches similar to that of the first, second, and third pair, but inner branch (bearing a blunt process at base) much elongated, about twice as long as outer. This is due chiefly to the lengthening of the three distal joints, of which the first two increase only slightly, while the last one is considerably longer than these two together. All three terminal joints are destitute of setae, but the last one bears at its end a long and stout spine. The fifth pair of pleopods is similar to the second and third.

In young males the pleopods are not so strongly developed; in the second, third, and fifth the inner branch is distinctly longer than the outer (two or three joints projecting beyond the tip of the outer), and the inner branch of the fourth is not so greatly elongated, although the remarkable increase in length of the distal joints is distinctly indicated.

Uropods (Plate I, fig. 13) well developed, with well developed otolith; both branches longer than the telson, but the outer one much longer than the inner. Margins setose. Inner margin of the inner branch with a row of seven spines near the otolith, of which the distal one is remote from the rest.

Telson (Plate I, fig. 13) elongate-triangular; margins straight, with 16–18 spines along the greater distal part of the margins; the spines increase slowly toward the end, the last one on each side being twice as long as the one preceding it. Between the two long spines forming the outer corners of the telson the apex is truncated and carries 4 spines, the two outer ones short and stout, the inner ones very long and setiform.

The largest female represented in the collection (Station No. 4264) measures 40 mm. The conical process of the antennule is lacking in the female. The marsupium consists of three pairs of leaflets, of which the first pair is quite small. The pleopods (Plate I, fig. 12) are all uniform, being simple and of the usual shape in the family, increasing slightly in length from the first to the last.
Subfamily MYSINAE Norman.

*Diagnosis.*—Outer uropods one-jointed, their outer margin setose. Gnathopods (2. Cormopods) conforming in general character of endopodite to the maxillipeds (1. Cormopods). First true legs (3. Cormopods) similar to the following in general character. Male with first, second, and fifth (exception. *Hemimysis*) pleopods as in female; the third consists of a basal joint and two branches, rarely it is also simple; the fourth consists of a basal joint and two branches, the inner minute, the outer styliform and generally of great length.

*Genera.*—*Hemimysis* Sars; *Dimnysis* Czerniavsky; *Neomysis* Czerniavsky; *Macropsis* Sars; *Mysis* Latreille; *Schistomysis* Norman; *Macromysis* A. White.

Genus NEOMYSIS Czerniavsky 1882.

*Diagnosis* (according to Norman).—Antennal scale subulate, very long and narrow, six to ten times as long as broad (running out into an acute, spine-like termination), ciliated on both margins. Labrum acutely pointed in front. Legs with multiarticulate tarsus (propodite), posterior pairs more strongly built than the anterior, and with more articulations in tarsus. Telson subtriangular, elongated, apex entire, pointed, margins spined (the spines subequal, no smaller spines alternating with larger c). In the male the third as well as the first, second, and fifth pleopods are simple, and resemble the same organs in female; fourth pleopod with a short peduncle, not much longer than broad, inner branch as usual in Mysinæ, outer branch consisting of only two articulations, the first very long, the second rather short; from its end spring two subequal, spiniform, ciliated filaments of no great length.

*Type.*—*Mysis vulgaris* J. V. Thompson.

NEOMYSIS KADIAKENSIS Ortmann, new species.

*Station No. 472*.—1 male, 2 females.—Afognak Bay, Afognak Island, Kadiak Group, 17 to 12 fathoms.

Body slender; total length of largest individual (female), 21 mm. Frontal margin slightly produced, bluntly triangular (corresponding closely to that of *N. vulgaris*, as figured by Sars.) Eyes, antennæ, and antennæ similar to those of *N. vulgaris*, but antennal scale more slender, 13–14 times as long as wide (9–10 times as long as wide.

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b Norman, Idem, p. 261.

c This sentence is to be dropped on account of *Neomysis americana* (Smith).

d Monogr. Mysid., Ill, 1879, pl. xxxiv, fig. 1.
wide in *N. vulgaris*). Propodites of legs with 9 to 12 joints, i.e., the third cormopod (first true leg) has 9 joints, the fourth and fifth have 11 joints, the sixth, seventh, and eighth have 12 joints; for the rest, the true legs resemble those of *N. vulgaris*. Telson elongate-triangular, about three times as long as broad at the base, margins with 20 to 23 spines, occupying a little more than the distal two-thirds of the margin, the proximal part being unarmed. These spines are rather uniform in size, increasing slightly and uniformly toward the tip, being very crowded near the tip, while near the proximal part of the margin they are slightly more distant from each other. Spines at the corners of the narrowly truncated apex resembling the adjacent marginal spines; between them are two small spines. Uropods as in *N. vulgaris*. Pleopods of male resembling closely those of *N. vulgaris*, but the distal joint of outer branch of the fourth is about half as long as the proximal, and a little longer than the terminal filaments.

Type.—Cat. No. 31493, U.S.N.M.

This species is closely allied to *Neomysis vulgaris* (Thompson) of North Europe, but differs in the more slender antennal scale, the number of joints of the propodites of the true legs, the relative length of the two joints of the outer branch of the fourth pleopods of the male, and in the shape and armature of the telson. *N. vulgaris* attains a length of 17 mm.

*Neomysis americana* (Smith) from the northeastern coast of North America is distinguished by the evenly rounded rostrum the antennal scale, which resembles that of *N. vulgaris*, the fourth pair of pleopods of the male, in which the first joint of the outer ramus is 4 to 5 times as long as the second, while the latter is little more than half as long as the terminal filaments, and by the telson, which resembles in shape that of *N. vulgaris*, and has unequal marginal spines, with several smaller ones in the intervals of the larger. Size, 14 mm.

Another species belonging to this genus is *Neomysis rayi* (Murdoch), from Point Barrow, Alaska, but this species is much larger (up to 65 mm.), the rostral projection is quadrangular with rounded corners, the propodites of the true legs have 8 to 9 joints. The telson resembles that of *N. vulgaris*, but the account of it given by Murdoch is not full enough to make an exact comparison.

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Neomysis awatchensis (Brandt), from Avacha Bay, Kamchatka,* is rather incompletely known. It is said to be of an entirely black color, and to resemble \( N. \) vulgāris, with the exception of a shorter antennal scale and a "truncated and four spined telson." This latter character, however, does not seem to differ from \( N. \) vulgāris.

EXPLANATION OF PLATE I.

(All figures are considerably enlarged.)

Holmesiella anomala, new genus and new species.

Fig. 1. Antennula of young male from Station No. 4192.

2. Antenna of adult female.

3. Mandible of adult female.

4. First maxilla of adult female.

5. Second maxilla of adult female.

6. First cormopod (first maxilliped) of adult female.

7. Second cormopod (second maxilliped) of adult female.

8. Fourth cormopod (second true leg) of adult female.


10. Third pleopod of adult male.

11. Fourth pleopod of adult male.

12. Fourth pleopod of adult female.

13. Telson and uropods of adult female.

* Brandt, Krebse, in Middendorf's Sibirische Reise, II, Pt. 1, 1851, p. 126.
Parts of Holmesiella anomala from Alaska.

For explanation of plate see page 10.
NOTES ON A COLLECTION OF FISHES FROM THE GULF OF MEXICO AT VERA CRUZ AND TAMPICO.

By DAVID STARR JORDAN and MARY CYNTHIA DICKERSON,
Of Stanford University.

During the winter of 1898-99, Professors Jordan and Snyder made a large collection of fishes in Mexico. The greater part of this collection came from the rivers, and the species obtained have been already recorded in the Bulletin of the United States Fish Commission for 1899.

The marine species are not included in this paper, and these are here recorded. The localities are two—Vera Cruz and Tampico. At Vera Cruz seines are used on the sandy beaches, and the fishes secured are sent to the markets of the City of Mexico, our specimens having been obtained in these markets. At Tampico specimens were taken from the muddy estuary of the Rio Panuco and elsewhere along the sandy shores.

The fish fauna of the east coast of Mexico is not rich, and it is confined mainly to species which inhabit sandy shores. It is, however, of interest, as hardly any collecting has been done hitherto between Yucatan and Corpus Christi, in Texas. In all this region

"The thousand miles of shapeless strand
From Brazos to San Bias that roll
Their drifting dunes of desert sand,"

none of the rock fishes or coral fishes, Chaetodontidae, Pomacentridae, and the like, so characteristic of the fauna of Cuba, are to be found.

A series of the specimens mentioned in this paper is in the collections of the United States National Museum.

A single species (Bairdiella vera-cruceis) is described as new.

Family CARCHARIIDÆ.

CARCHARIAS PLATYODON (Poey).

One specimen from Tampico.

Length 2½ feet. Evidently identical with specimens collected by Doctor Jordan at Galveston in 1882 and described as C. platyodon.¹


Family ENGRAULIDÆ.

ANCHOVIA BROWNII (Gmelin).

Three specimens (largest 3\(\frac{3}{4}\) inches) from the lagoon at Tampico.
Head 3\(\frac{3}{4}\) in length; depth 1\(\frac{1}{2}\); eye 3\(\frac{1}{2}\) in head. D. 15; A. 21; scales, 40.

ANCHOVIA MITCHELLII (Cuvier and Valenciennes).

Eight specimens (2 to 2\(\frac{1}{2}\) inches long) from a lagoon near mouth of Rio Panuco.
Head 1 in length; depth 4\(\frac{1}{2}\); eye 3 in head; D. 14; A. 28; scales 37.

Family DOROSOMATIDÆ.

DOROSOMA CEPEDIANUM (Le Sueur).

Two large specimens (10 inches long) from the market of Mexico City, originally from Vera Cruz; also more than a hundred young specimens (the largest 2\(\frac{1}{2}\) inches long) from a lagoon near Tampico.

Family CHARACIDÆ.

ASTYANAX ARGENTATUS Baird and Girard.

The collection contains 6 examples, the largest measuring 2 inches, from a lagoon near Tampico.

Family SILURIDÆ.

GALÈCHTHYS GÜNTHERI Regan.


One specimen 1 foot long from Tampico, Gulf of Mexico.
This species is closely related to Galeichthys milberti (felis), the shorter maxillary barbel (reaching opercle instead of end of head) and the broader occipital process being noteworthy points of distinction. The original Silurus felis of Linnaeus is the gaff-topsail catfish (Felichthys felis), not the present species. The type, still preserved, has been examined by Doctor Günther.

ICTALURUS PURCATUS (Le Sueur).

Three large specimens from Tampico.
Family SYNGNATHIDÆ.

DORYRHAMPHUS LINEATUS (Valenciennes).

Three specimens (1 female, 2 male) from lagoons at Tampico.

Family MUGILIDÆ.

MUGIL CEPHALUS Linnaeus.

Three typical specimens from Tampico.

MUGIL CUREMA Cuvier and Valenciennes.

Many small specimens from the lagoon at Tampico.

JOTURUS PICHARDI Poey.

This large river Mullet, described as Agonostomus globiceps by Günther, is common about the base of cascades in the neighborhood of Jalapa, Xico, and Orizaba. It is locally known as Bobo, and was seen on the hotel tables at Jalapa.

Family POLYNEMIDÆ.

POLYDACTYLUS VIRGINICUS (Linnaeus).

One example, 8½ inches in length, from Vera Cruz.

Family CARANGIDÆ.

CARANX HIPPOS (Linnaeus).

One specimen, 10½ inches, from Tampico.

SELENE VOMER (Linnaeus).

Two specimens from Vera Cruz.

Family CENTROPOMIDÆ.

CENTROPOMUS UNDECIMALIS (Bloch).

Four large specimens from Vera Cruz, found in the market of Mexico City.
CENTROPOMUS PEDIMACULA Poey.

Two specimens from Vera Cruz, found in the market of Mexico City. These correspond to the account given by Jordan and Evermann.

Regan regards Centropomus pedimacula of Poey, to which our specimens correspond, as identical with Poey’s pectinatus, a name which has page priority over pedimacula. We have seen no specimens referable to Centropomus pectinatus, but from the description of Poey, confirmed in part by that of Boulenger, Centropomus pectinatus would seem to be a distinct species, differing from C. pedimacula in the smaller eye (6 in head), in the smaller scales (lateral line 65, not 55), in having the ventral fins pale, and in having no dark streak along the lateral line. If all these characters prove fallacious, the name Centropomus pedimacula should give way to Centropomus pectinatus.

CENTROPOMUS PARALLELUS Poey.

Six specimens from Vera Cruz.

This species is distinguished by its small size, by the very small scales—85 to 90—a pale lateral line, and the presence of teeth on the preorbital.

Family SERRANIDÆ.

EPINEPHELUS ADSCENSIONIS (Osbeck).

Vera Cruz, obtained in markets of Mexico City.

Family LUTIANIDÆ.

LUTIANUS GRISEUS (Linnaeus).

Locality, Tampico. One example.

LUTIANUS CYANOPTERUS (Cuvier and Valenciennes).

Locality, Tampico.

Length, 1½ feet. A single example of the so-called “Cubera” of the Cuban markets, bearing a close resemblance to Lutianus griseus, but distinguished—as noted in Jordan and Evermann’s Fishes of North America—by the \|\ shape of the vomerine patch of teeth, the large size of the canines of the lower jaw, and the somewhat caducous character of the scales.

\(a\) Memorias, II, p. 121. \(b\) Cat. Fishes, I, p. 368.
Family THERAPONIDÆ.
HAEMULON PLUMIERI (Lacépède).

Two specimens from Vera Cruz, found in the market of Mexico City.

BATHYSTOMA RIMATOR (Jordan and Swain).

One specimen from Vera Cruz, found in the market of Mexico City.

CONODON NOBILIS (Linnaeus).

Seven specimens from Vera Cruz, found in the markets of Mexico City.

Family SPARIDÆ.
ARCHOSARGUS PROBATOCEPHALUS (Walbaum).

Four specimens (longest 12½ inches) from Tampico.

Family GERRIDÆ.
GERRES PLUMIERI Cuvier and Valenciennes.

Gerres patuo Poey, Memorias, II, 1868, p. 320 (Havana).
Gerres embry Jordan and Starks, in Jordan and Evermann, Fish, North and Mid. Amer., II, 1898, p. 1379 (Charleston).

Nineteen specimens from Tampico forming a graduated series, from 3¾ inches to 12½ inches in length.

These show plainly the identity of the nominal species of Gerres, plumieri, brasilianus, and embry. Embry was separated from brasilianus mainly because of the greater length of the pectorals, a character which does not hold good in this series. Plumieri, as described, differs from brasilianus chiefly in the greater length of the second dorsal spine (longer than head, instead of two-thirds to three-fourths of head), again an untrustworthy character as the following measurements prove. Plumieri, as described, is the young of brasilianus, that is, the dorsal and anal spines are proportionately longer in younger specimens. However, there are exceptions to the presence of long spines in the young, as occasionally a young example will show the measurements of the adult.
This identity of the three species has already been pointed out by Regan.

**Dimensions.**

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<tr>
<th>Length of specimen (Inches)</th>
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**EUCINOSTOMUS PSEUDOGULA** (Poey).

Eight small specimens (averaging 2 inches in length), from lagoons at Tampico.

These agree with *Eucinostomus pseudogula*; but, on the other hand, they can not be distinguished from *Eucinostomus harengulus*, by comparison either with the description of the species or with specimens (Mayaguez, Porto Rico). It would therefore seem probable that *pseudogula* and *harengulus* are identical.

**Family SCILÉNIDÉ.**

**CYNOSCION NEBULOSUS** (Cuvier and Valenciennes).

Two specimens from Tampico.

**BAIRDIELLA VERÈ-CRUCIS** Jordan and Dickerson, new species.

*Corynus (Homopriam) acutirostris* Steinbach, *Zur Fisch-Fauna des Magdelenen-Stromes*, 1878, p. 9. (Magdalena River) : not type (1875), which was from Panama.

**Bairdilia armata** JORDAN and EVERMANN, *Fish North Mid. Amer., II* (1898), p. 1437 (Rio Magdalena, San Mathias, and other localities in Brazil) : not *Bairdilia armata* Gill., 1863, from Panama.

Head 3 3/2 in length to base of caudal; depth 3 1/2; eye, 4 1/2 in head. D. X-I, 23; A. II, 8. Scales 51 to 53.

Snout long, somewhat shorter and more robust than in the *Bairdilia armata*; chin pores large; lips thin; inner teeth of the lower jaw somewhat enlarged (outer teeth of the upper jaw conspicuously enlarged). Preorbital one-half diameter of eye. Gill rakers 9+16, two-fifths diameter of eye.
Dorsal spines flexible, the longest 1 2\(\frac{3}{4}\) in head, the first two considerably thicker than the remaining spines; anal spine somewhat curved, 1 2\(\frac{1}{4}\) in head, 1 3\(\frac{3}{4}\) in base of soft dorsal. Lateral line pores, each with 4 simple spreading branches.

Color silvery, a broad dorsal area from snout to base of caudal covered with brown dots as in B. armata and B. ensifera; also brown dots aggregated along the sides in the middle of the scales forming horizontal lateral streaks; spinous dorsal black at tip; caudal and soft dorsal dusky.

The collection contains 3 specimens 8 to 9\(\frac{1}{2}\) inches in length. They were obtained by Doctor Jordan in 1898, in the market of the City of Mexico, having been received from Vera Cruz.

*Bairdiella vera-crucis* is very close to *B. armata*, which it represents in the Gulf of Mexico, and with which it has been hitherto con-
which gradually give place to 2 rows on the sides instead of being relatively few and biserial throughout.

*Bairdiella vera-crucis* is probably the species obtained by Stein-dachner from the Rio Magdalena (Atlantic) in 1878 and classified as *Corvina (Homopriion) acutirostris*, a species (identical with *B. armata*) which he had described in 1875 from Panama Bay. He mentions the fact that the East Coast specimens show "eine etwas stärker gerundete und ein wenig kürzere Schnauze," and notes also the somewhat larger preopercular spines and the longer second anal spine.

Direct comparison of the two species, *Bairdiella vera-crucis* from Vera Cruz (Atlantic) and *Bairdiella armata* from Panama Bay (Pacific), leaves no doubt that the two are distinct although undoubtedly representative or "geminate" species.

The type of *Bairdiella vera-crucis* is Cat. No. 61676, U.S.N.M.; Cotypes are in Stanford University.

**BAIRDIELLA RONCHUS** (Cuvier and Valenciennes).

One specimen from Tampico, length 10\(\frac{1}{2}\) inches.

**MICROPOGON UNDULATUS** (Linnaeus).

Many dozens of immature specimens from a lagoon near the mouth of the rio Panuco.

**POGONIAS CROMIS** (Linnaeus).

Two specimens from Tampico and from Vera Cruz.

**UMBRINA COROIDES** Cuvier and Valenciennes.

Locality. Vera Cruz. Obtained from market of Mexico City.

Two specimens, each 8 inches long.

Head 3\(\frac{1}{2}\) in length; depth 3; D. X; I, 27; A. II, 6; scales 48. In all respects the specimens correspond with the description in Jordan and Evermann.

Family **EPHISSIPID.E.**

**CHÆTODIPTERUS FABER** (Broussonet).

A single specimen, 6\(\frac{1}{2}\) inches long, from Tampico.

Family **CICHLID.E.**

**NEETROPLUS CARPINTIS** Jordan and Snyder.

Locality. Tampico.

Two specimens of *Neetroplus carpintis*, a species first described in 1889 from material collected by J. O. Snyder at Laguna del Carpinte, near Tampico.
The smaller of the 2 specimens (length 8\(\frac{1}{2}\) inches) corresponds to the original description; the larger (length 9\(\frac{3}{4}\) inches), a very old representative of the species, disagrees in that the depth has increased disproportionately to the other measurements. The depth is 2 in the length in the types, whereas in this specimen it measures barely 1\(\frac{1}{2}\).

Family GOBIIDÆ.

**Gobiomorus dormitor** (Lacépède).

Locality. Tampico.

Five specimens from 3\(\frac{1}{2}\) to 12\(\frac{1}{2}\) inches in length.

The genus *Gobiomorus* was based by Lacépède on 4 species, belonging to the modern genera *Nomeus*, *Valenciennes*, *Philypnus*, and *Periophthalmus*. It was first revived by Jordan and Gilbert in 1882, and restricted to *dormitor*, the type of *Philypnus*. Later, 1882, it was restricted to the *taiboa*, the type of *Valenciennes*, by Gill, by the method of elimination. Still later, 1907, it was used by Jordan for *gronovii*, the type of *Nomeus* by the “first species rule.” By the rule of type by first designation, in accordance with the International Code, *Gobiomorus* replaces *Philypnus*, a matter of regret, as the latter name was one especially well chosen.

**Eleotris abacurus** Jordan and Gilbert.


A single specimen 2 inches long from a lagoon near Tampico.

Head 3 in length; depth 4\(\frac{1}{2}\). D. VI–9; A. I–8. Scales 51–20.

The preopercular spine is well developed; the long depressed head completely scaled. The scales on back and belly are cycloid, those on the sides ctenoid. The teeth in the outer and inner rows of the villiform bands are somewhat enlarged.

The body is brown, darker on the sides, the combined effect of obscure lengthwise streaks along the middle lines of the scales: continuous with this lateral color is a brown band over the head, through the eye to the end of the snout; two dark streaks extend from the eye downward and backward over the cheeks, and a small black spot (size of eye) lies at the base of the pectoral fin partially hidden by the opercle. The color of the fins, as well as this body color, agrees with the original description by Jordan and Gilbert, but the specimen is smaller than the original type and the markings more distinct.
EVORTHODUS BREVICEPS Gill.


Locality, lagoon near Tampico.


Pectorals not extending to vent, each with 14 rays. Ventrals completely united, not adherent to the belly; shorter than pectorals. Spinous dorsal with third and fourth rays longest (two-thirds of head). Rays of soft dorsal and of anal as long as third ray of spinous dorsal. Caudal rounded, slightly longer than head, with 21 rays.

Scales ctenoid, of moderate size; those on belly very small. Nape, occiput, and opercles scaled, the scales on opercles rather obscure. Cheek apparently with a number of embedded scales and one or two rows of minute papillae.

Color in alcohol, brown, darker above; irregularly and conspicuously spotted and blotched on the sides; pale and unspotted below; the larger blotches of one side meet those of the other side along the dorsal line, producing the effect of irregular crossbars over the back; two dark spots at base of caudal alternate with a single dark spot on caudal peduncle. Pectorals somewhat pigmented in transverse bands; ventrals without color; spinous dorsal conspicuously barred with black; soft dorsal more or less checkered or barred with dark; anal pale slightly pigmented on the rays; caudal irregularly barred.

This singular little goby, distinguished by the unusual form of its teeth, has been but once recorded since it was originally described.
by Doctor Gill from the island of Trinidad. Günther mentions a specimen from Surinam.

We have six examples, the largest 2½ inches long, from a lagoon near Tampico, in Tamaulipas.

Rhinogobius Shufeldti (Jordan and Eigenmann).


Several score of specimens of Rhinogobius shufeldti were taken from a lagoon near the mouth of the Rio Pannco.

The largest measures 2½ inches in length. All agree very closely with the original description by Jordan and Eigenmann.

Gobiosoma Bosci (Lacépède).


Gobius alepidotus Bloch and Schneider, Syst. Ichthol., 1801 (after Lacépède), p. 547.


Teeth in several rows; the outer of both jaws somewhat enlarged, the inner of the lower jaw considerably enlarged and hooked inward.

The color in alcohol is plain olivaceous, studded with dark pin points and shows faint traces of crossbars. The fins are all more or less dusky, dorsals and anals being nearly black.

The head has a complicated arrangement of papillae and pores, the former close set in rows. The largest papillae are those encircling the chin; they approach barbels in size and are visible to the naked eye.

The arrangement of papillae is as follows:

Five rows pass downward from the orbit; the anterior two end in a line of papillae bordering the maxillary; the middle and the posterior two respectively meet two horizontal rows on the cheek, which rows in turn are at right angles to a perpendicular series extending on a line with the posterior margin of the orbit. A vertical series on the anterior part of the opercle joins a backward extending horizontal row; a double series edges the preopercle below and extends forward around the lower jaw; short rows mark the symphysis, also the snout between the nasal tentacles and the orbits; two rows on the top of the head follow the outlines of the orbits behind and meet in the mid-dorsal line.
This arrangement of papillae is very similar to that described in *Barbulifer* by Doctor Eigenmann in his description of that genus.

Of this species we have a single representative 1½ inches long. This specimen seems to agree with the nominal species *Gobiosoma bosci*, but also with *Gobiosoma molestum*. In fact, judging from the material at hand in the Stanford University Museum—specimens from Pensacola, Florida, from Corpus Christi, Texas, and from Roanoke River, Virginia—the two species, *G. bosci* and *G. molestum*, are one and the same. The teeth, however, have been incorrectly described. They are as noted above, i.e., teeth in several rows, the outer of both jaws somewhat enlarged, the inner of the lower jaw considerably enlarged and hooked inward.

**Family PLEURONECTIDÆ.**

*Citharichthys Spiopterus* Günther.

Locality, Tampico.

A single specimen, 6¾ inches long.

Head 3¼ in length; depth 2; D. 78; A. 57; scales 46.

Color brownish, with darker dots and blotches.

**Family BATRACHOIDIDÆ.**

*Opsanus Tau* (Linnaeus).

Four specimens from Tampico, the largest 10 inches long, not evidently different from northern specimens.
THE PARASITIC ISOPOD LEIDYA DISTORTA (LEIDY) FOUND ON A NEW HOST.

By Harriet Richardson.

Collaborator, Division of Marine Invertebrates, U. S. National Museum.

Prof. A. E. Verrill has recently sent me specimens from the Bermuda Islands of Pachygrapsus transversus (Gibbes), infested with an Isopod parasite. The parasite is located in the branchial cavity of the host. On examination the Isopod was found to be Leidya distorta (Leidy), heretofore recorded as parasitic on Uca pugilator (Bosc). This genus and species is therefore not confined to one genus and species of host.

The species found by Fritz Mueller in the branchial cavity of a Grapsoid Pachygrapsus transversus (Gibbes), from the coast of Brazil, is probably this species and genus, and not Grapsicepon fritzi, the nominal species of Giard and Bonnier.¹

Because Grapsicepon edwardsi was found on a Grapsoid, Planes minutus, according to the theory advanced by these authors the parasite of another Grapsoid of the same family, Pachygrapsus transversus, would naturally be a Grapsicepon. The facts prove, however, that this is not always the case, in this instance as in other parasitic Isopod genera before cited.

Leidya is found parasitic on both Uca and Pachygrapsus, two widely separated genera of hosts belonging to different families.

As no descriptions or figures of this form have been given since those published by Leidy, the following descriptions and figures may be of interest, in that the young female is also described and figured for the first time:

¹Trav. du Labor. de Wimereux, V, 1887, p. 70, and VIII, 1900, p. 226.

LEIDYA DISTORTA (Leidy).


Localities.—Atlantic City, New Jersey, on Uca pugilator (Bosc); Bermudas on Pachygrapsus transversus (Gibbes).

It is interesting to note that although Leidy distorta was first found at Atlantic City, New Jersey, its host, Uca pugilator, extends as far south as the coast of Florida, and the new host, Pachygrapsus transversus, extends as far north as the Florida coast, so that the continental ranges of the two hosts overlap.

Description of female.—Body rather irregular in outline, oblong-oval. Color yellow. (See figs. 1–2.)

Head large, bilobed, and with the front produced in a wide border or margin. Eyes wanting.

First two segments of thorax short. The three following segments are the largest, and are subequal in length, about twice as long as the first; sixth a little shorter than fifth; seventh about half as long as sixth. The second, third, fourth, and fifth segments have in the middle of the dorsal part of the segment a squarish plate, which in the fifth segment has the outer edges considerably elevated, so as to form a longitudinal carina on either side, which extends posteriorly over the sixth segment. Coxal plates or epimera are present on the anterior portion of the lateral margin of all the segments, but are almost completely hidden by the large ovarian boss which projects upward in a large, prominent lobe. There are five pairs of incubatory plates, which

Fig. 1.—Leidy distorta. Adult female (dorsal view).

Fig. 2.—Leidy distorta. Adult female (ventral view).

* Figs. 1, 2, and 5 are from photographs taken in the U. S. National Museum. In the specimens photographed the pleural lamellae and the pleopoda were bent, so that they do not appear as long as in Leidy’s figures.
overlap each other on the ventral side, completely enclosing the marsupial cavity. The seven pairs of legs are small and feeble, the propodus and dactylus forming a prehensile hand."  (See fig. 3.)

The six segments of the abdomen are more or less coalesced in the middle of the dorsal surface. The lateral parts of each of the first five segments are produced into an elongate double-branched pinnate appendage on either side, so that altogether there are five pairs or ten pinnate appendages to the first five segments. The upper branches probably represent the pleural lamellae and the lower branches the pleopods, so that, in this interpretation, there are five pairs of single-branched pleopoda and five pairs of single-branched pleural lamellae. The sixth or terminal segment is furnished with a single pair of elongated pinnate appendages, the uropoda.

Description of young female.—The young female differs from the adult in its narrower and elongated form, in not having the thorax so greatly distended, in the more equal length of the segments of the thorax, which do not have the median dorsal plate as in the adult, in having the segments of the abdomen more distinctly separated and the lateral appendages more elongated.

*Leidy mistook the prehensile hand for the "recurved, abortive hooklet." In some positions the hand has the appearance of a blunt hook and the dactylus is difficult to see. Leidy's figure is inaccurate and misleading. The article immediately preceding the "hooklet," in Leidy's figure, is probably the carpus and the merus combined. The line of separation between the two articles is somewhat difficult to see. Another interpretation might be given to Leidy's figure, the "hooklet" being the dactylus, the article preceding it, the propodus, and the one preceding that, the combined carpus, merus, and ischium.
The incubatory plates are much smaller than in the adult, and the marsupial pouch greatly reduced in size. The pouch is never filled with eggs at this stage. (See fig. 4.)

Description of male.—Body narrow, elongate. Color yellow. (See fig. 5.)

Head but little wider than long; frontal margin straight, with antero-lateral angles rounded. Posterior portion somewhat wider than anterior. Eyes wanting. First pair of antennae composed of three joints, second pair composed of seven, the last two being minute and tipped with hairs.

The seven thoracic segments are separated from each other by lateral incisions, so that the lateral margins are not continuous. There are seven pairs of prehensile legs.

The six abdominal segments are perfectly distinct, are separated from each other by lateral incisions, and decrease gradually in width, from the first to the sixth, which carries a pair of elongated, tapering appendages, the uropoda. The pleopoda are rudimentary.

*Some allowance must be made for Leidy’s figures, which are somewhat diagrammatic.*
DESCRIPTIONS OF FOUR NEW SPECIES OF AMPHIPODOUS CRUSTACEA FROM THE GULF OF MEXICO.

By Arthur S. Pease,
Of Harvard University, Cambridge, Massachusetts.

The species here described form a small part of a collection of amphipods from the Gulf of Mexico which was sent to the author for study by the United States National Museum. As lack of time prevents the completion of a full report in the near future, it is thought best to publish now the new forms already discovered.

The type specimens are in the United States National Museum.

AMPELISCA HOLMESII, new species.

Cephalon about equal to first 3 segments of mesosome, tapering anteriorly, truncated, first coxal plate slightly expanded distally, broader than second, about same width as third, fourth plate deeper than broad, lower edge much shorter than posterior margin. Last ephimeral plate of metasome produced at posterior ventral corner, bisinuate; both the process and lobe are less pronounced than in A. macrocephala Lilljeborg. First segment of urosome with a slight dorsal transverse depression and behind it a low carina (more distinct in male) with a slight projecting angle. Corneal lenses small but distinct, lower pair occupying inferior corners of cephalon. First antennae about the length of the cephalon, reaching only slightly beyond the tip of the second segment of the peduncle of the second pair, those of the male reaching almost to tip of third segment, flagellum 8-segmented. Second antennae in female scarcely half the length of body, third joint of peduncle shorter than second. Gnathopoda slender, propodus in first about the length of the carpus and slightly tapering distally, that of the second about half as long as the carpus and slender. Dactylus of first two pereopoda much longer than two preceding segments combined. Last pair of pereopoda with the basal joint almost as long as remainder of leg, posterior
expansion broad and rounded at the tip, with 7 spines on outer surface; propodus tapering and almost equal to two preceding segments combined; dactyl slightly longer than propodus. Last pair of uropoda with rami broadly lanceolate. Uropoda 2, outer ramus somewhat shorter than inner, long spine near tip. Telson, lobes tapering, tip blunt, armed with two spines, four pairs of dorsal spines arranged in a sinuous line.

Length, female, 11 mm.

Abundant in a collection from Ferguson's Pass, Oyster Bay, Florida.

_Type._—Cat. No. 7502, U.S.N.M.

_{Named for Prof. S. J. Holmes._

**HAUSTORIUS AMERICANUS,** new species.

Body tumid. First antenna, flagellum 7-jointed, the tips of the 6 distal joints bearing calceoli, accessory flagellum one-jointed, second antenna little longer than first antenna, flagellum 7-jointed. Mandible, palp large, middle joint longer than others. Second gnathopod about as stout as first gnathopod, fifth joint of second gnathopod armed with calceoli on its posterior distal margin. Third uropod,
rami both one-segmented. Telson twice as broad as long, cleft shallow, distal row of long spines and two dorsal lateral spines.

Length, 8.2 mm.

A single specimen collected by L. R. Cary at Cameron, Louisiana. Type.—Cat. No. 38340, U.S.N.M.

Body slender, smooth. Head, lateral lobes rounded. First side plate produced anteriorly into an acute process; third rounded; second and fourth truncate. Third pleonie segment, postero-lateral corners slightly produced, hind margin slightly crenate. Eyes narrow elliptical. First antenna, second joint of peduncle a little longer than first; third short, flagellum as long as peduncle, 27-jointed, accessory flagellum 10-jointed. Second antenna, peduncle slightly shorter than that of first antenna, flagellum subequal to ultimate joint of peduncle. Second gnathopod, fifth joint longer than sixth, palm straight, oblique, hind margin convex, setose. Second gnathopod, much larger, fourth joint produced into an acute process, fifth more than twice as wide as long, palm with a tooth at its outer angle and a
shallow notch at each end, denticulate. Third to fifth peraeopods, second joint well expanded, oval, with free corner. Fifth peraeopod subequal to fourth. Third uropod slightly longer than others, pen-
duncle short, rami equal, truncate. Telson cleft to base, a deep notch just outside the apex of each side from which a seta projects.

Length, 13 mm.

**Distribution.**—Gulf Stream, off Key West, Florida, 98 fathoms, February 14, 1902, Station 7279, U. S. Bureau of Fisheries, steamer *Fish Hawk*; also 122 fathoms, February 26, 1902, Station 7296.

**Type.**—Cat. No. 38341, U. S. N. M.

Named for Miss Mary J. Rathbun.

**PROTELLOPSIS STEBBINGII**. new species.

Head, bearing two acute spines above. First segment of peraeon longer than head, third segment with two blunt dorsal spines at middle, fourth segment with two slight dorsal elevations at center; first four segments rugose above; second, third, and fourth bear large rugose lamellae at their anterior ventral angles; fifth segment longest; third longer than fourth, fourth longer than second, sixth much longer than seventh, fifth almost twice as long as sixth and seventh together. Eyes rounded or slightly oval. First antennæ
twice as long as second, first joint shorter than head and first segment of pereon; first segment half as long as second, third two-thirds as long as first; flagellum longer than peduncle, 14-segmented. Second antennae more slender than first, third segment twice as long as first two; flagellum 2-jointed, penultimate twice the length of ultimate joint. Mandibles, with two plates, each bearing 5 teeth, prominent molar tubercle with strongly denticulate crown. Maxillipeds, with inner prismatic plate very small, bearing 2 small teeth and 4 apical spines; outer plate almost three times as long as inner, bearing 1 apical spine and 2 others near the inner distal margin. First gnathopoda of male, palm lamellate, finely denticulate and armed with many spines. Second gnathopoda with carpus subequal to merus, palm concave with proximal angle greatly
extended into a lamelle which is produced into a spinous process at both angles and has a notch near the proximal angle, dactyl strong and sinuate. Two anterior peraeopoda, 2-segmented, one-third as long as gill, which is rather slender and elliptical; third peraeopod much more slender than last two. Terminal segment of first abdominal appendage ending in a conical process, around the base of which are a circle of small acute spines. Second abdominal appendage blunt and spinose at tip.

Length, 11 mm.

Female with dorsal spines much less prominent. Second gnathopod with a notch in the center of the palm and just behind this a spinous process.

This species was abundant in the Gulf of Mexico, off Northwest Channel, February 24, 1902, Station 7292, U. S. Bureau of Fisheries, steamer *Fish Hawk*, 10½ fathoms.

Type.—Cat. No. 38342, U.S.N.M.

DESCRIPTION OF PANTOSTEUS SANTA-ANÆ, A NEW SPECIES OF FISH FROM THE SANTA ANA RIVER, CALIFORNIA.

By John Otterbein Snyder,
Of Stanford University, California.

A small collection of fishes taken from the Santa Ana River near Riverside, California, by Mr. Edmund Heller, in May, 1897, contains a Pantosteus which differs from any of the known forms. It is here described as Pantosteus santa-ana, new species.

Pantosteus santa-ana is closely related to P. delphinus of the Colorado basin, a form with a thick skull and greatly restricted fontanelle, which early becomes obliterated. It differs from it in having larger scales. It seems to have no affinities with P. arizone or P. clarki, the other species indigenous to the Colorado basin. In external characters it resembles P. generosus of the Salt Lake basin. It has a much thicker skull, the fontanelle being closed, even in very small individuals, while in P. generosus it is evident in examples measuring 200 millimeters or more in length. It differs widely from the Pantosteus of the San Joaquin basin and also from the species of western Nevada and adjacent parts of California.

PANTOSTEUS SANTA-ANÆ, new species.

Head 4\(\frac{1}{2}\) in length to base of caudal; depth 4\(\frac{1}{2}\); depth caudal peduncle 10; snout 1\(\frac{9}{10}\) in head; eye 6\(\frac{1}{2}\); width interorbital space 2\(\frac{2}{5}\) D. 11; A. 7; scales in lateral series 79; before dorsal 32.

Body robust, the head long; interorbital space convex. Skull very thick, the fontanelle completely closed even in individuals not more than 45 mm. long. Width of mouth contained 4 times in length of head; width, including lips, equal to length of snout; lips with narrow, smooth shields within; papillae irregularly arranged, about 6 rows on upper lip, the inner ones large, the outer ones very small; lower lip not deeply cleft, there being 5 rows of papillae between cleft and inner margin.

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Proc. N. M. vol. xxxiv—08—3
Origin of dorsal nearer tip of snout than base of caudal (end of last vertebra) by a distance equal to diameter of orbit; height of longest rays 1 1/2 in head; last 2 rays closely apposed, completely united in some cases. Height of anal 1 1/2 in head. Caudal deeply concave, length 1 3/2 in head. Pectorals broad, rather pointed posteriorly, 1 3/8 in head. Ventrals rounded, 1 3/8 in head; origin of fin below seventh dorsal ray.

Lateral line straight except for a slight upward curve at its origin. Scales small anteriorly, growing gradually larger posteriorly, minute on breast and abdomen; 15 in a series, counting upward and forward from lateral line to a point midway between occiput and dorsal, about 12 between lateral line and base of dorsal, 13 between lateral line and insertion of ventral.

Color in spirits dusky above, lighter below; each longitudinal row of scales with a conspicuous light stripe which is equal to about one-third of a scale in width.

Described from the type, Cat. No. 61675, U.S.N.M., a specimen 153 mm. long, from near Riverside, California. Collected by Edmund Heller. Many other examples, among which are cotypes No. 20660, Stanford University collection, show but little variation from the type. The following measurements of 10 specimens are expressed in hundredths of the length from the tip of the snout to the end of the last caudal vertebra:

**Measurements.**

<table>
<thead>
<tr>
<th>Description</th>
<th>Measurement (in hundredths of length)</th>
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<tbody>
<tr>
<td>Length of body (in millimeters)</td>
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<td>Length head</td>
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<tr>
<td>Interorbital width</td>
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<tr>
<td>Depth head</td>
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<tr>
<td>Snout to occiput</td>
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<tr>
<td>Snout to dorsal</td>
<td>50 50 48 48 48 48 48 48 48 48</td>
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<tr>
<td>Snout to ventral</td>
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<tr>
<td>Length base of dorsal</td>
<td>135 15 14 14 14 14 14 14 14 14</td>
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<td>Length base of anal</td>
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<td>Height - dorsal</td>
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<tr>
<td>Height anal</td>
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<td>Length caudal</td>
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<tr>
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<tr>
<td>Scales below lateral line</td>
<td>13 13 13 13 13 13 13 13 13 13</td>
</tr>
<tr>
<td>Scales before dorsal</td>
<td>52 13 13 13 13 13 13 13 13 13</td>
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</table>
THE DALMANELLAS OF THE CHEMUNG FORMATION,
AND A CLOSELY RELATED NEW BRACHIOPOD GENUS
THIEMELLA.

By Henry S. Williams,
Of Cornell University, Ithaca, New York.

The Dalmanellas have for many years been known to be well represented in the Chemung formation of New York State. In the process of drawing a paleontological boundary across Watkins Glen and Catatonk quadrangles at the base of the Chemung formation Dalmanella was discovered to be one of the most distinctive genera of the Chemung fauna. Specimens of this genus are among the first brachiopods to show the coming of the new fauna in the sections of central New York. As the collections were elaborated, it was discovered that the representatives of the genus increased in size on ascending the Chemung; that certain characters distinguish the Dalmanellas of western New York from those of central New York, small and large; and that the published definitions of the species fail to note the distinguishing marks by which the evolution of species is indicated. These observations have led to the belief that a redefinition of the Dalmanellas of the Chemung formation will be helpful to students using fossils as a means of discriminating geological horizons.

The Chemung Dalmanellas (particularly the small specimens) closely resemble Orthis testudinaria of the Ordovician. There are also several species in the upper Devonian of Great Britain and continental Europe, which present much similarity to the New York forms.

Without here attempting to show the exact place occupied by the Chemung species in either the geological evolution of the race or in its adjustment to world-wide conditions of environment, the present paper will attempt to define the characters which are definitely connected with range and distribution of the species for this limited portion of Devonian time and for the area of New York and neighboring States.

In reporting species in previous papers on Devonian Paleontology the author has made no attempts to revise the definitions of

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the species cited. They have been taken with their accepted meanings. This method is sufficiently accurate for practical purposes so long as the chief object in view is to identify the faunal aggregates and to define and locate them stratigraphically and geographically.

This general work has already been accomplished for a limited area and for the faunas ranging through a limited portion of the geological time scale. It is now proposed to take a step in advance and to attempt to discriminate the species of a single genus for the field under investigation on the basis of their geologic range and geographic distribution.

In any specific definition it is, of course, important to take note of characters by which the specimens described are distinguished from other representatives of the genus; but to distinguish species alone by the conspicuousness of their characters tends to emphasize the aberrant and rare. The dominant rather than the rare, the common rather than the aberrant characters must be used in discriminating the characteristics of natural species. But in seeking the dominant characteristics of a species the basis upon which the aggregation of the individuals making up the group is founded must also be natural and not artificial. In some cases the specimens selected by authors as types of their specific definitions are fairly good representatives of the natural species to which they belong, but in numerous cases of paleontologic species it is discovered, after the definitions have become established, that the selected types are actually aberrant forms, rare and not characteristic of any natural aggregation of individuals.

Without positively knowing the cause of aggregation it is possible to distinguish natural from artificial aggregates. Examples of natural aggregates of organic individuals are (a) the contents of a single stratum at a single outcrop (that is, a faunule); (b) the series of successive faunules in a single section through which range the majority of the same species holding approximately the same proportions of abundance in comparison with other species (that is, a fauna considered geologically); and (c) the group of faunules spread over a particular geographic area and extending to the limits within which the particular species occupies the same general place of abundance or rarity in the composite fauna (that is, the fauna geographically considered); all these are natural aggregates. On the other hand, the specimens in a museum labelled Hamilton or Trenton or Cretaceous do not necessarily constitute natural aggregates for purposes of specific description. It is also probable that no set of specimens combined on the basis of exhibiting the same characters is necessarily on that account a natural aggregate of individuals.
Prior to determining what particular part environment or heredity
may take in determining the characters of organisms record must be
made of the relations borne by the characters to a change of condi-
tions of environment and to a breaking of continuity of the sequence
of individuals in the stream of life.

To ascertain these relations it is not sufficient to study living organ-
isms alone. From living organisms we may learn of the results of
past adjustments to environment, but not of the steps by which those
adjustments were attained. The periods of time open to man’s ob-
servation are too brief for demonstrating the consequences of current
changes of environment upon a mass of living organisms. Nor do
living organisms furnish the evidence necessary to disentangle the
effects of uniformity of environmental conditions from community
of descent. In order to distribute the consequences to their specific
causes it is necessary to ascertain under what conditions each chief
force acts with uniformity upon the individuals under study.

The three chief forces concerned may be called Heredity, Environ-
ment, and Evolution, using these terms to express those preexisting
conditions which, being uniform for any genetically related group of
organisms, may be assumed to produce uniform morphologic effects.
Heredity will then connote the forces operating in direct genetic
descent, that is, the control exercised by the ancestry upon the char-
acters of offspring. Environment will connote the forces and the con-
trol exercised upon organisms of the same ancestry by particular en-
vironmental conditions. Evolution will connote the forces and the con-
trol exercised upon a race of organisms of like ancestry under the
same environment by continuous reproduction for periods of
time of geologic significance.

In the present study the morphologic results of such forces acting
upon the representatives of a single genus are employed for the pur-
pose of discovering those forces and their modes of operation.

It is assumed as a working hypothesis that differences in form, am-
ong the representatives of a single genus aggregated in a single
local faunule, may be traced chiefly to hereditary causes; that differ-
ences associated with areal distribution may be assigned chiefly to
environmental conditions; and that differences associated with geo-
logical succession may be assigned chiefly to evolution.

The reason for thus distributing the hypothetical causes of differ-
ences is derived from the following considerations:

First. In the local faunule environmental conditions may be as-
sumed to have been approximately uniform for all the individuals
represented in the faunule, and the stage of evolutionary progress is
also the same for all, hence of the three chief causes of modification
we are restricted to the operation of the laws of heredity.
Second. In the case of geographic distribution, at the same geologic horizon, we are restricted to heredity and environmental influences. Modifications of form, therefore, which are expressed only as between faunules of separate localities are accounted for as occasioned primarily by the differing conditions of environment of the separate localities.

Third. Finally, in the case of modifications of form observed in the faunules of successive stratigraphic stages of the same locality, the distinguishing differences, so far as they are other than those of the local faunule and other than those of the geographic provinces, are evolutionary.

It would not be safe to conclude that in producing any one of these three classes of modification only one of the assigned forces has been in operation, but only that in each case the one indicated has been chiefly operative.

The Dalmanellas of the Chemung formation of New York State are closely enough related to each other morphologically to make it probable that they are all of common descent. The question of their relationship to Dalmanellas of earlier geologic periods, or to those of other geographic provinces of the Devonian, can be determined with greater precision after the facts of their relations to each other have been thoroughly established. We may also leave for later consideration the question whether the subgroups into which they are divisible do or do not show indication of intersterility. As a whole they constitute for the time and place a well-defined group of organisms which for the present may be regarded as a genus. The subgroups into which the genus is divided will be called species.

THE GENERIC CHARACTERS OF DALMANELLA.

The name Dalmanella was proposed by Hall and Clark in 1892 for a subdivision of the genus Orthis Dalman. This group of Orthis had been previously called "group of Orthis testudinaria Dalman" by Hall in the year 1890.

The characters of Orthis testudinaria perpetuated in the Devonian Dalmanellas are as follows:

First. The general form varies in outline from subcircular to subquadrate and wide-hinged forms.

Second. The pedicle valve has a small but elevated beak from which a blunt carination of the outer surface extends, broadening and flattening toward the front.

Third. The brachial valve has a sulcus along the center which broadens toward the front.

*Pal. N. Y., VIII, 1892, p. 205.
* Bull. Geol. Soc. of Am., 4, pp. 19-205.
* Pal. N. Y., VIII, 1892, p. 205, pl. IV, fig. 29.
* Figs. 27 and 33.
* Fig. 32.
Fourth. The hinge is shorter than the greatest width of shell.

Fifth. The elevated radiating lines ("striae") are about fourteen at the beak and increase to fifty at the front in the smaller species, and to nearly twice that number in larger species. They are more or less fasciculated. In extreme cases several very fine secondary lines are seen lying on the sides of the dominant primary lines of the group.

Sixth. In the interior of the pedicle valve there is a more or less quadrate muscular impression, pointed toward the beak and bilobed anteriorly.

Seventh. The hinge teeth are prominent and continue into a ridge about the muscular scar (much as in Schizophoria.)

Eighth. In the brachial valve the cardinal process is either simple or subdivided in larger shells by three, four, or more longitudinal furrows.

Ninth. The crura are proportionately well developed, and show serrations on their bases facing the cardinal margin.

Tenth. In size, specimens of this genus vary from less than 10 to over 30 mm. in length, and reach a width in some species of 45 to 50 mm.

Comments.—The exterior of the pedicle valve of the Dalmanellas is distinguished from the corresponding valves of Schizophoria by the carination of the median line of the shell proceeding from a point between the place of the muscular scars to the front. Schizophoria has a broad sulcus from half way down which becomes stronger and wider at the front.

In the interior of the shell of Schizophoria the muscular scars are divided by a strong median septum, which is evident at the posterior end of the scars and becomes stronger toward their front ends. It continues forward in a slight septum which in extreme cases nearly reaches the front margin of the shell. A similar septum divides the muscular scars in Dalmanella carinata, but it is shallow at the posterior end of the scars, widens and becomes stronger anteriorly, and at near the front extremity of the muscular scars it suddenly divides into two ridges and becomes lost or inconspicuous around the front margin of the scars. Between the prongs of this V-shaped anterior termination of the median septum the upfolding of the shell begins which constitutes the carination along the middle of the exterior of the shell, characteristic of all the larger forms of upper Devonian Dalmanellas. In the smaller forms the carination is present, but the Y-shaped median septum is not strongly developed.

This character is expressed on Plate VIII, fig. 30, of the original illustrations of Orthis carinata. Fig. 16 of the same plate is drawn to represent a narrow depressed line of the same kind in a specimen that would otherwise represent a Schizophoria. Typical expressions
of the Chemung Schizophoria are represented in figs. 19, 17, and 18 of the same plate, in which a slight septum extends forward. Fig. 29, is drawn to express a depression along the center of the pedicle valve of a Dalmanella tioga. I have not seen such a form, and it is possible that the drawing at this point is erroneous. In all specimens hitherto examined by the writer, the V-shaped anterior termination of the median septum separating the muscular scars marks the Dalmanellas, and does not occur on specimens of Schizophoria. In some specimens of Schizophoria there are seen two grooves continuing anteriorly, the inner edges of the muscular scars lying so close together as to form a thin median ridge, but in these cases the ridge is continuous with the median septum and does not divide into the V-shaped septum. The interpretation is that in such cases the double grooves are vascular markings which would not be likely to affect the exterior of the shell. The V-shaped forking of the median septum at the front end of the muscular scars in the pedicle valves is considered as a generic character separating the Devonian Dalmanellas from Schizophoria with which they are often associated. This character can be detected in some specimens in which the external carination is so slight as to be unrecognizable.

A full statement of the authors' interpretation of the characters of Dalmanella is given by Hall and Clarke in the work above cited, in which is given the following list of species representative of the genus there established (p. 207):

Orthis subaquata Conrad.—Chazy fauna.
Orthis testudinaria, O. conica, O. meeki, O. multisepta, etc.—Trenton and Hudson faunas.
Orthis elegantula.—Niagara.
Orthis perdelegans, O. concinna, O. plano-convexa, O. subcarinata.—Lower Helderberg.
Orthis lenticularis Vanuxem, not Wahlenberg.—Corniferous.
Orthis lepida Hall [not Schnur, H. S. W.].—Hamilton.
Orthis superstes, new species.—Chemung.

To this list the authors add (p. 324) Orthis quadrans Hall from the lower Helderberg, and Orthis infera Calvin and O. leonensis Hall from the Chemung.

Schuchert adds to the list:
Orthis nettana Rathbun.—Middle Devonian.

In 1905, H. S. Williams called attention to the fact that the species Orthis carinata and O. tioga of Hall, referred to the group Schizophoria by Hall and Clarke proper belong to the group Dalmanella.

a As in the Plate XI, fig. 14, of Generic Illustrations of Brachiopods. Eleventh Ann. Rept. of the State Geologist for the year 1891. Albany, 1892.
Of the species cited above, the one reported from the Hamilton under the name *Orthis lepida* Hall is either identical with *Orthis lepida* Schm., which it closely resembles, or else should receive a new name, as it was not described till 1860, after the application of the name had been made by Schm. As it is reported from the shores of Canandaigua Lake, it may be appropriately called *Dalmanella canandaigua*.

**AMERICAN SPECIES OF DALMANELLA.**

There are at present known the following species of the group Dalmanella, occurring in the rocks of the Devonian of North America as high as the Hamilton formation: *Dalmanella (lepida* Hall, 1860, not Schm. 1853.) *canandaigua* Williams, 1907, Hamilton formation.

*D. infera* Calvin, 1878, Chemung formation.

*D. iconensis* Hall, 1867, Chemung formation.

*D. superste* Hall and Clarke, 1892, Chemung formation.

*D. carinata* Hall, 1843, Chemung formation.

*D. tioga* Hall, 1843, Chemung formation.

**BRITISH AND EUROPEAN CONTINENTAL SPECIES.**

The Dalmanellas were early recognized in the European Devonian by Sowerby, Phillips, C. Roemer, Verneuil, Schm, and others, and have been described under various specific names.

Sowerby in 1840 described *Orthis interlineata*. Hall's original of *Orthis tioga* was first identified with Sowerby's species, *Orthis interlineata*, but as was afterwards discovered Sowerby's description is not fully applicable to the New York form and the new name *O. tioga* was applied to it. In 1841 Phillips revised Sowerby's species, restricting the name *O. interlineata* to such forms as were moderately wide (*a*), and assigned a new name, *Orthis arcauta*, to similar broadly elliptical forms from the middle Devonian (*b*), and erected still another species, *Orthis parallelata* (*c*), for orbicular forms in which the greatest width is near the front. (See *Thiemella villosa* on p. 60.)

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*a* Paleontographica, XXX, 1853, p. 213.


*c* Geol. Trans. London, 2d ser., V. 1840, pl. xiv, fig. 14, and explanation of plate.

*d* Geol. N. Y., 4th Dist., 1843, p. 268, figs. 3 and 4 on p. 267.

*e* Pal. N. Y., IV, 1867, p. 59, pl. viii, figs. 20-29.

*f* Phillips's Pal. Foss. Cornwall and Devon, 1841, (*a*) p. 63, pl. xxvi, figs. 106 *a, b, c*, 106 *d, e, f, g, h; (b)* p. 64, pl. xxvi, figs. 107 *a, b, c; (c)* p. 64, pl. xxvi, figs. 109 *a, b, c, d.*
Hall, in 1843, recognized Sowerby’s species (*Orthis interlineata*) in the New York Devonian, but later, as previously stated, assigned the name *Orthis tioga* to that form.\(^a\)

Davidson, in 1864–69, again revised the British Devonian Dalmanellas and placed Phillips’s species *O. parallela* under *O. interlineata* as a synonym. He also recognized Phillips’s species *O. arenata* as the name for the middle Devonian forms; and the upper Devonian forms were included under the name *O. interlineata*.

C. F. Roemer (1844)\(^b\) included the German Devonian Dalmanellas under the specific names *Orthis testudinaria* and *Orthis testudinaria* var. *ventro-plana*.

These forms were later revised by Verneuil and Schnur.

In the year 1845 Verneuil\(^d\) described the species *Orthis opercularis*, which closely resembles Hall’s species *Orthis tioga*. Verneuil calls attention also to its close resemblance to *Orthis testudinaria* Dalman, and expresses the opinion that the species is identical with the form described in 1844 by C. F. Roemer under the name *Orthis testudinaria*, var. *ventro-plana*;\(^f\) The Eifelien form described by Roemer under the name *Orthis testudinaria*, was referred by Verneuil to Sowerby’s species *Orthis lunata*.

The specimen figured as the type of *Orthis opercularis* is from the Devonian limestone of the Eifel, and the form provisionally referred to the species from Russia is from the region of the Volkof River.

Schnur, in 1853 described this species,\(^g\) but his figures give it finer surface lines than are represented on Verneuil’s figures.

In 1850, Verneuil described the species *Orthis dumontiana*,\(^h\) which also closely resembles a species from the New York Chemung, *Orthis tioga* Hall, 1867. The original specimen of *O. dumontiana* was found in the Devonian limestone of Alejé near Sabero, Spain. In this same paper (1850) Verneuil cites in the list of species coming from the Devonian rocks of the mountains of Léon and Asturia two species, *Orthis gervilii* Verneuil (MS.) and *O. eifelicensis* Verneuil (MS.), without descriptions. Schnur, in the paper above cited, refers to and figures the second of these species,\(^i\) and it is clearly a Dalmanella.

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\(^a\) Geol. X. Y., 4th Dist., 1843, p. 268.

\(^b\) Brit. Dev. Brachiopoda, III, 1864–69, p. 91, pl. xvii, figs. 18–23, and p. 93, pl. xvii, figs. 13–17.

\(^c\) Rhein. Uebergangsgeb., p. 76, pl. v, figs. a, b, c, d.

\(^d\) Géologie de la Russie, II, Paléontologie (Edw. de Verneuil), 1845, p. 187, pl. viii, figs. 2 a, b.

\(^e\) Rhein. Uebergangsgeb., p. 76, pl. v, figs. 6 c, d.

\(^f\) Idem, p. 76, pl. v, figs. 6 a, b.

\(^g\) Géologie de la Russie, II, Paléontologie, p. 180.


\(^i\) Soc. Geol. de France, Bull., VII, 2d ser., 1856, p. 181, pl. vi, figs. 7 a, b, c.
Orthis eifelensis closely resembles Hall's species Orthis leonenisis (Hall, 1867). It is common in the Eifelian Devonian.

There are several other species from the European Devonian rocks belonging to this same group of Orthids, though less closely resembling species already described from New York than those cited above. The following may be mentioned:

Orthis lunata Sowerby 1839. Ludlow and Old Red also cited by Verneuil.


Orthis tetragona Verneuil. Paleontographica, 1853, p. 213.

REDEFINITION OF THE NEW YORK SPECIES.

In proposing to redefine the Devonian Dalmanellas of the New York upper Devonian, the great similarity of the European forms to ours is not overlooked. It is strongly probable that the European species are, genetically, very closely related to those of the New York Devonian. But for the purpose of discriminating geological horizons it is important to take notice of those characters by which closely related forms express their adaptation to local conditions of environment. In doing this it has been found necessary to break up some of our well-known specific groups, to give restricted definition to the types, and to apply new names to forms generally included with one of the restricted types but differing from it by the characters here emphasized. To do the same for the European forms would require more exhaustive study of the European material than is practicable at once, and when done it will not materially add to the value of our definitions of local forms for students dealing with them in practical study of our American formations, and it is believed that it can be better done after this analysis is accomplished.

SUBDIVISION OF THE GENUS INTO SPECIES.

The Dalmanellas of the upper Devonian of the New York geological province may be divided into the following groups, based upon characters which are associated with either the geographic distribution or the geologic range of the species exhibiting them.

To some of these groups specific names have already been applied. Those names have been adopted in their full sense in case the definitions do not confuse forms having different range or distribution. In case the characters selected for specific definition are so confused the author's name is retained for that part of the species which includes the forms first described by him as types of the species: and

a Sil Syst. Murch., p. 611, pl. iii, fig. 12d and pl. v, fig. 15.
b Geologie de la Russie, p. 189, pl. xiii, figs. 6 a, b, c, d, Russia and Eifel.
c Paleontographica, 1853, p. 213.
d Geologie de la Russie, p. 214.
those forms which have a different distributional or range value are removed and redescribed under a separate specific name.

The following-named specific groups are sufficiently well restricted in either their geographic distribution or geologic range to serve a useful purpose in the indication of geological horizon:

*Dalmanella leconensis* Hall, 1867. This species appears in the Chemung formation of Chautauqua and Cattaragus counties, and extends as far eastward as the Genesee Valley. It ranges from the earliest appearance of the typical Chemung fauna upward, but the limit of its upward range is not known to the writer.

*Dalmanella danbyi*, new species, appears in the Danby Dalmanella zone at the base of the Chemung formation in Schuyler, Tompkins, Chemung, and Tioga counties of central New York. It is restricted in range to the lowest 150 feet of the Cayuta member of the Chemung, that is, the *Dalmanella danbyi* zone.

*Dalmanella superses* Hall and Clarke, 1892, associated with *D. danbyi*, is found in the *Dalmanella danbyi* zone at the base of the Chemung in Steuben, Chemung, and Tioga counties.

*Thiemella villenoria*, new genus and new species, is associated with *D. leconensis* in Chautauqua County, New York.

*Dalmanella tioga* Hall, 1867, appears in the Cayuta member of the Chemung formation in Schuyler, Tompkins, Chemung, and Tioga counties, central New York. It is common in the lower Cayuta member above the *Dalmanella danbyi* zone but it is not common above the middle of that member.

*Dalmanella elmsira*, new species, appears in the Cayuta member of the Chemung formation in Chemung and Tioga counties; is common throughout the Cayuta member above the *Dalmanella danbyi* zone, but is rarely if ever seen in the Wellsburg member.

*Dalmanella carinata* Hall, 1843, appears in the third Tropideleptus zone and the upper part of the Cayuta member of the Chemung formation of Chemung and Tioga counties, central New York.

*Dalmanella allegania*, new species, appears in the lower part of the Chemung formation at Cuba, Allegany County, where it is associated with *Dalmanella leconensis*. The limits of its range are not known.

*Dalmanella virginia*, new species, appears in the Chemung formation of West Virginia; it has not been seen in New York State. The limits of its distribution and range are not known, but it is restricted according to present knowledge to the eastern extension of the Chemung basin.

**GENERAL CHARACTERS.**

Examination of the Dalmanellas in their relations of distribution and range has made some general facts clear which may be mentioned before classifying them or going into details in defining their differences.
Size.—The collections at present in hand show a geographical difference in expression of size and a definite law of increase in size on continued occupation of the area.

The species Orthis (Dalmanella) leconensis Hall is the common form in western New York, and so far as known there are no Dalmanellas in the western New York Chemung attaining a diameter of 20 mm., and rarely is a specimen seen exceeding 15 mm. in width. Further search may modify this statement.

The collections from central New York east of the Genesee River show another law. The Dalmanellas from the geological sections of Watkins Glen and Catatank quadrangles exhibit a general increase in size with each successive stage from their first appearance to their final exhibition. The first zone, called the Dalmanella danbysii zone, at the base of the Cayuta member, about 150 feet thick, contains only small individuals, the majority of which do not exceed 12 mm. in width and the largest of which probably do not exceed 15 mm. The specimens in the succeeding fossiliferous zones of the Cayuta member are rarely under 20 mm. in width and an occasional specimen reaches a width of 40 mm. In the separate fossiliferous zones of the middle and upper Cayuta the average size differs, but for each zone the variation in size is restricted within narrower limits than the extremes, showing that local conditions of environment exercised some control upon the dimensions. In some zones the average size is about 20 mm., in other zones about 25 mm. In the zones with the smaller average there is evidence of slower growth, while those of larger average give indication of luxuriance of growth. In general, however, the zones near the top of the Cayuta member exhibit larger dimensions than those of the earlier zones of the Cayuta member.

The specimens from the highest zones of the Cayuta member and the later representatives of the genus show the greatest average dimensions, about 30 mm., running up to 40 mm. or over in width.

Contour forms of shells of Dalmanella.—A comparative study of the Dalmanellas has demonstrated the importance of designating by some distinct term the form of contour or outline of the shell without regard to size or taxonomic rank assigned to the specimens. This matter of contour seems to be an expression of differential rate of growth of the shells in various directions during growth from embryonic to adult age. A shell in which the growth proceeds at a relatively uniform rate in all directions will assume a circular contour. The shells of Dalmanella grow much more rapidly toward the front than toward the cardinal side of the umbones or starting point of growth. In general the contour of a Dalmanella is deltoid, and looked at from a point vertical to the hinge line the cardinal margin presents a straight line. The contour rapidly broadens from the end of the straight part of the hinge so that the shell assumes in general
a gently curved cardinal margin. The growth from umbo directly toward the front is commonly nearly twice as rapid as the growth parallel to the hinge. The resulting effect is the production of a shell whose width is less than twice its length.

The important dimensions of the contour are those from beak to front along the median line, which is the length, and the greatest diameter attained in a direction at right angles to the length, which is the width.

Taking these two diameters, we may define the forms of contour to be as follows:

Form alpha.—Length and width, nearly equal, greatest width about half way from beak to front.

Form beta.—Width greater than length, shell elliptical, greatest width subcentral.

Form gamma.—Length and width subequal, but greatest width near front margin.

Form delta.—Length and width subequal, but greatest width near hinge line.

For all the above four forms the two valves are slightly convex.

As the growth accelerates in the direction from beak to front, the surface of the brachial valve arches upward making that valve gibbons while the opposite valve remains nearly flat and becomes in some cases concave at the margins. The actual contour around the plane of meeting of the edges of the two valves does not greatly depart from the form already designated, although the decrease in relative rapidity of growth in a lateral direction results in placing the greatest width up above the middle near the hinge line. This mode of growth is seen in species *D. carinata* and *D. virginia*, resulting in two contour forms.

Form epsilon.—Actual contour oval with width greater than length, but the brachial valve strongly arched, the pedicle valve flat or slightly convex, giving to the brachial valve an outline approaching the form delta and to the pedicle valve an elliptical form like beta, but with the greatest width near hinge line. This form is seen in *D. carinata* var. epsilon.

Form zeta.—Same as epsilon except that the pedicle valve is concave, particularly along the median line from beak to front and with the margin of shell scooping outward as seen in typical *D. carinata*.

These contour forms are not evolutionary but affect specimens at each stage of their history except in the following particulars, viz:

The form alpha dominates throughout the Chemung series; form beta is rare among the earliest small forms, but as the size increases the form beta dominates in the Cayuta member for the zone immediately following the *Dalmanella danbyi* stage. When the second stage of increase of size is attained the form gamma becomes domi-
nant, and in the upper part of the Cayuta member this form tends to throw the maximum width up toward the hinge line to make form delta. In only the highest zones are forms epsilon and zeta found.

Striae and lines.—In their definition of the genus Dalmanella, Messrs. Hall and Clarke speak of the surface as "covered with fine rounded striae."

In this, as in other cases of descriptive literature, the term stria (pl. striae) is often used in such a way as to indicate that the author refers to linear markings raised above the general surface and does not mean incised narrow grooves. In discussing the surface markings of such shells, it is important to distinguish between linear markings raised above the surface and those depressed below the surface.

From its etymology the term stria properly means a depressed furrow or channel, but for the elevated linear markings the term line is more appropriate. In this paper line (and not stria) will be used wherever the markings indicated are raised above the surface, and stria will be used only where a groove between two lines is meant or where the linear markings are actually incised below the general surface of the shell.

The radiating lines increase in number with growth of each individual by implantation of secondary lines on the sides of the primary lines; the primary line is generally retained as primary in the fascicule of secondary and tertiary lines out to the front of the shell.

Upon the initial entrance of the genus into the province, a primary radiating line occupies a median position at the beak of the brachial valve in the smaller specimens and retains its dominance there to the front. On passing upward in the series as the size increases the effect is most pronounced upon the central part of the shell. The implantation of secondary and then of tertiary lines takes place higher up toward the beak in the later forms, resulting in a fuller fasciculation of the lines at corresponding distances from beak than in the smaller species.

In this acceleration of growth the central line becomes dichotomized early in growth so that in most specimens of D. tioga, D. elmira and later forms the dominance of a median central line in the brachial valve is lost sight of and a depressed stria is dominant from very close to the beak all the way to the front in the middle of the sulcus of the brachial valves. This difference in the arrangement of the lines in the central fascicule of the brachial valve, instead of being

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regarded as indication of different race, is regarded as definite indication of the closest relationship between the several successive representatives of the genus. It is an expression of acceleration in growth coordinate with increase of size of individuals, and therefore may be ascribed to some evolitional force or forces operating upon the race, considered as a continuous series of genetically related individuals, rather than to either heredity or environment.

DESCRIPTION OF SPECIES.

DALMANELLA LEONENSIS Hall, 1867.

Plate 11, figs. 1, 2, 5, 6, 9, 10, 13, 24.

A small orthoid shell of the type of Orthis testudinaria of the Ordovician (ordinarily not over 12 mm. wide); valves subequal in thickness; the beak of the pedicle valve extends slightly beyond the hinge line; the hinge is short; greatest width of shell is at or below the middle line; in the brachial valve the sulcus is not evident at the beak but gradually indents the shells along the median line; toward the front it is broad and shallow. The central part of the pedicle valve is slightly carinated from the beak forward. Neither the sulcus nor the fold is sharply separated off from the low, curved general surface of the shell.

The surface is marked by fine radiating, elevated lines, arising at the beak in 12 to 14 primary lines which are increased by implantation of secondary lines on their sides; the secondary lines are generally in pairs. A little further along in growth these secondary lines increase to nearly the size of the center ones, when a pair of tertiary lines appear on their sides, thus forming a spreading fascicle of lines which are subequal in size at the front. The lines curve backward at the cardinal angles. They increase to 20 or 25 each side of the middle at the front margin of specimens of ordinary size.

One, two, or three concentric lines of growth occasionally appear.

The type specimens used by Hall and specimens found in the same region identified with his figures appear all to have been thin shells, as indicated by the faint expression of their muscular scars and the appearance on molds of the interior in many specimens of lines running over the place of the muscular scars.

In the molds of the interior of brachial valves there is a distinct narrow flat groove (a narrow flattened ridge in the original) separating the muscular scars but inconspicuous beyond the anterior edge of muscular scars. There is a sulcus extending from between the scars forward to the front rim of the shell where it is generally broadened and shallow. The molds of the interior of the pedicle valves are nearly evenly rounded, showing little trace of central carination, but the central part is more abruptly curved than the sides.
The hinge teeth sharply differentiate the muscular scars from the sides of the shell; the muscular scars run up to a blunt point in the pedicle area, and are bilobed anteriorly. A slight, rim-like elevation generally continues from the base of the teeth around and in front of the muscular scars.

In the brachial valves the muscular scars are generally only faintly indicated, though in specimens with thick shell they are distinguishable as four subquadrature scars occupying the deepest portion of the valve (in molds of the interior they show on the highest part of the surface), the posterior edges and the interior edges of the posterior set are most strongly differentiated from the general surface by the median ridge extending forward from the base of the cardinal process.

The crura are small at their bases, and in size inferior to the base of the cardinal process which rises abruptly from the general shell wall, and is pointed strongly backward. The space back of the muscular scars in the brachial valve is about one-tenth of the total length of the shell. It is twice as large in shells of *D. danbyi* of the same size.

In a set of specimens preserving the shell, from locality 517 A7, the lines are beautifully rounded above and separated by flattened spaces (i.e., striae) slightly broader than the lines. This appears to be a character distinguishing this species from *D. danbyi*, in which the lines are subangular.

The following specimens, representing the characteristics of the species as above restricted, are figured on Plate II.

Fig. 13 (1225 Bl, specimen No. 21), mold of interior of brachial valve.

Fig. 24 (1225 Bl, specimen No. 37), mold of interior of pedicle valve.

The numbers and letters associated with the specimens cited in this report are locality numbers of specimens listed for the U. S. National Museum. When numbers are given they are serial numbers assigned to the collections of the Devonian made by the author and his party for the U. S. Geological Survey. Example 517=Wesville, Chautauqua County, New York; 1225=Villenova, Chautauqua County, New York. In the case where the label begins with letters, the letters indicate the quadrangle, the number and letter following indicate the block of the 15-minute quadrangle. As for instance 11th, 3 K, means Ithaca 15' quadrangle, third block of the one-minute blocks from left to right, and block K of the one-minute blocks from top of quadrangle down lettered alphabetically, or the eleventh in order.

The letters and numbers following these primary marks indicate the section number and the zone of the section according to the system used in gathering and labeling the specimens. The specimens of *Dalmanellus* have been permanently mounted on tablets. In case several Dalmanellus are mounted on a single tablet serial numbers are assigned the specimens. These are indicated by the specimen numbers.
Figs. 1–2 (1225 B1, specimen No. 67–67a), mold of exteriors of brachial valve.

Figs. 5–6 (1225 B1, specimen No. 97–98), mold of exteriors of pedicle valve.

Fig 9 (517 A7+, specimen No. 24), exterior surface brachial valve.

Fig. 10 (517 A7+, specimen No. 25), exterior surface pedicle valve.

The specimens marked 1225 are from Villenova, Chautauqua County, near the eastern boundary of the town. Specimens marked 517 A7+ are from a loose slab found in Chautauqua Creek, Westville, Chautauqua County, at about 850 feet A. T. The slab is believed to come from near the base of the Chemung formation of that locality.

Comments.—The species Orthis leonensis as defined and figured by Hall'a covers three forms, namely, form alpha (figs. 3, 7, and 8 of his Plate VIII) ; form beta (figs. 4 and 6) and form gamma (fig. 5).

The form alpha, represented by Hall's figures 3, 7, and 8, is chosen as the type of the species Orthis leonensis as here restricted. No specimen of form beta has been seen by the writer in collections from Chautauqua or Cattaraugus counties. A few specimens from a quarry south of Cuba, Allegany County, have this form. As they are there associated in the same rock with typical specimens of O. leonensis it is assumed that the two forms were genetically differentiated at the time and the name Dalmanella allegania is proposed for individuals of general likeness to D. leonensis but having the form beta as described beyond.

The specimen represented by Hall's fig. 5 is associated with typical forms of D. leonensis in a series of specimens collected in the town of Villenova, Chautauqua County. These specimens present features distinct from those of D. leonensis, and for them the name Thiemella villenoria is proposed.

DALMANELLA DANYBY, new species.

Plate II, figs. 3, 4, 7, 8, 14, 15, 21, and 25.

In size and general form this species is very similar to form alpha of Orthis leonensis Hall. It differs from that species in the following characters: The elevated radiating lines tend to preserve the fasciculate character to the front, thus causing the shell to appear as covered by lines of differing size. (In D. leonensis the fasciculate character of the lines is conspicuous near the beak but inconspicuous toward the front.) The lines increase by division a little more rapidly than in D. leonensis. At the front of specimens of 10 mm. length the number of lines each side of the middle is about 30. In specimens of D. leonensis of the same size there are about 20 to 25. From the

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aPal. X. Y., IV, 1867, p. 62, pl. viii.
evidence in hand the radiating lines of \( D. \) danbyi appear to be slightly angular while in well preserved specimens of \( D. \) leonensis they are evenly rounded and the spaces between them are flat. The median sulcus on the brachial valve and the median carination on the pedicle valve are more sharply differentiated from the general slope of the surface in \( D. \) danbyi than in \( D. \) leonensis.

The cardinal process on the inside of the brachial valve of \( D. \) danbyi is more elongate, the crura are considerably stronger, and the internal muscular and vascular markings are in general stronger for shells of corresponding size than in \( D. \) leonensis.

The molds of the interior of brachial valves (the condition in which the specimens are generally found) may be quickly distinguished from \( D. \) Leonensis by their strong curae. The curae are much larger than the cardinal process: in specimens 10 mm. in length the curae reach anterior from the point of the beak about 2 mm., or are approximately one-fifth of the length of the shell. The cardinal process forms, in the interior molds, a narrow slit of less than half the length of the base of the slits representing the curae. In the ordinary form of \( D. \) danbyi, as well as in all specimens of \( D. \) leonensis at present examined, the cardinal process is simple.

In a specimen of the form \( \alpha \) (\( Dalmanella \) danbyi, var. \( \alpha \), new variety), from the \( Dalmanella \) danbyi zone at West Danby, a faint indication is seen of the trifid slitting of the cardinal process on its outer side. (See Plate II, fig. 18.)

The length of this specimen is only 10 mm., but its breadth is 14 mm. It occurs in the upper part of the \( Dalmanella \) danbyi zone in association with specimens of the ordinary form \( \alpha \) of \( Dalmanella \) danbyi. It is only about half the size of specimens of \( Dalmanella \) tioga of the same form, occurring in the strata of the Cayuta member not far above. In this form of \( D. \) tioga the trifid character of the cardinal process is distinct in all specimens examined. I have regarded this specimen as possibly a young or undeveloped form of \( D. \) tioga, but on account of its size and associations it is listed as \( D. \) danbyi, var. \( \beta \).

In no specimen of the western form, \( Dalmanella \) leonensis, has the trifid marking of the end of the cardinal process been seen, though it is not impossible that well-developed specimens may exhibit this character.

As the shell thickens (shown by the obliteration of the impressions of outer striations upon molds of the interior) the interior molds of brachial valves show a gradual increase of distinctness in the outline of the muscular impressions and the grooves for vascular channels over the surface. There is also, coordinate with this development, a contracting of the lateral and front margins forming a more gibbous shell. These facts are well exhibited in a series of
specimens from zone Dr. 7 I. 1 e. Nos. 1 to 26 belonging to the Cornell University Museum, and for the pedicle valves Nos. 27 to 41 of the same station.

The specific name *Orthis* (*Dalmanella*) *superstes* was given by Hall and Clarke to these thickened forms with vascular markings.*a* The "broad, low, median sinus" on the pedicle valve running from the middle of the valve to the front, described as a distinctive character of *O. superstes,* is not seen on specimens of *D. danbyi*.

Although the specimens of *D. danbyi* generally occur in the condition of molds, a few have been collected with the shell of the surface preserved.

In size the specimens of *D. danbyi* rarely exceed 12 mm. in width.

The following specimens are selected and figured as types of *Dalmanella danbyi* on Plate II.

Fig. 15 (1th. 3 K. 1 kk, specimen 1), mold of interior of brachial valve. (Compare with 1225 B I. 21.)

Fig. 14 (1th. 3 K. 1 oo., specimen 1), mold of interior of brachial valve. (Compare with 1225 B. I. 21.)

Fig. 25 (Dr. 7 I. 1 e., specimen 31), mold of interior pedicle valve.

Fig. 7 (Dr. 7 I. 1 e., specimen 46), mold of exterior pedicle valve.

Fig. 3 (1th. 3 K. 1 oo., specimen 2), mold of exterior brachial valve.

Fig. 8 (1th. 3 K. 1 oo., specimen 3), mold of exterior pedicle valve.

Fig. 4 (1th. 3 K. 1 rr.), mold of exterior of brachial valve.

Locality 1th. 3 K. is in West Dauby, Tompkins County, and is the typical section of the *Dalmanella danbyi* zone at the base of the Chemung formation.

Dr. 7 I. is a section on the east side of Bald Hill, Caroline, Tompkins County, and also contains the fauna of the *Dalmanella danbyi* zone.

**DALMANELLA ALLEGANIA**, new species.

Plate II, figs. 17 and 20.

This name is proposed for specimens having the form *beta* and figured by Hall*c* among the types of his species *Orthis leconensis.*

The specific character, namely, its broadly oval shape, distinguishes it from the typical *Dalmanella leconensis* of Chautauqua County.

The typical specimens measure 8 by 11 mm. and 8.7 by 12.3 mm. The surface markings and the interior markings of both valves are very similar to those of *D. leconensis.* The muscular scars of the pedicle valve are wider than in *D. leconensis.* No specimens of this form have been seen by the writer among the specimens of *D. leconensis* of Chautauqua County.

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*a* Pal. N. Y., VIII, Pt. 1, 1892, p. 342.

*b* See p. 33.

*c* Pal. N. Y., IV, p. 167, pl. viii, fig. 4.
The type specimens are from the quarry south of Cuba, Allegany County, New York, in the Chemung formation near the base; but the exact distance above the base is not ascertained.

**ORTHIS (DALMANELLA) SUPERSTES** a Hall and Clarke, 1892.

Plate 11, figs. 26 and 27.

The characters which distinguish this species from *D. danbyi*, the Devonian form of New York which is most closely resembles, are the following: In general form it is subquadrate, inflated, thick-shelled, but with surface markings much as in *D. danbyi*. The exterior of brachial valves is marked by a "shallow sinus from near beak to front which broadens toward the front." In the pedicle valve, according to the original description, "the beak is somewhat inflated and slopes evenly in all directions for nearly one-half of the shell; from this point forward is a broad low median sinus, which is most conspicuously developed in old and gibbons shells." In this character the species differs from both *D. inconcensis* and *D. danbyi*.

The interior of the brachial valve has, besides the quadrate muscular markings, two pairs of vascular channels running obliquely from them toward the margins; the first, or posterior pair, starts from the groove between the two scars of the same side and runs out obliquely toward the center of the lateral margin: the second set starts near the middle in front of the anterior scars and runs obliquely toward the antero-lateral corners of the shell.

In the interior of pedicle valves, on each side of the middle of the shell, two faint vascular channels proceed forward from the front edge of the muscular scars and diverge slightly from each other as they proceed; about halfway to the front each suddenly again divides into two smaller channels which diverge at nearly right angles from each other to near the front margin: the central branches nearly touch on the median line; the other two reach the front at about one-third distance from center to the antero-lateral angle of the shell. In Hall and Clarke's figures there is also a central branch between the two lateral channels; this has not been detected in specimens in the U. S. Geological Survey collections.

The above characters constitute the diagnostic marks by which this form is distinguished. The following specimens are selected as representative and are shown on Plate 11:

- Fig. 27 (El. 3 I, E2 No. 11), mold of interior of brachial valve.
- Fig. 26 (Dr. 7 I, E2 No. 37), mold of interior of pedicle valve.

Localities, El. 3 I is directly east of Elmira, at base of hill rising above the northern bridge crossing Newtown Creek.

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*a* Pal. N. Y., VIII, Pt. 1, p. 342, pl. Vc, figs. 44-47. Original specimens from the Chemung group near Howard, Steuben County, New York.
Dr. 7 I is on the east side of Bald Hill, Caroline, Tompkins County, New York. Both of these localities are of typical sections of the Dalmanella danbyi zone at the base of the Cayuta member of the Chemung formation.

ORTHIS TIOGA Hall.

Among the original figures illustrating Hall's species Orthis tioga a two distinct forms are recognized. Figs. 26 and 21 on Plate VIII are of form alpha; figs. 20, 22, and 29, are form beta, as those terms are used above in describing Dalmanella leonensis. The form gamma is not represented among the figures of this species. Subsquare forms in which the hinge line is long and the cardinal angles abrupt is represented in figs. 25 and 23; this is form delta. Orthis carinata Hall is an extreme of the modification expressed by form delta, and has been called forms epsilon and zeta. b

In order to discuss the geological and geographical relationship of these several forms specific names are required to represent them. The form beta, first figured by the author, is adopted in his original description as the typical form of Orthis tioga. Figs. 20 and 23 on Hall's Plate VIII are typical of that description. That form was referred to Sowerby's species O. interlineata by Hall in 1843, and the statement was made that "the figures of Sowerby correspond better with the fossils than those of Mr. Phillips. The casts, however, fig. 3 above, and 106a of the latter, very closely resemble each other, and there can be no doubt of the identity of the fossils." c

More careful study of the New York forms led Hall to refer these broadly elliptical forms (form beta) to the species Orthis tioga, but with them were associated others of the form which Phillips regarded as specifically different and to which he gave the name Orthis parallelula, placing it in his group of "orbicular orthides" instead of "elliptical orthides" in which O. interlineata was included.

The second form alpha is represented among the figures of Hall's species O. tioga by figs. 3 and 8. d To the small representatives of form alpha the names D. leonensis and D. danbyi are here given. For the large species of form alpha, such as Hall included in the species Orthis tioga, the name Dalmanella elmira is proposed.

a Pal. X. Y., IV, 1867, p. 50, pl. viii, figs. 20-29.

b See p. 46.

c Geol. X. Y., 4th Dist., 1843, p. 268.

d Hall, Pal. X. Y., IV, Brachiopodes, 1867, pl. viii.
DALMANELLA TIOGA Hall, sensu stricto.

Plate III, figs. 1, 2, 3, 4, 5, 7, 9, 10, 12.

(=Orthis tioga Hall in part.)

In the original description of Orthis tioga the form is defined as follows: "Shell transverse, broadly elliptical, about two-thirds as long as wide; length of hinge line a little greater than half the width of the shell; the extremities rounded into a general curved outline."  

Hall's figs. 20, 22, 29, and 24 on Plate VIII accompanying the description represent such a form, and they are regarded as types of the species as here restricted. The broadly elliptical form is characteristic, and the specimens are gently convex but neither gibbous nor flat. The median sulcus of the brachial valve is distinct but shallow, and the median ridge of the pedicle valve is also distinct from beak to front, but it is low and not carinated. The radiating surface lines ("striae") are distinctly fasciculated as is shown on our fig. 4, Plate III.

The cardinal process is rather small and narrow, but in well-preserved molds its subdivision into three longitudinal ridges is evident.

In dimensions the species is intermediate between the earlier forms (D. danbyi, superstes, and leonensis) and the common Chemung forms D. elmira, and carinata.

The specimens in the U. S. Geological Survey collection selected to represent this species (see Plate III) measure as follows:

Fig. 7, 12.3 by 19.5 mm.
Fig. 4, 12.9 by 19.7 mm.
Fig. 10, 16 by 25.5 mm.
Fig. 1, 13.6 by 19.7 mm.
Fig. 3, 14.9 by 22 mm.
Fig. 12, 15.4 by 21.5 mm.
Average, 14.1 by 21.3 mm.

Hall's figures on his Plate VIII measure as follows:

Fig. 20, 14.3 by 21.3 mm.
Fig. 29, 18 by 27 mm.
Fig. 22, 20 by 29 mm.

The molds of an interior and an exterior of a large brachial valve of this form from Granville center, Bradford County, Pennsylvania, 1455 B3 show the following dimensions: 25.2 by 40 mm. Plate III, figs. 2 and 5.

All of the forms mentioned above come from the lower part of the Cayuta member of the Chemung formation but above the Dalmanella danbyi zone. The species is associated with D. elmira, but D. elmira

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a Pal. N. Y., IV, 1867, p. 59.
is the prevailing form in the upper half of the Cayuta member, and
this typical form. *D. tioga*, is rare above the middle.

Specimens from the Survey collections selected to represent this
species are figured on Plate III.

Fig. 7 (El. 2K. In. No. 11), mold of interior brachial valve.
Fig. 4 (El. 6C, B6, No. 8), mold of exterior pedicle valve.
Fig. 10 (El. 7J. 1c. No. 1), mold of interior brachial valve.
Fig. 1 (El. 7J. 1c. No. 3), mold of exterior brachial valve.
Fig. 3 (El. 7J. 1c. No. 5), mold of exterior pedicle valve (distorted).

Fig. 12 (El. 7J. 1c. No. 2), mold of interior pedicle valve.

The localities represented above are:

El. 2K.—Elmira town, above Delaware, Lackawanna and Wester Railroad, on east side of river about a mile north of Big Island.

El. 6C.—Catlin, about one and a half miles south of Pine Valley
at base of hill west of Northern Central Railroad track.

El. 7J.—Section from Fitch bridge up ravine southeast side of
Hawley Hill, a few miles west of Elmira.


**DALMANELLA ELMIRA, new species.**

Plate III, figs. 6, 8, 11, 13, 14, 15, 16, 17.

(= Orthis tioga Hall (in part), as represented by figs. 21, 26, 27, and 28 on Plate VIII, Pal. N. Y., IV, 1867.)

This species differs from *O. tioga*, as restricted, by its subquadrable form; the length is from four-fifths to five-sixths the width. In the smaller as well as earlier specimens the greatest width is nearly medial, in specimens from the middle and upper Cayuta member the greatest width is in the upper third of the shell.

The typical surface form is low convex for the brachial valve, and
nearly flat, but not concave for the pedicle valve. In molds of the pedicle valve the muscular scars are convex on their outer faces. The shell is convex along the line running through the middle from beak to front; it is flat or slightly concave in typical specimens of *D. carinata*.

The typical *D. elmira* is found associated with *D. tioga* in the
lower part of the Chemung, but in the middle and upper part of the Cayuta member *D. elmira* becomes the prevailing species.

Type specimens of Dalmanella elmira are figured on Plate III as
follows:

Fig. 13 (El. 6C, B6, No. 2), mold of interior brachial valve.
Fig. 11 (El. 6C, B6, No. 3), mold of interior brachial valve.
Fig. 15 (El. 6C, B6, No. 5), mold of interior pedicle valve.
Fig. 17 (Wv. 1A, 1h, No. 1), mold of interior of brachial valve.
Fig. 8 (Wv. 1A, 1vv, No. 5), mold of exterior brachial valve.
Fig. 11 (Wv. 1A, 1vv, No. 1), mold of interior brachial valve.
Fig. 6 (Wv. 1A, 1vv, No. 2), mold of exterior of same specimen.

The localities from which these types of the species come are:
El. 6C.—Southeast corner of Catlin, Chemung County, 1½ miles south of Pine Valley, on side hill above and west of the Northern Central Railroad tracks.

Wv. 1A.—The ravine west of Spencer Lake, in northwest corner of town of Spencer, Tioga County, New York.

The specimens come from the middle portion of the Cayuta member of the Chemung formation above the *Dalmanella daniyi* zone.

**DALMANELLA CARINATA** Hall.†

Plate IV, figs. 1, 2, 4, and 6.

The distinctive specific characters of *Dalmanella carinata* are considered to be its large size (25 to 35 mm. long and larger); its form, oval with the breadth greater than length, the greatest breadth above the middle line of growth; the brachial valve convex, the greatest convexity along the center from beak to front; the pedicle valve flat to concave along the median line; in molds of the interior of the pedicle valve the muscular impression presents a flat to concave surface and elevated pointed beak. In extremely developed specimens the median carination in the pedicle valve is nearly obliterated by the broad inscoot of the surface.

The cardinal process is wide and the trifid slitting of its end is conspicuous; the crura are broadly divergent and strong. In molds of the interior of well-developed pedicle valves there is a narrow furrow running from the beak to the side of each muscular scar, representing (in the original shell) an elevated linear ridge, about a millimeter distant from, and nearly parallel to, the inner face of the hinge teeth bounding the muscular scars.

Specimens representing these characters from the U. S. Geological Survey collections are figured on Plate IV.

Fig. 4 (Wv. 1A, 1mm, No. 1), mold of interior of brachial valve.
Fig. 1 (Wv. 1A, 1www, No. 14), mold of interior of pedicle valve.
Fig. 2 (Wv. 1A, 1www, No. 15), mold of interior of pedicle valve.

The convexity of the brachial valve, the flat to concave form of the pedicle valve, and the elevation and flattening of beak of the pedicle valve produce a form similar to that of *Orthothetes*.

† N. Y. Geol. Rept. 4th Dist., 1843, p. 267; also Pal. N. Y., IV, 1867, p. 58, and pl. viii, figs. 30, 31, and 32. The specimens selected from the Geological Survey collection as representing this species are Wv. 1A, 1mm, Nos. 1 and 4, 15 and 14.
DALMANELLA CARINATA var. EPSILON, new variety.

Plate IV, figs. 3, 5, 7, 8, 9.

In the collections of Dalmanella from the Chemung in New York the two valves are always separate. This variety epsilon is founded on pedicle valves having the earlier half of the shell flattened with sharply pointed small elevated beak, but the margins of the shell are gradually or abruptly turned inward, producing a convex general form with flat or gently hollowed center of the shell, instead of the concave shell of the normal shape of the species.

These forms with convex pedicle valves are believed to be not specifically distinct from, but rather varietal modifications of, D. carinata and are adult individuals, the form resulting from an abrupt retardation of radial growth along the perimeter of the shell in later stages of its growth.

In the normal forms there is the same retardation of growth along the perimeter, but it begins early, is continuous and results in bending the margin outward instead of inward, making a concave pedicle valve.

Types of variety epsilon are represented on Plate IV by —

Fig. 3 (Ith. 3K, 1vvv, 2), mold of interior of pedicle valve.

Fig. 8 (Ith. 3K, 1vvv, 1), mold of interior of pedicle valve.

Fig. 5 (Wv. 7B, 1j1, 15). (Cornell Univ. Mus.), mold of interior of pedicle valve.

Fig. 9 (Wv. 7B, 1j1, 1). (Cornell Univ. Mus.), mold of interior of pedicle valve.

Fig. 7 (Wv. 7B, 1j1, 5), mold of interior of pedicle valve.

The localities of D. carinata and variety epsilon are Ith. 3K, 1vvv, West Danby, high up in the section a mile or so south of West Danby, upper part of Cayuta member; Wv. 7B, 1j1, section above Swartwood, from the faunule of the third or Swartwood Tropidoleptus zone at the top of the Cayuta member of the Chemung formation.

DALMANELLA VIRGINIA, new species.

Plate IV, figs. 10, 11, 12, 13, and 16.

The brachial valve of the type-specimen is subcircular in outline; dimensions 20.5 mm. long by 24.2 wide; very gibbous (8.3 mm. deep) median sulcus deep, bounded on each side by prominent rounded ridges rising 2 or 3 mm. above the bottom of the sulcus; cardinal process, crura and muscular scars strongly developed; cardinal process sharply cut longitudinally into three parts. These characters are illustrated by type-specimen No. 1 of 1380 B3 (Plate IV,
fig. 12) from near White Sulphur Springs, West Virginia, from the faunule described in U. S. Geological Survey Bulletin, No. 244 (1905), p. 35. In the list of faunule it is entered as "6 D. tioga."

The exterior of the shell is marked by coarse, uneven, radiating lines rapidly bifurcating and fasciculated as shown in fig. 11. Plate IV (type-specimen 14 of 1380 B superscript 3).

The pedicle valve is irregularly concave, with sharp beak, greatest width near cardinal margin, evenly rounded in front, a median carination extending from beak to front bounded by rounded grooves; short coarse fasciculated radiating lines, those on the carination finer and more even in size than on the sides. These characters are shown on fig. 13. Plate IV, illustrating type-specimens, No. 6 of 1380 B superscript 3. of which the dimensions are 13.4 mm long by 20.2 wide, and by specimen No. 10 of the same faunule, fig. 16 of same plate.

The interior of the pedicle valve has strong cardinal teeth, muscular scar sharply defined posteriorly, but its outlines are indistinct posteriorly; the median carination is sharp at the front edge which is indented into a shallow sinus. This is expressed by fig. 10 of Plate IV, representing a mold of the interior, No. 7, of 1380 B superscript 3.

**DALMANELLA VIRGINIA** variety BETA, new variety.

Plate IV, figs. 11 and 15.

The casts of the exterior and interior of a small elliptical specimen, from the faunule containing the typical specimens of *Dalmanella virginia*, are believed to represent a young specimen of the same species. Its form is broadly elliptical, dimensions are 6.4 mm long by 10.3 mm broad, sides evenly rounded, a well defined sulcus from beak to front, fasciculated radiating lines; in the mold of interior the mark of the cardinal process is a narrow slit; its trifid termination is distinctly evident when magnified. Surface broadly convex.

Type-specimens are figured on Plate IV.

Fig. 14 (1380 B superscript 3 specimen No. 11), exterior mold of brachial valve.

Fig. 15 (1380 B superscript 3 specimen No. 12), exterior mold of same brachial valve.


**THIEMELLA, new genus.**

In Hall's description of *Orthis leonensis* a specimen was included (fig. 5) which on the following page was referred to as possibly belonging to C. A. White's species *Orthis thiemei*, coming from the

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*a* Pal. N. Y., IV, Pt. 1, p. 62, pl. viii.

Specimens from Villenova, Chautauqua County, New York, a few miles north of Leon, Chautauqua County, where some of these forms were obtained by Hall, have been studied in connection with Dalmanella leonensis. They prove to be generically distinct from Dalmanella and for them the name Thiemella is proposed, taking the new species, Thiemella villenovia, described beyond, as the type of the genus.

The generic characters combine some of the characters of Schizophoria, Rhipidomella, and Dalmanella. In exterior form the adult specimens resemble Rhipidomella, as indicated by White, who likens the species to Western forms of Orthis (Rhipidomella) ranuvemif but the mature brachial valve has a distinct fold and the pedicle valve has a broad sinus at the front. The muscular scars of the pedicle valve are, in outline, very similar to those of Schizophoria, and the "forked septum" is less sharp than in the typical larger species of Dalmanella. The muscular scars of the brachial valve are heart shaped, not fan shaped as in Rhipidomella, and they are less distinct than in either Rhipidomella or Dalmanella. There are two radiating ridges proceeding from the crura bounding the muscular scar as in Rhipidomella. The cardinal process and crurae are described as strong, but both are confined closer to the hinge area than in Dalmanella.

The strong rounded septum "extending from the cardinal process nearly half the length of the shell," resembles Rhipidomella, though it is less sharply marked than in Dalmanella.

The surface lines are finer than Dalmanella leonensis after the first third of growth; this may, however, be a specific character of T. villenovia.

**Thiemella villenovia.** new species.

Plate 11, figs. 11, 12, 16, 19, 22, and 23.

In the young stage of growth (for the first 5 mm.) this species is undistinguishable exteriorly from specimens of Dalmanella leonensis with which it is associated. From that point onward it changes form rapidly, the distinct sulcus of the brachial valve flattens out so as to make an evenly convex surface, and in larger shells there is an elevation of the central part of the brachial valve corresponding with the distinct sinus of the opposite valve (see fig. 11). The pedicle valve in like manner begins with an elevated broadly carinated center but upon reaching the front the surface becomes centrally depressed into

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a broad sinus (see fig. 12). The radiate surface lines after the first stage of growth lose their fasciculated mode of growth and become fine and uniform over the surface, finer than on the surface of *D. leonensis*. The cardinal process and crurae are close up to the hinge line and are not conspicuous on the inner walls of the shell.

In the brachial valve the radiating, slightly elevated ridges bounding the muscular scars are dominant, other markings of the scars are inconspicuous.

In the pedicle valve the muscular scar is bilobed, the central portion of the medial septum low but running forward, as in *Schizophoria*; the diverging part of the septum is inconspicuous.

The form of the pedicle valve is narrower at cardinal than at front end but it is not so wide anteriorly as is the brachial valve. The brachial valve shows a short hinge line and a gradual increase in width to near the front where it abruptly curves into the front margin (see fig. 16). The form of the pedicle valve is nearly flat about the beak, and scoops outward toward the antero-lateral angles as in typical *Dalmanella carinata* (see figs. 12 and 22). In size the species averages about 14 mm. long by 16 mm. wide; larger specimens reach the width of 17 mm.

One of the figures given by Hall in illustration of *Orthis leonensis* representing a brachial valve and another figure of a pedicle valve referred with doubt to *Orthis thienci* White are both believed to belong to this species.

Type specimens of *Thiemella villenora* were found associated with *D. leonensis* in Dye's quarry in the eastern part of the town of Villenova, Chautauqua County, western New York. They are figured on Plate II.

Fig. 16 (1225 B1, specimen No. 31), mold of interior of brachial valve.

Fig. 19 (1225 B1, specimen No. 35), mold of interior of brachial valve.

Fig. 22 (1225 B1, specimen No. 46), mold of interior of pedicle valve.

Fig. 23 (1225 B1, specimen No. 55), mold of interior of pedicle valve.

Fig. 12 (1225 B1, specimen No. 103), mold of exterior of pedicle valve.

Fig. 11 (1225 B1, specimen No. 104), mold of exterior of brachial valve.

The specimens were collected by G. D. Harris for the U. S. Geological Survey and will be deposited in the National Museum, Washington, D. C.

*Pal. N. Y., IV, Pl. 1, pl. viii, fig. 5."
EXPLANATION OF PLATES.

PLATE II.

Dalmanella iconicusis.

Figs. 1, 2. Molds of exterior of brachial valves.
5, 6. Molds of exterior of pedicle valves.
(Specimens 9 and 10 were found at side of Chautauqua Creek in a loose slab, believed to have fallen from rocks exposed in the creek.)

Dalmanella danbyi.

Figs. 3, 4. Mold of exterior of a brachial valve.
7, 8, Mold of exterior of a pedicle valve.
14, 15. Molds of interior of brachial valves.
21, 25. Molds of interior of pedicle valves, Danby Dalmanella zone of Cayuta member, Chemung formation. Figs. 4, 8, 14, 15, 21, from West Danby, Tompkins County, New York. Figs. 7, 25, from Eastern slope Bald Mountain, Caroline, New York.

Dalmanella danbyi var. beta.

Fig. 18. Mold of interior of a brachial valve. From middle part of Danby Dalmanella zone, West Danby, New York.

Thiereilla villenoria.

Fig. 11. Mold of exterior of a brachial valve.
22, 23. Molds of interior of pedicle valves, Chemung formation, Villenova, Chautauqua County, New York.

Dalmanella allegania.

Fig. 17. Mold of interior of brachial valve.

Dalmanella superbus.

Fig. 26. Mold of interior of a pedicle valve, Danby Dalmanella zone, Chemung formation, eastern slope Bald Mountain, Caroline, Tompkins County, New York.
Plate III.

Dalmanella tioga,

Fig. 1. Mold of exterior of a brachial valve.
7. 10. Molds of exterior of brachial valves of normal size. Chemung formation, lower part of Cayuta member, Elmira, New York. (No. 7 from east side river about a mile north of Big Island; No. 10 from Hawley Hill, west of Elmira.)
12. Mold of interior of pedicle valve. Chemung formation, lower part of Cayuta member, Hawley Hill, west of Elmira.

Dalmanella clairv.

Figs. 6, 8. Molds of exterior of brachial valves. Chemung formation, Cayuta member, ravine opposite Spencer Lake, Spencer, Tioga County, New York.

Plate IV.

Dalmanella carinata,

Figs. 1, 2. Molds of interior of pedicle valves. Chemung formation, near top Cayuta member, Spencer Lake Ravine, Spencer, Tioga County, New York.

Dalmanella carinata var. epsilon.

Figs. 3, 5, 7, 8, 9. Molds of interior pedicle valves. Chemung formation, near top of Cayuta member; 3 and 8 from Seely Hill, upper part of West Danby section, West Danby, Tompkins County, New York; 5, 7, 9 from Swartwood Tropideloptus zone, top of Swartwood section, Austin Hill, Erin, Chemung County, New York.
Dalmanella virginia.

Fig. 10. Mold of interior of pedicle valve.
11. Mold of exterior of brachial valve.
12. Mold of interior of brachial valve.
13, 16. Molds of exterior pedicle valves.

Dalmanella virginia var. beta.

Figs. 14 and 15 molds of the exterior and interior of a young specimen of a brachial valve.

All the specimens of Dalmanella virginia are from the Chemung formation, White Sulphur Springs, West Virginia.

The specimens figured in this paper all belong to the collections of the U. S. Geological Survey, ultimately to be deposited in the U. S. National Museum, in Washington, except specimens fig. 7, 25, and 26 of Plate 11, and figs. 5, 7, and 9 of Plate IV, which belong to the collections of Cornell University Museum, Ithaca, New York.
Dalmanellas of the Chemung Formation.
For explanation of plate see page 62.
DALMANELLAS OF THE CHEMUNG FORMATION.

FOR EXPLANATION OF PLATE SEE PAGE 63.
Dalmanellas of the Chemung Formation.

For explanation of plate see pages 63 and 64.
DESCRIPTIONS OF THREE NEW SPECIES OF SATURNIIDAE.

By William Schaus.

I desire to put on record descriptions of three new species of Saturniidae, the types of which I have placed in the collection of the U. S. National Museum.

ORMISCODES ALBILINEA, new species.

_Male._—Head and thorax light brown. Abdomen, ochreous above, light brown below; a lateral row of black spots containing a grey dot. Wings, light brown, the veins finely ochreous. Primaries, a white shade in the cell; an oblique dark streak from base of costa to inner margin, interrupted by a broad white streak below cell from base to close to outer margin, where it is joined by a straight white streak edged on either side with darker brown and which extends from costa close to apex. Secondaries, a very faint outer whitish shade.

_Expanse._—95 mm.

_Habitat._—Goyas, Brazil.

_Type._—Cat. No. 11374, U.S.N.M.

ORMISCODES AMARILLA, new species.

_Male._—Head black; collar dark roseate. Thorax, above and below greyish brown, the patagia, which are dull yellow, covering nearly the whole thorax above. Abdomen, above black, the basal and anal segments roseate; a lateral roseate shade crossed by transverse black lines; fulvous ventrally with black spots. Wings, dull yellow. Primaries, the veins dark violaceous grey; a similar streak along costa, in cell, and below cell; an antemedial and a postmedial transverse violaceous shade; a dark red spot at end of cell. Secondaries, the outer half of veins dark violaceous grey; a roseate spot at end of cell.

_Expanse._—85 mm.

_Habitat._—Volcano of Turrialba, Costa Rica.

_Type._—Cat. No. 11375, U.S.N.M.
HELIICONISA ARPI, new species.

Male.—Body dark brown. Primaries, the base and costal margin broadly, lightish brown, sparsely irrorated with black; the inner margin to beyond middle and the outer margin dark brown, the latter with some submarginal paler brown shadings; a blackish antemedial shade outwardly straight from costa into cell, then inwardly oblique and wavy to submedian vein; a transverse black streak near end of cell, followed by some white, and a round brown spot on discocellulars; a broad whitish postmedial space from vein 7 to inner margin near angle, suffused with light brown below vein 5, incurved at cell, and below vein 3, so that the median brown space looks very much like a dog's head facing the outer margin, the spot at end of cell forming the eye; a narrow whitish shade extends from vein 7 to costa near apex. Secondaries, ochreous, the base and outer margin broadly dark brown; dark irrorations extending from outer margin on to ochreous space; underneath the primaries have the postmedial space broader, clearer, and tinged with ochreous, and a white spot at end of cell; the secondaries are paler, the ochreous space suffused with whitish.

Expanse.—95 mm.

Habitat.—Curitiba, Brazil.

Named after Mr. J. Arp. of Rio Janeiro, to whom I am indebted for this fine species.

Type.—Cat. No. 11376, U.S.N.M.
DESCRIPTION OF A NEW ISOPOD OF THE GENUS EURYCOPE FROM MARTHAS VINEYARD.

By Harriet Richardson,
Collaborator, Division of Marine Invertebrates, U. S. National Museum.

Two specimens of a new species of *Eurycope* were obtained by the U. S. Bureau of Fisheries steamer *Albatross* in 1884 off Marthas Vineyard, as well as one from Georges Bank. These specimens have been in the Peabody Museum at New Haven, Connecticut, but have recently been transferred to the U. S. National Museum collection.

References to the literature may be found on pages 701-717 of my Monograph on the Isopods of North America, Bulletin 54, U. S. National Museum, with the exception of the following, which has been published recently:


The description of the form follows:

**EURYCOPE TRUNCATA**, new species.

Body oblong-ovate, a little more than twice as long as wide. Dorsal surface smooth.

The head is wider than long, and is produced anteriorly in a truncate process which extends between the basal articles of the first pair of antenna. On either side of the median process there is a slight double emargination. The eyes are wanting. The first pair of antenna have the basal article large and dilated. There is a large and conspicuous spine on the inner margin. The second and third articles are small and feeble, and of equal length. The flagellum extends to the end of the fourth article of the peduncle of the second antenna, and is composed of about seven articles. The second antenna have the basal article short and furnished with a long, conspicuous spine on the outer margin.

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Fig. 1.—*Eurycope truncata* (1).
The second article is about twice as long as the first, and is furnished on the anterior margin with one long spine. The third article is about as long as the second, and has two spines, one on the outer and one on the inner margin. The fourth article is short, and is not furnished with any spines. The last two articles of the peduncle and the flagellum are missing. The mandibles have a well developed palp and molar process.

The first four segments of the thorax are about equal in length.

The antero-lateral angles of the first segment are drawn out on either side in one long, sharp epimeral spine. The lateral margins of the second segment are drawn out on either side in one long, sharp spine and one small spine just back of it, both epimeral. The lateral margins of the third and fourth segments are produced on either side in three spines, two small spines and one long, sharp median one, a little curved anteriorly. The last two spines are epimeral. The last three segments have the lateral margins produced on either side in one long, sharp spine directed anteriorly. The fifth and sixth segments are of nearly equal length in the median dorsal line. The seventh segment is nearly twice as long as either of the preceding segments.

The abdomen is composed of one segment. Near the base of the segment the lateral margin is produced on either side in one long, sharp spine directed anteriorly. Below these spines the lateral margins are almost straight to about the middle of the segment, where there is an abrupt indentation on either side. This indentation is followed by two long, sharp spines, one on either side, directed posteriorly. Below these two spines the lateral margins slightly converge to a truncate extremity. Just within the two indentations of the lateral margin are indications of two tiny tubercles on the dorsal surface. The uropods are placed on either side of the truncate extremity just below the second lateral spine. They are small and feeble and consist of a basal article and two branches of nearly equal length.

All the four anterior pairs of legs are missing. The three posterior pairs are similar, natatory, with the merus much enlarged and both the merus and propodus furnished with long, plumose hairs.

The operculum of the female is furnished with a small spine about the middle.
Only two specimens, both females, were taken by the U. S. Bureau of Fisheries steamer *Albatross* in 1884, off Marthas Vineyard at a depth of 1,525 fathoms in gray ooze, and one specimen, also a female, from southeast of Georges Bank at a depth of 1,769 fathoms. These specimens have been heretofore in the collection of the Peabody Museum at Yale University, and have recently been placed in the collection of the U. S. National Museum, where they have Cat. No. 38528.

This species differs from *Eurycope fragilis* Beddard, *Eurycope atlantica* Beddard, and *Eurycope caribbea* Benedict, the forms to which it is most closely allied in the truncated character of the extremity of the terminal segment and in the absence of spines on the dorsal surface of the body.

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*a* Challenger Report, XVII, 1886.

NOTES ON SOME WESTERN ORTHOPTERA: WITH THE DESCRIPTION OF ONE NEW SPECIES.

By ANDREW NELSON CAUDELL.


During the summer of 1906 the writer spent three months on the Pacific coast in company with Dr. H. G. Dyar. The main object of the expedition was the collecting and breeding of mosquitoes, but as occasion permitted some collections were made in other orders, especially Orthoptera, to which the following notes pertain.

On the way out to the coast a stop was made at El Paso, Texas, where on May 25 about an hour was spent just before dark collecting across the Rio Grande in Mexico, near Ciudad Juarez. The collecting here was quite productive, and it is to be regretted that more time could not have been spent at this point. The immediate locality collected over was a sandy desert region sparsely covered with Larrea, etc. In this shrub Bootettix argenteatus was found in some numbers and on the bare ground Trimerotropis vinculata and Heliastus aridus were common.

We spent May 30 collecting along the course of a creek at Sierra Madre, California. On June 1 we went to San Diego and the following day a trip was made to Tia Juana in Lower California. The morning of June 3 was spent in collecting near San Diego, and we returned to Los Angeles in the evening. Orthoptera were few in this region, in fact all through southern California insect life was surprisingly scarce.

On June 5 the writer proceeded to Indio and Cochella, where three days were spent collecting. This desert region is much below sea level and very hot, the thermometer registering considerably over 100 degrees during the middle of the day even at that time of the year.

From June 9 to June 12 was passed in the vicinity of Los Angeles, and on June 13 a steamer was taken at San Pedro for Santa Catalina Island, where the 14th was spent collecting back of Avalon. The ground there is hilly and rocky, vegetation scant, and insects, especially Orthoptera, not abundant.
On June 18 another trip was made to San Diego, returning to Los Angeles on June 20. On June 23 the writer started alone for various points north. While at Los Angeles collecting trips were taken to various points in the surrounding region.

On June 25 and 26 my time was spent in collecting at Guadalupe, and then the journey north was continued, a stop of one day being made at San Luis Obispo. San Francisco was reached on the evening of June 28, and on the 30th a steamer was taken for Eureka, where I arrived on the following day. Here one week was spent, when I returned south and proceeded to Chico, where I met Doctor Dyar on July 10. Together we resumed travel northward, stops being made at various points. From Sisson we ascended Mount Shasta as far as the snow line, and from Thrall we made a side trip to the Klamath Lake region in Oregon.

On July 30 we reached Portland, Oregon, and the following day stopped in Seattle, Washington. On August 1 we made a trip to Mount Rainier, returning to Seattle on August 4. At Paradise Valley, on Mount Rainier, we found insect life abundant, and, though time prohibited our lingering there for more than a few hours, we secured a number of desirable specimens.

On August 5 we proceeded to Vancouver, British Columbia, and on the following day went to Nanaimo and Wellington, on Vancouver Island. We left Wellington for Victoria on August 8, stopping at several points on the way. On August 14 we left Vancouver and traveled eastward, stopping at Laggan, Calgary, Medicine Hat, and Moose Jaw, Canada, and Portal, North Dakota. At Portal our last collecting was done, and we left there for home on August 26, reaching Washington three days later.

Following is a list of the Orthoptera observed on this trip.

**Family BLATTID.E.**

**BLATTA ORIENTALIS** Linnaeus.
One male, one female, Chico, California.

**BLATTELLA GERMANICA** Linnaeus.
One male, on steamer off the coast of California in early July.

**PERIPLANETA AMERICANA** Linnaeus.
One male, Indio, California.

**Family MANTID.E.**

**LITANEUTRIA OBScura** Scudder.
One female, Indio, California, June 5. This specimen is immature. It was found running in the desert and was very much like the surface of the ground in color.
Family PHASMIDAE.

At Ciudad Juarez, Mexico, I found two green nymphs of a Phasmid and tried to rear them to maturity, but failed. One cast its skin once, but both soon died. They have a pair of small horns and were found on *Larrea* species.

Family ACRIDIDAE.

**TELMATETTIX HESPERUS** Hancock.

One female. Sierra Madre, California. This specimen was taken on sandy ground near a creek and its ashy and brown coloration offered little contrast to its surroundings.

**BOOTETTIX ARGENTATUS** Bruner.

Four males, two females. Ciudad Juarez, Mexico, May 25. Found on *Larrea* bushes at dusk, so dark in fact that insects even in exposed positions were scarcely distinguishable. These specimens would not have been found but for their song which at that hour was very loud.

Bruner a refers with doubt the genus *Gymnus* of Scudder to the genus *Bootettix*, likewise referring *Gymnus punctatus* to the synonymy under *Bootettix argentatus*. I have a male of Scudder's species from Palm Springs, California, and have examined his type specimen, a female. I have both sexes of *Bootettix argentatus*, including the type. From a study of this material I unhesitatingly pronounce the two species distinct, but congeneric. Thus the genus *Gymnus* of Scudder is a synonym of the earlier established *Bootettix* of Bruner and its only species is valid and must be called *Bootettix punctatus*.

**OPEIA TESTACEA** Scudder?

One nymph. Dominguez, California, June 2.

**PHIBOSTROMA QUADRIMACULATUM** Thomas.

Common at Calgary and Medicine Hat, Canada. There should be recognized two forms of this common and widely distributed species. The typical form *quadrimalcatum*, having *parvum* Scudder and *lactum* Uhl as synonyms, has the elytra decidedly shorter than those of the other form, which must be known as *P. pictum* Scudder. For convenience these two forms may be differentiated on the relative length of the elytra as compared with that of the pronotum. In the typical form the elytra are three or less times as long as the pronotum, while in the long-winged *pictum* they are more than three times as long. The short-winged form is usually smaller than the long-winged variety.

**STENOBOTHRUS CURTIPENNIS** Harris.

Both macropterous and brachypterous forms taken at Portal, North Dakota.

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BRUNERIA SHASTANA Scudder.
   One female, Sisson, California.

GOMPHOCERUS CLAVATUS Thomas.
   Common at Portal, North Dakota.

PSOLGESSA BUDDIANA Bruner.
   One female, Ciudad Juarez, Mexico. This specimen has a conspicuous yellow dorsal stripe extending from the vertex of the head to the tip of the elytra. The femoral spot is also distinct, but this is not unusual.

PSOLGESSA MACULIPENNIS Scudder.
   Both sexes taken at Ciudad Juarez, Mexico.

AGENEOTETTIX SCUDDERI Bruner.
   One female, Medicine Hat, Saskatchewan, Canada.

ARPHIA PSEUDONIETANA Thomas.
   Common at Calgary, Medicine Hat, and Moose Jaw in Canada and at Portal, North Dakota.

CHIMAROCEPHALA PACIFICA INCISA Caudell.
   Two females, Sierra Madre, California, May 30. These specimens were filled with eggs.

ENCOPTOLOPHUS PARVUS Scudder.
   Four males, six females, Moose Jaw, Canada. These can not be distinguished from specimens from New Mexico now before me. Some specimens of this species are decidedly green, but the usual color is brownish. The green form was described by Bruner as montanus, but both green and brown forms from Medicine Hat and Moose Jaw, Canada, and Bozeman, Montana, were identified by him as montanus. I can find no character for separating these into two forms and am therefore constrained to consider montanus a synonym of parvus. Over fifty examples are before me.

CAMNULA PELLUCIDA Scudder.
   This common species was taken at Sisson and Eureka, California, Klamath Lake, Oregon, on Vancouver Island, British Columbia, and at Calgary, Alberta, Canada.

HIPPISCUS. species.
   Two females, Medicine Hat, Canada, and Portal, North Dakota.

LEPRUS GLAUCIPENNIS Scudder.
   Two males, one female, one nymph, Catalina Island, California. The male has the base of the wings blue like those of interior, not greenish blue as in typical specimens. Interior may yet prove to be but a form of glaucipennis.

DISSOSTEIRA CAROLINA Linnaeus.
   Common at places on Vancouver Island, British Columbia, and also taken at other points.

SPHARAGEMON AQUALE Say.
   Both sexes taken at Calgary and Medicine Hat, Canada.
SPHARAGEMON COLLARE Scudder.
Both sexes taken at Portal, North Dakota.

SPHARAGEMON VENUSTA Stål.
Both sexes taken on Santa Catalina Island, California. Also collected at Sisson and Thrall in California.

LACTISTA GIBBOSUS Saussure.
One female, Sierra Madre, California.

TRACHYRHACHIS KIOWA Thomas.
Common at Calgary, Moose Jaw, Canada, and Portal, North Dakota.

CONOZOA BEHRENSI Saussure.
Seven males, one female, Guadalupe, California, one female, San Diego, California. This species is very similar to sulcifrons but the pronotum is decidedly more rugose above and the median carina more distinctly bilobate. The pronotum is also noticeably less elongate than in sulcifrons.

CONOZOA SULCIFRONS Scudder.
Both sexes taken at Indio, California.

TRIMEROTROPIS ALBOLINEATA Bruner.
Two males, San Diego, California.

TRIMEROTROPIS CERULEIPENNIS Bruner.
Two males, Santa Catalina Island and Sisson, California.

TRIMEROTROPIS CERULEIPES Bruner.
This species was taken at Thrall and Sisson in California and at Wellington and Nanaimo on Vancouver Island, British Columbia. At the latter place they were very active, making a loud crackling noise while in the air.

This is a very variable species. The form with the apical half of the wing clouded was described by McNeill as tessellata from a single male specimen from Turkey Tanks, Arizona. I have a female from the same place taken on the same date, July 17, and it is unquestionably this species and is topotypical. The name may be used in a varietal sense but the form is certainly not specifically distinct from the typical form with the wings apically hyaline. About seventy specimens are before me and the range of variation covers both forms. The variety has about as wide a range as the typical form, the above specimens from Vancouver Island belonging to it.

TRIMEROTROPIS CITRINA Scudder.
Taken at Calgary, Alberta, Canada.

TRIMEROTROPIS KEOBELEI Bruner.
One male, Dunsmuir, California.

TRIMEROTROPIS MONTICOLA Saussure.
Both sexes taken at Calgary and Moose Jaw, Canada.

TRIMEROTROPIS OBSCURA Scudder.
Collected at Dunsmuir, California, and Ashford, Washington.
TRIMEROTROPIS SUFFUSUS Scudder.
Two females, foothills of Mount Shasta in California.

TRIMEROTROPIS TEXANA Bruner.
One male, Tia Juana, Lower California.

TRIMEROTROPIS VINICULATA Scudder.
This common and widely distributed species was taken at Ciudad Juarez, Mexico, in Lower California, at Indio, Sierra Madre, and Pasadena in California, and also on Santa Catalina Island, California.

The stigma, which is usually blue in this species, is often yellowish or colorless. In desert regions, as at Indio, this species often flies into a thorny desert shrub, when they are very difficult to secure.

TRIMEROTROPIS VINICULATA SIMILIS Scudder.
One male, Calgary, Alberta, Canada. A study of a long series of similis has resulted in my reducing it to a variety of viniculata. I have it from California, and its distribution is probably as extensive as that of viniculata.

AULOCARA ELLIOTTI Thomas.
One male, Klammth Lake, Oregon, July 27.

ANCONIA INTEGRA Scudder.
Several specimens at Indio, California, June 5. This is one of the commonest grasshoppers in this dry desert region, but even it occurs only sparingly. These grasshoppers are wild and hard to catch, especially as they often fly in thorny shrubs, where they are very difficult to get. They are protectively colored when on the ground and when flushed fly long distances, especially the females which fly much farther than the males.

HADROTETTIX TRIFASCIATUS Say.
Two females, Calgary, Alberta, Canada.

HELIASTUS ARIDUS Bruner.
Three females, four males, Ciudad Juarez, Mexico.

HELIASTUS CALIFORNICUS Thomas.
Both sexes taken at Sierra Madre, California, May 30. These beautiful little grasshoppers are fine examples of protective coloration. They were taken on sand along a creek and their color so perfectly blended with their surroundings that they would most certainly have escaped observation had they remained inactive. In specimens taken on white sand the white predominated, while one taken in a field on dark sand was mostly dark brown with darker mottlings. The varying coloration seems wholly due to surroundings. The type specimens in the U. S. National Museum are reddish, having probably been taken on similarly colored ground.
PHRYNOTETTIX ROBUSTUS Bruner.
One pair taken at Ciudad Juarez, Mexico. Notwithstanding its large size, this is an inconspicuous insect, owing to its color, which harmonizes with the surroundings. It is a clumsy creature and lives on bare, rocky ground.

SCHISTOCERCA VAGA Scudder.
Two gravid females, Sierra Madre, California, May 30.

HESPEROTETTIX FESTIVUS Scudder.
One male, three females, Indio, California. One of these females is light brown, an unusual coloration.

BRADYNOTES OBESA Thomas.
One male, foothills of Mount Shasta, in California.

MELANOPLUS BIVITTATUS Say.
Collected at Moose Jaw, Alberta, Canada, and Portal, North Dakota.

MELANOPLUS BORCKII Stal.
One male, Guadalupe, California, June 24.

MELANOPLUS DAWSONI Scudder.
Taken at Moose Jaw, Canada, and Portal, North Dakota.

MELANOPLUS DAWSONI TELLUSTRIS Scudder.
Common at Calgary and Moose Jaw, Canada, and Portal, North Dakota.

MELANOPLUS DEVASTATOR CONSPICUUS Scudder.
Collected at Chico and Thrall, California, and at Wellington on Vancouver Island, British Columbia.

MELANOPLUS DEVASTATOR OBSCURUS Scudder.
Taken at Sisson and Carpenteria, California, on lupine; also taken at Klamath Lake, Oregon.

MELANOPLUS DEVASTATOR TYPICALIS Scudder.
One male, Santa Catalina Island, California; others of both sexes on the mainland.

MELANOPLUS MONTICOLA Bruner.
Five males, six females, Laggan, Alberta, Canada. These specimens were taken high up in the mountains near Laggan, some on Mount Fairview and others near Lake Agnes.

MELANOPLUS FEMORATUS Burmeister.
One female, Sisson, California; one male, Wellington, on Vancouver Island, British Columbia.

MELANOPLUS FEMUR-RUBRUM DeGeer.
Collected at Klamath Lake, Oregon, and at Portal, North Dakota, in the United States, and at Medicine Hat in Canada.

MELANOPLUS FLAVESCENS Scudder.
One female, Indio, California, June 6.

MELANOPLUS FUSCIPES Scudder.
One male, two females, Sierra Madre, California, May 30.
PROCEEDINGS OF THE NATIONAL MUSEUM.

MELANOPLUS GLADSTONI Scudder.

Common at Calgary, Medicine Hat, and Moose Jaw, Canada. Three females from Calgary are indistinguishable from others of the same sex except that the posterior tibiae are pale greenish instead of red.

MELANOPLUS INFANTILIS Scudder.

Many specimens of both sexes taken at Calgary, Medicine Hat, and Moose Jaw, Canada, and Portal, North Dakota.

MELANOPLUS INTERMEDIUS Scudder.

Both sexes at Eureka, California, July 6.

MELANOPLUS MARGINATUS PAUPER Scudder.

Common at Guadalupe, California, where it was taken on sugar beets. Also collected at Chico, California.

MELANOPLUS PACIFICUS Scudder.

Common at Dunsmuir and Sisson, California.

MELANOPLUS PACKARDII Scudder.

Collected at Moose Jaw and Calgary, Canada.

MELANOPLUS PUNCTUS Scudder.

One pair at Sweetwater Junction, California, and one female at San Diego, California.

MELANOPLUS TENUIPENNIS Scudder.

One male, on sugar beets at Guadalupe, California, June 24.

MELANOPLUS, species.

Two females, Klamath Lake, Oregon.

MELANOPLUS WASHINGTONIANUS Bruner.

Three males, four females, Laggan, Alberta, Canada, August 17. These were taken on Mount Fairview and across the valley from that point near Lake Agnes. This is probably the insect recorded by Walker from Laggan as questionably Podisma dodgei, his record being based on a single female specimen. This species is near montanus, but the acute prosternal spine of the male and the wider mesoternal interspace of the female serve to separate it from that species.

ASEMOPLUS RAINIERENSIS Caudell.

Many specimens, both sexes and nymphs, in Paradise Valley, Mount Rainier, Washington, in August.

Family LOCUSTID.E.

PLATYLYRA CALIFORNICA Scudder.

One immature male apparently in the last stage, Sierra Madre, California, May 30.

ORCHELIMUM AGILE DeGeer.

One male, Sisson, California, in July.

XIPHIDION SALTANS Scudder.

One male, Portal, North Dakota, in August.
XIPHIDION VICINUM Morse.
One immature female, Sisson, California; one long-winged female, var. productum, at Portal, North Dakota.

CAPNORBOTES FULIGINOSUS Thomas?
One immature female, foothills of Mount Shasta in California, on a species of Ceanothus.

NEDUBA CARINATA Walker.
Three males and one immature female at Eureka, California, on July 5, and several young specimens, which probably belong to this species, at Sierra Madre, California, May 30.

NEDUBA CARINATA PICTURATA Scudder.
One male, Eureka, California, July 5.

IDIONOTUS BRUNNEUS Scudder.
Three males, Thrall, California, July 28, chirping in the evening.

IDIOSTATUS HERMANI Thomas.
One male, Dunsmuir, California, July 19; several nymphs, foothills of Mount Shasta, California, July 24.

ATELOPLUS NOTATUS Scudder.
One immature male, Indio, California, June 5. This was under the loose bark of a small dead tree in the desert.

STENOPELMATUS FUSCUS Haldemann.
Taken at Sierra Madre, Gaudalupe, and San Luis Obispo in California. At the latter place they were quite common under cow droppings, most of the specimens collected being immature. The one at Sierra Madre was found dead in a field.

CYPHODERRIS PIPERI Caudell.
Two males, Longmires Springs, Washington, at the base of Mount Rainer. These two were stridulating at night. (See Ent. News, vol. xvii, p. 335-336.)

MARS A PACIFICA Scudder.
A pair of immature specimens at Dunsmuir, California, July 20.

MARS A SALEBROSA Scudder.
One male, two females, Ashford, Washington, in August. All immature.

MARS A TUBERCULATA, new species.

*Description.*—Color ashy gray mottled with black. Antennae slender, over twice as long as the body, testaceous, apically with some of the joints darker. Head mostly pallid, somewhat infuscated behind the eyes and especially above the acute vertex, which is prolonged between the enlarged basal joints of the antennae as an elongate triangular process; palpi long, the last joint excavate beneath for three-fourths its length or more. Thorax pale brown, blackish dorso-laterally, the lower part of the lobes mottled; metanotum and mesonotum about equal in length, together about equaling the pronotum. Abdomen somewhat compressed, pale beneath.
dorsally and laterally infuscated; in the male the dorsal surface of all but the last two or three abdominal segments is covered with high acute brown tubercles, mostly about three times as high as the basal width; on the sides these tubercles grow smaller and shorter, fading entirely below: in addition to this conspicuous covering of long tubercles the abdomen of the male is ornamented above on each of the 2, 3, 4, and 5 segments by a prominent, smoothly rounded process, twice as long as the tubercles, subcylindrical, brownish in color with an oblique white \( V \)-shaped spot on the anterior surface of each toward the base: the process on the 2 segment is smaller and more conical than the others. Ceri of both sexes long and stout, but little shorter than the pronotum, simple, cylindrical and slenderly pointed in the female; in the male cylindrical, apically blunt and with a short subapical pointed branch. Legs moderate, dark and light mottled, the mottling assuming a somewhat banded form, especially on the tibiae: anterior femora about as long as the pronotum, unarmed; anterior tibiae as long as the femora, unarmed above, except apically, below armed with about three sharp spines in the apical half; intermediate legs similar to the anterior ones except the femora has a genicular spine posteriorly and the tibiae are armed above with a couple of distinct sharp spines on each side; posterior femora about four times as long as wide, moderately swollen basally above, the lower margin straight and inconspicuously dentate; posterior tibia slightly longer than their corresponding femora, straight in both sexes, armed below on the median line with two or three minute fine spines near the apex, and above with a series of triangular teeth and five long calcaria on each side, besides apical spurs; tarsi of all the legs long, the basal joint equaling in length that of the rest combined. Ovipositor stout, of moderate length, apically smooth, the teeth of the lower side of the inner valves dull.

Length.—Pronotum, male, 3 mm., female, 3.5 mm.; posterior femora, male, 8 mm., female, 10 mm.; cerci, male, 2 mm., female, 2.5 mm.; ovipositor, 5 mm.

Type.—Cat. No. 11420, U.S.N.M.
One male, one female, Eureka, California, July 5.

These specimens were taken under the loose bark of an old tree close to the ground. This is the smallest species in the genus.

Family GRYLLID.E.

**GYLLUS VOCALIS** Scudder.
One male, Santa Catalina Island, California. *Gryllus assimilis* has been recorded from this island by Rehn.

**GYLLUS PENNSYLVANICUS** Burmeister.
One male, Dunsmuir, California.
 Gryllus pennsylvanicus abbreviatus Scudder.
  Both sexes at Moose Jaw, Canada.

 Nemobius fasciatus abortivus Caudell.
  Both sexes at Calgary, Medicine Hat, and Moose Jaw, Canada, and Portal, North Dakota.

 Cecanthus argentinus Saussure.
  One male, San Diego, California, June 9.

 Myrmecophila oregonensis Bruner.
  Wellington, on Vancouver Island, British Columbia, a single immature specimen. Rev. G. W. Taylor gave me a number of other specimens of this species taken on the island by himself.

 Proc. N. M. vol. xxxiv—08—6
ON THE REVISION OF THE MOLLUSK GENUS PTERINEA GOLDFUSS.

By Henry Shaler Williams.

Of Cornell University, Ithaca, New York.

In the course of preparing descriptions of the fossils of the Chap-
man sandstone of Maine (from specimens belonging to the U. S.
National Museum in Washington), it has been found necessary to
revise the generic limits of the genus *Pterinea* as originally defined
by Goldfuss.\(^a\)

In the generic diagnosis (both the Latin and German forms of it)
Goldfuss made no mention of the surface sculpture. In the present
state of taxonomy, however, the presence or absence of radial surface
sculpture appears to be of more than specific significance.

It is therefore proposed to restrict the genus *Pterinea* to that sec-
tion of the original genus which includes the first species, *Pterinea
laris*, as type, the surface of which is normally marked only by con-
centric lines of growth; and to erect new generic groups for the other
species of Goldfuss’s genus.

The following fourteen species were placed under the generic name
*Pterinea* by Goldfuss:

1. *Pterinea laris*, the type of *Pterinea* Goldfuss, *sensu stricto*.
2. *P. ventricosa*, the type of *Micropteria* Frech.
5. *P. elongata*, a species of *Tolmaia*, new genus.
8. *P. carinata*, *Byssopteria carinata*.
9. *P. elegans*, a species of *Cypricardinia*.

\(^a\) Goldfuss, Petrefacta Germaniae, 2d ed., 1863, Pl. 2, pp. 126-129, pls. cxix. cxx.

12. *P. trigona*, *Conocardium trigona*.
14. *P. fasciculata*, the type of *Cornellites*, new genus.

Of the above list, numbers 2, 3, 7, 8, 9 and 12 are already recognized by authors as not included in Goldfuss's genus *Pterinea*. The disposition of them and the other species is indicated above at the right of the list of names.

Of the original species described by Goldfuss under the generic name *Pterinea* the following are without radial surface sculpture: *Pterinea lavis*, *P. ventricosa*, *P. bicarinata*, *P. plana* (in part as represented by figs. 4 b, c, d, e and f, not 4 a). *Pterinea lavis* is the first species described and well illustrates the genus. It is the type of the section of *Pterinea* in which there is no radial sculpture, and may appropriately be taken as the type of the genus as emended.

Genus *PTERINEA* Goldfuss (sensu stricto).

*Type.*—*Pterinea lavis* Goldfuss.

*Diagnosis.*—1. Hinge line long.

2. Valves equal in circumference but unequal in convexity; both more or less convex: the left valve always convex; the right valve in first half of growth convex but less so than the left, and low convex to flat or concave (resupinate) in the ventral part of shell at maturity.

3. Ears well developed, more or less distinctly differentiated from the body of shell, reaching to or in front of the extreme anterior edge of the body of the shell.

4. Wings more or less distinctly differentiated from the body, flattened, reaching posteriorly as far as the extreme posterior margin of the shell.

5. Body of shell with its longer axis produced ventrally at a considerable angle from the hinge line.

6. Posterior muscular scar distinct, large and more or less sharply impressed in the shell wall.

7. Anterior muscular scars small and generally strongly impressed, situated on the ear, not body, of the shell.

8. Ligamental area well defined and longitudinally striate.

9. Posterior lateral teeth (or tooth) distinct, elongate, and situated at or near the junction of wing with the body of the shell.

10. Anterior cardinal teeth distinct, short, separated from the lateral teeth, and inclined at large angle from hinge line.

11. Surface smooth with concentric growth lines of surface entire, normally not wrinkled or elevated into radial lines or ribs.

The type of the genus, *Pterinea laevis* Goldfuss, comes from the upper Coblenzian, Ems, Germany. The Ordovician species *Pterinea demissa* of Conrad, and *Avicula ampliata* Phillips of English Ordovician may belong to the genus thus emended.

(† Subgenus) **MICROPTERIA** Frech.

**Type.—** *Pterinea ventricosa* Goldfuss.

*Pterinea ventricosa* is shown by Frech to be separated from the group of *P. laevis* by the continuity of its hinge teeth and by the smallness of the anterior ear. The form of convexity of the left valve of that species is different from typical *Pterinea laevis*. *P. ventricosa* forms the type of Frech’s division “gruppe der *Pterinea ventricosa*,” regarding the character of the teeth of which he says, “und könnte wegen dieses, an Actinodesma erinnernden Merkmals zum Vertreter einer Untergattung (etwa Micropteria) erhoben werden.” This removes *P. ventricosa* from the genus *Pterinea* Goldfuss, *sensu stricto* as here emended. *Pterinea hicarinata* is a Grammysia. *Pterinea plana* Goldfuss is recognized by German authors as in part equivalent to *P. lineata*. The smooth valves will probably remain in the genus *Pterinea*.

**PTERINEA LINEATA GOLDFUSS THE TYPE OF A NEW GENUS TOLMAIA.**

Besides the typical group of *Pterineas* the original genus of Goldfuss includes several species with distinct radial surface sculpture. The *Pterineas* with fine radial lines were made by Frech the type of his “gruppe der *Pterinea lineata*” for which he gave the following diagnosis: “Linke trappe gewölbt, rechte flach. Radial streifen fein. Vorderes ohr undeutlich.” This group forms a definite and natural section of the original Goldfuss genus *Pterinea*. In the diagnosis of the genus, therefore, belong in addition to the points of difference the other positive characters of the original genus, namely, the long hinge line, but chiefly posterior to umbones; right valve resupinate:

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*a* Frech’s remark that “*Pterinea laevis* . . . zeigt zwannen Andeutungen von Radialrippen” (pl. x, fig. 3 b.). (Die Devonischen Aviculiden Deutschland, p. 80), does not invalidate the restriction above made, but furnishes reason for the opinion that generic characters like specific characters can not be regarded as absolutely fixed. In the specimen referred to by Frech there is a rudimentary puckering of the border of the outer shell lamelle in a late stage of growth. It is, however, sufficient to state that this is abnormal to the group of shells to which the emended definition of the genus *Pterinea* Goldfuss applies.

*b* Die Devonischen Aviculiden Deutschland, p. 97.

*c* Idem, p. 80.

*d* Idem, p. 79.
presence of cardinal and lateral teeth; general form of the shell; and well defined muscular scars. In *P. lineata* the radial sculpture covers the body, wing, and ears of the left valve; in the right valve the radial markings are restricted to the posterior wing.

Erecting this group into generic rank it is proposed to call it Tolmaia. Frech included as representative species in the group the species *Pterinea lineata* Goldfuss (with *Pterinea elongata* Goldfuss, *P. plana*, ex parte, f. 4. *P. lineata* Goldfuss of Sandberger, Roemer and Follmann, and *Pseudomonotis minuta* Maurer, as synonyms of *P. lineata*) and the species *Avicula expansa* Maurer as emended by Frech.

In describing the "gruppe" as a genus and applying to it a definite generic name it is intended to adopt as much as possible of Frech's definition.

**TOLMAIA, new genus.**

**Type.—*P. lineata* Goldfuss.**

**Diagnosis.—**A Pterinoid shell of medium size, the anterior ear inconspicuous ("vorderes ohr undeutlich"); fine radial sculpture marking the surface of the shells ("radial streifen fein"); combined with the following characters which the genus holds in common with *Pterinea* Goldfuss as here emended: namely, valves inequivalve; left valve convex but less so than in group of *Pterinea costata*; right valve less convex than left and flat to concave (that is, resupinate) toward its ventral end; both anterior ear and posterior wing present; ligamental area longitudinally striate; cardinal teeth short and radial; lateral teeth (or tooth) oblique, situated near junction of wing and body; anterior muscular scar well defined, small and situated on the anterior ear. The type species is from the Upper Coblenzian, Coblenz, Germany. The species *Pterinea* (*Pterinotella?*) *incurrata* Clarke may belong to this genus.

A NEW GENUS FOLLMANNELLA PROPOSED FOR PTERINEAS OF THE GENERAL FORM OF P. OSTREIFORMIS FRECH.

In the "gruppe der *Pterinana ventricosa*" Frech included a new species described by him under the name *Pterinea ostreiformis*.

This species differs from *P. ventricosa* in having fine radial lines on the left valve and in other ways. Specimens from Maine offer superficial resemblance to Frech's species, but differ from both the genus *Micropteria* Frech and the species *Pterinana ostreiformis* Frech. A Maine specimen has already been figured, and specifically named by Clarke *Pterinea mainensis," which will serve as a type for this new

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*a* From the Greek *tollac*, signifying boldness or courage.

*b* Frech, Die devonischen Aviculiden Deutschland, pp. 90, 91.

genus. For this group the name Folmannella is proposed in honor of Dr. Otto Folmann, who has rendered a lasting service to Paleontology in his work Uber Devonischen Aviculoaeen.

**Follmannella, new genus.**

*Type.*—Pterinea mainensis Clarke.

*Diagnosis.*—Pterinoid shells with low convex left valve, and flat or concave (resupinate) right valve; hinge line produced, wider than body of shell in young, but much shorter than greatest width of mature shells. Body of shell oblique, in young shells inclining backward 25 to 40 degrees from the hinge line in a straight line; in mature shells (50 mm. long and over) the lower part of the body curves backward forming a broad posterior extension, the extreme margin of which reaches considerably beyond the posterior end of the wing. This is a characteristic expression of full grown shells of this genus.

Radial sculpture on outer surface of nondecorticated left valves usually fine and numerous as in *Tolmaia*; similar sculpture on body of right valves of type species but less distinct than on left valves. Cardinal teeth, posterior lateral teeth, muscular scars, and resupination of right valve as in *Pterinea* (sensu stricto), *Tolmaia*, and *Cornellites*. Teeth not as in *Micropteria*.

The type species of this genus is from the Eodevonian of Moosehead Lake region in Somerset County, Maine.

**A new pterinoid genus Actinopterella resembling externally the aviculooid genus Actinopteria.**

Among the Pterinoid shells of Maine, specimens which at first were referred to *Actinoptera* appear to be distinctly Pterinoid, as shown by their teeth and muscular scars, but differ generically from the *Pterineas* (see *Tolmaia*) by their strongly convex right valves.

For this group of shells the generic name *Actinopterella* is proposed.

**Actinopterella, new genus.**

*Type.*—Pterinea radialis Clarke, part.

*Diagnosis.*—Oblique pterinoid shells with posterior wing and anterior ear both well developed; both valves strongly convex, left valve ventricose, with narrow oblique body; right valve generally less convex than left but convex from beak to ventral margin, not becoming resupinate. Umbones protruding slightly beyond the hinge line. Ligamental area well developed, striated; cardinal teeth present, three or four in number; lateral teeth (or tooth) well developed and close to ligamental area. A small, deep, anterior muscular scar
situated on the ear; the large posterior muscular scar is obscure. Surface ornamentation fine or strong radial ribs on body and wing and occasionally on ear of left valve; radial ribs on body of right valve occasionally strong but generally obscure. Size smaller than many pterinoids, largest specimens from Maine collections rarely over 35 mm. long.

Several species of this type have been recognized in the Chapman fauna of Maine, the description of which was in process when Clarke's paper on Some new Devonian Fossils was issued. The species referred to were found to differ from *Actinoptera* Hall in their interior characters, and they differ also from the radially sculptured *Pterinea* of Goldfuss in having the right valve convex from the beak out to the ventral margin, though less convex than the left valve (not resupinate as in my new genus *Tolmaia*.)

In the description of *Pterinea radialis* Clarke refers to teeth and anterior muscular scar in combination with an Actinopteria-like exterior, but in figuring the species he has given first two figures of the exterior of Actinopterella followed by two figures of *Folmannella*, new genus.

In citing the name *Pterinea radialis* Clarke as type of the genus the latter two figures are not included and the statement that the "hinge line is but slightly extended" does not apply to specimens of the genus *Actinopterella* although it does apply to *Folmannella* represented by the lower two figures.

*Pterinea edmundi* Clarke \(^a\) also belongs to the genus *Actinopterella*.

The description and figures of *Pterinotella peninsulae* Clarke \(^b\) also indicate molds of the interior of right valves of this same species. Because of the uncertainty and confusion occasioned by the wording and figures given under the name *Pterinea radialis* Clarke, the following brief definition of *Actinopterella radialis*, based upon specimens collected for the U. S. Geological Survey, is here given. The illustration and full discussion of the species is reserved for the monograph of the Chapman Fauna now in preparation.

**ACTINOPTERELLA RADIALIS** Clarke, sensu stricto.


**Specific diagnosis.**—Shells obliquely rhomboid; hinge line long, equaling greatest width of shell; anterior ear and posterior wing

\(^a\) Some new Devonian Fossils, p. 203. \(^b\) Idem., p. 212.
both well developed; anterior ear strong, distinctly separate from shell body; beaks protrude above the hinge line, that of left valve gibbous and larger than that of right valve; posterior margin of body protruding backward about the same distance as the posterior end of wing. Left valve ventricose, right valve convex but less so than the left. Ligament narrow and striate, developed both sides the umbone. Anterior muscular scar small but deeply incised, situated in front of the umbones at the base of foremost cardinal tooth between the ear proper and byssal sinus. Posterior muscular scar large and shallow, situated partly on body of shell, partly on the wing. Teeth several, varying in number (3 to 4); simple cardinal teeth; one or two lateral teeth situated near the edge of the hinge area and nearly, but not quite, parallel to it. Surface of left valve covered with rounded radial riblets, somewhat irregular, varying in size from fine lines to strong riblets, strongest on posterior half of body, either absent or only faintly marked on the wing or ear. Right valve either without radial sculpture, or radial lines or riblets obscure.

The specimens of this species are abundant in the Chapman sandstone on Presque Isle Stream, Chapman Plantation, Aroostook County, Maine, from which the type specimens here illustrated came.

CORNELLITES, new genus.

Type.—Pterinea fasciculata Goldfuss.

Generic diagnosis.—A strongly marked Pterinoid shell with gibbous, rather narrow oblique body (left valve); large ear, set off from body by well defined sulcus; a large, broad flat wing, abruptly set off from body; the right valve slightly convex in umbonal region, flat to resupinate ventrally. Ligamental area striate; both cardinal and lateral teeth present; posterior muscular scar distinct and anterior muscular scar smaller and strongly impressed.

The surface marked by a few strong radial ribs, with generally finer radial lines between them, and the fine concentric lamellae of growth generally evident over the radial sculpture. The radial sculpture covers the body and both wing and ear of the left valve in the type species. In other species which may be referred to the genus the sculpture on the ear is restricted to concentric lines of growth, and the radial markings on the wings may be obscure. The right valve generally lacks radial sculpture except on the posterior wings where it is obscure; occasionally the stronger radial ribs are evident upon the body of the right valve.

The name Cornellites is given in honor of Ezra Cornell, the founder of Cornell University, at which institution this description is written. The well marked section of the original genus Pterinea is represented by the species Pterinea fasciculata Goldfuss and P. costata Goldfuss.
It is also represented in America by the common Hamilton form *Pterinea flabella* Conrad.

It was recognized by Frech under the heading "gruppe der *Pterinea costata*." That species while holding the generic characters is more extreme and less typical of the generic characters than *P. fasciculata*, which is here taken as the generic type.

The genus as defined is not certainly known to appear in the Maine rocks. Clarke has described a small species from Presque Isle Stream, under the name *Pterinea cf. fasciculata* Goldfuss, and others from Dalhousie, New Brunswick, under the name *Pterinea fasciculata* Goldfuss, var. *occidentale*, but both of those forms have the right valve convex, whereas in the right valve of *Cornellites* (as in *Pterinea sensu stricto*, *Micropteria*, *Follmannella*, and *Tolmaia*) the right valve, while slightly convex at the umbonal end, rapidly flattens and before reaching the ventral margin in adult shells becomes resupinate.

In North America *Cornellites* (*Pterinea*/ *flabella* Conrad is a representative species of this genus and it is often abundant in the Hamilton rocks of New York State.

In this paper no attempt is made to go beyond the set of forms included by Goldfuss in his genus *Pterinea*. Of the accepted *Pterineas*, those of the type *P. heris*, normally without radial surface sculpture, constitute the genus *Pterinea* Goldfuss sensu stricto.

The species of type of *P. ventricosa*, without radial surface sculpture, are mentioned under the name *Micropteria* Frech. The species with fine radial sculpture of types of *P. lineata* Goldfuss are called *Tolmaia*; forms resembling *Tolmaia* in sculpture, but having biconvex shells, probably including *P. lamellosa* and *P. reticulata* are assigned to a new genus *Actinopteria*. Other forms of similar surface markings but with large shells and curved body, the ventral portion extending backward beyond the extreme end of wing, like Frech's *P. ostreiformis* in form, are called *Follmannella*, new genus; and finally the species of type *P. fasciculata* and represented in America by *Pterinea flabella* are called *Cornellites*, new genus.

In the preparation of this paper the valuable assistance of Mr. C. L. Breger is hereby acknowledged. He has thoroughly reviewed the literature bearing upon the subject and worked over the materials with the author, making several important suggestions. The author, however, is responsible for the classification and descriptions here given.
DESCRIPTIONS OF NEW SPECIES OF SOUTH AMERICAN GEOMETRID MOTHS.

By William Warren.

Of one hundred specimens submitted to me for determination by Mr. William Schaus, the following proved to be new to science, and they are accordingly characterized herewith. The types have been placed in the collection of the U. S. National Museum by Mr. Schaus.

Subfamily MECOCERATINAE.

POLYSEMIA DIVECTA, new species.

Fore wing.—Wood brown, freckled with darker brown; costal area above subcostal vein with some rough pale green scales to middle; lines and scale tufts blackish; first line from one-third of costa, bluntly rounded in cell close before the large vertical discal tuft, acutely angled basewards on submedian fold, almost touching the long basal scale tuft, again angled outwards just above submedian vein, then oblique inwards to about one-sixth of inner margin; outer line from two-thirds of costa oblique outwards, bluntly angled on veins 6 and 4 and deeply incurved between, bluntly rounded basewards nearly beneath the discal tuft on submedian fold and sharply angled outwards above submedian vein, to three-fifths of inner margin, preceded in its lower half by a slight brown shade which is inwardly limited by a fine, more or less parallel line, which above vein 4 is obscurely rounded inwards to a black costal streak above the discal tuft; submarginal line formed of pale interrupted wedge-shaped marks, inwardly filled in with darker scales, between 4 and 6, preceded and followed by black scaling; a row of black marginal lunules; fringe brown, with inner half darker.

Hind wing.—Without basal line; two antemedian diffuse brown parallel lines, sharply dentate on veins; outer line black and distinct, acutely dentate on vein 6, thence nearly straight to inner margin at two-thirds, preceded below vein 6 by a thick brown shade; a row of diffuse pale submarginal lunules, preceded by larger brown
lunules: the marginal black lunules slightly edged with whitish; discal tuft slight, linear and black, with paler scales on each side.

Under side grayish or brown, striated with fuscous, the outer half of both wings suffused with dull reddish; cell spots linear, velvety black, smaller in hind wing; three submarginal dark blotches, at costa, beyond cell, and at anal angle; inner margin of fore wing below median dull gray to middle.

Head, thorax, and abdomen like wings; face, bluntly prominent, with two dark streaks; shoulders dark brown; patagia much paler; abdomen with dark segmental rings; palpi with first and second segments externally velvety brown; abdomen beneath and legs pale.

*Expanses of wings.* — 44 mm.

*Locality.* — One male from St. Laurent, Maroni River, French Guiana. September, 1904.

Distinguished by the straight outer line of hind wings. I have seen four specimens from Rio Demerara: *P. stigmatica* Walker, (Boarmia) to which it is most closely allied, is smaller (34 mm.), and has the line of hind wing twice distinctly angled.

*Type.* — Cat. No. 11383, U.S.N.M.

**POLYSEMIA ILLINEATA, new species.**

Differs from *P. calcina* Druce as follows: The ground color of the wings is pale olive green, instead of dark; the veins are all pale ochreous, with short brown transverse striola, instead of pink; the two lines instead of being dark and clear through their pink edging, are gray, regularly lunulate-dentate, but obscure and without pale edging of any sort, the outer line being also preceded by an equally indistinct gray line; all three rise from distinct dark brown costal spots, absent in *calcina*, the first shortly before the discal tuft and therefore father from the base; the submarginal line is bluish white, not pink; the basal and discal tufts are red brown instead of green and pink; the outer line is marked by distinct dark dashes on the veins, especially clear in the hind wings. The under sides and the bodies show little difference.

*Expanses of wings.* — Female, 52 mm., slightly larger than in the same sex of *calcina*.

*Locality.* — One female from St. Jean, Maroni River, French Guiana. April, 1904.

Over and above the differences manifest in color and markings it is noticeable that the radial of the hind wing runs out into a small but distinct tooth, which is quite absent in *calcina*.

*Type.* — Cat. No. 11384, U.S.N.M.
Subfamily ORTHOSTIXINAE.

ZANCLOPTERYX CONSPERSA, new species.

Fore wing.—Whitish gray, densely speckled with fuscous, the speckles in places forming striae; the extreme hind margin with a brownish-gray suffusion; the two lines marked by dark gray spots on veins; first from two-fifths of costa to one-third of inner margin, slightly curved in cell; second from three-fifths of costa, oblique outwards to vein 6, then sinuate inwards to two-thirds of inner margin; a slight dark cell spot; a row of distinct dark marginal spots; fringe gray brown.

Hind wing.—Whiter, the speckling also fainter; the lines clearer; the antemedian thick and blackish gray, the postmedian faint and sinuous. Under side with the speckling coarser and thicker, more coalescent; both wings with simuous dark outer line, the dark inner line of hind wings showing through from above; cell spots small and black.

Head, thorax, and abdomen whitish gray, like wings.

Expansc of wings.—27 mm.

Locality.—One male from Castro, Parana, southeast Brazil.

The fore wings have the apex produced and acute; all the previously known species of the genus are white.

Type.—Cat. No. 11385, U.S.N.M.

Subfamily HYDRIOMENINAE.

ANAPALTA INCISA, new species.

Fore wing.—Olive fuscous; the lines and shadings blackish; basal patch slight, its edge waved and vertical, blackish, at one-fifth; inner edge of central fascia slightly angled inwards on cell fold and outward on submedian fold, at one-fourth, the band preceding it pale olive ochreous, without any dark dusting; outer edge at two-thirds, oblique outwards and forming a slightly bidentate projection above and below vein 6, deeply incised above vein 5, and again projecting with two strong teeth between 4 and 2; the fascia is traversed by three or four waved dark shades alternating with paler ones; all the lines from base to outer edge of fascia rise from the subcostal vein, the costal area being pale except at extreme edge; submarginal line pale and waved, the hume between 3 and 4 being broader and paler than the others, preceded above middle by a blackish cloud and followed beyond cell by a dark shade; a black interrupted marginal line; fringe fuscous, checkered with paler; cell spot blackish, indistinct.

Hind wing.—Uniform olive fuscous, with traces of a middle and outer line; fringe paler. Under side dull olive ochreous, yellower in the hind wing; the markings obscure.
Head, thorax, and abdomen olivefuscous.

Expanse of wings.—26 mm.

Locality.—One female from São Paulo, southeast Brazil.
The insect when fresh is probably greener.

Type.—Cat. No. 11386, U.S.N.M.

**ORTHONAMA? ALBESCENS,** new species.

*Fore wing.*—Dull cream color, crossed by a succession of faint gray lines, all running oblique and parallel to outer margin, slightly darker marked on the veins; costa marked with fine gray dots and atoms; marginal area beyond the outer edge of central fascia clear, with a submarginal row of gray dots on the veins; fringe with two dark gray lines and five black dots at base.

*Hind wing.*—With the lines hardly indicated and a small dark cell spot as in fore wing. Under side, especially of hind wing, with coarse rufous scaling; the postmedian lines on each wing diffusely dark; cell spots distinct.

Head, thorax, abdomen above and below, and legs, dull rufous ochreous.

Expanse of wings.—28 mm.

Locality.—One female from Colombia.

Both fore and hind wings are somewhat produced at apex; the fore wing with outer margin oblique and slightly curved.

Type.—Cat. No. 11380, U.S.N.M.

**GRAPHIDIPUS FUMILINEA,** new species.

*Fore wing.*—Whitish gray, dusted and clouded with darker; base whiter with three black marks, one on costa and inner margin, the third at base of cell; a double blackish antemedian line, acutely angled outwards on the folds and inwards on the veins, the outward angles especially distinct, accompanied by a smoky transverse cloud; postmedian and submarginal lines strongly lunulate-dentate, the teeth all pointing inwards; veins of the median area marked with black scales; the discocellular also black; marginal area smoky gray, with dull pale spots at the ends of the veins; fringe (worn) mottled gray and dark.

*Hind wing.*—Semitransparent whitish, with a gray marginal border; veins finely dark, with a row of black submarginal dashes; fringe pale. Under side dirty whitish gray, with the veins dark, except in marginal area. Face white, with a black spot above; patagia white with a black basal spot (thorax damaged); abdomen white, tinged with gray; palpi and legs black with the joints white.

Expanse of wings.—48 mm.

Locality.—One female from Colombia. This seems a very distinct species.

Type.—Cat. No. 11381, U.S.N.M.
**Genothalia Rufaria**, new species.

*Fore wing.*—Dull brick red, with dense finely darker striae; a dark cell spot, followed on vein 5 by a small yellowish patch; there are traces of an outer line marked by black and white dots on the veins; fringe concolorous.

*Hind wing.*—The same, but without any yellow spot. Under side dull yellowish gray, speckled with rufous; the fore wing redder toward outer margin.

Head and thorax rufous (abdomen wanting); antennæ strongly bipectinate.

*Expense of wings.*—30 mm.

*Locality.*—One male from Rio Janeiro, Brazil.

*Type.*—Cat. No. 11382, U.S.N.M.

**Phellinodes Megalophysa**, new species.

*Fore wing.*—Gray with a brownish tinge, thickly vermiculated with darker; costa with more distinct dark striae, especially at base; apical portion of wing beyond cell above vein 4 smoky fuscous, containing a subquadrate snow-white blotch between veins 5 and 7, around which the shading is blacker, while above it the costal area remains of the paler ground color; obliquely above the outer corner of the white blotch are two minute white dots; immediately beyond the cell above vein 4 is a diffuse black spot; fringe brownish from apex to vein 5, pale gray below.

*Hind wing.*—Like fore wing in ground color, without markings; costal area without darker freckling; outer margin diffusely darker. Under side whiter, with the freckling darker and coarser; inner half of fore wing below the cell fold to near anal angle blurred gray; the white blotch with a grayish ochreous space above it along costa.

Head, thorax, and abdomen dull gray; palpi fuscous; pectus and legs whitish.

*Expense of wings.*—44 mm.

*Locality.*—A pair from St. Jean, Maroni River, French Guiana.

*Type.*—Cat. No. 11377, U.S.N.M.

**Hammaptera Obnubilata**, new species.

*Fore wing.*—Dull olive green, traversed in basal two-thirds by dark fuscous coalescent lines, all but obliterating the ground color, the edges of the band between basal patch and central fascia being somewhat more evident; outer edge of fascia projecting beaklike on vein 4, followed by a cream-colored band suffused with pale green; beyond this pale band the terminal area is a mixture of dark green and pink, with diffuse blackish blotches at costa, beyond cell, and
above inner margin; space between veins 3 and 4 pale green, running out into the darker green fringe, which is checkered with black beyond the pairs of black spots which stand at the extremity of the veins.

**Hind wing.**—Dull yellowish white; the inner margin dark, showing the commencement of lines; fringe yellowish white, becoming gray toward anal angle, where there are also some black marginal spots.

Under side of fore wing cream color, with the dark shades blackish; space between veins 3 and 4 pale, joining the pale band beyond the fascia; apex pale; hind wing yellowish, with an interrupted dark marginal border and traces of lines; cell spots dark on both wings.

Head, thorax, and abdomen grayish ochreous; patagia, metathorax, and basal segment of abdomen greenish fuscous; dorsum blackish, with paler segmental rings; palpi and legs dark, with pale joints.

**Expanses of wings.**—39 mm.

**Locality.**—One male from Ecuador.

**Type.**—Cat. No. 11378, U.S.N.M.

HAMMAPTERA VILARIA, new species.

**Fore wing.**—Dirty whitish; the markings dull black; the whole surface having a slightly furry appearance; basal patch and center of the following band dark gray; central fascia blackish, containing pale spaces at costa and on inner margin; its inner edge indented at middle, the outer incurved beyond cell, with slight teeth below costa and two larger ones between 2 and 4; the pale band following with a dull greenish central line; presubmarginal shade blackish from costa to vein 4, gray and indistinct below; submarginal line indistinct, marked in the costal half by whitish spots; pairs of black marginal spots at the vein ends; fringe dark gray.

**Hind wing.**—Dull white, with black marginal dots and traces of submarginal line; under side of fore wing black, with the band beyond central fascia from costa to vein 4 and the whole area below it whitish; hind wing white, with black speckling; cell spots visible on both wings. Face and vertex whitish; thorax and abdomen dull gray; palpi black.

**Expanses of wings.**—30 mm.

**Locality.**—One male from Ecuador.

**Type.**—Cat. No. 11379, U.S.N.M.

HAMMAPTERA SPATIOSATA, new species.

**Fore wing.**—Greenish gray, finely dusted with dark atoms; basal patch, central fascia, and marginal area dark gray, the lines black; intervals between basal patch and central fascia and between fascia
and submarginal line broadly greenish gray, without markings; basal patch quite small, edged by a black line; central fascia narrow, constricted on submedian fold, its inner edge outcurved between subcostal vein and submedian fold; its outer acutely projecting below vein 4 and insinuate on each fold; the veins across it partially black; cell spot black in a paler space; the usual pale band and following dark line beyond fascia expressed only at costa; submarginal line wavy, pale, preceded by slight dark clouds at costa, beyond cell, and on submedian fold; pairs of black marginal spots at the vein ends; fringe concolorous.

Hind wing.—Gray, with dark cell spot, fine outer line and dark gray marginal shade beyond a paler curved band; fringe pale gray with dark spots at veins. Under side ochreous washed with dark gray, except in the upper half of the pale band beyond central fascia, which is pale and unspeckled; fore wing with outer acutely angled black shade and quadrate black apical patch fading out below middle, the margin at apex and between 3 and 4 paler; hind wing with narrow submarginal border and dotted outer line; black cell spots in both wings.

Head, thorax, and abdomen gray green.

Expansion of wings.—34 mm.

Locality.—One male from Ecuador.

Type.—Cat. No. 11388, U.S.N.M.

*HAMMAPTERA SUBNOTATA*, new species.

Fore wing.—Pale green; the lines and shades all darker green; four dark green bands are conspicuous: the first narrow and curved, forming the edge of basal patch; second and third forming the limiting bands of central fascia, the outer wider, projecting at veins 6 and 4 and lunate-edged throughout; the fourth the presubmarginal shade, containing three dark lunulate-dentate lines above middle and two below: the pale band preceding this is whitish green, traversed by a green lunulate-dentate line; the pale band following basal patch also contains in its costal half a darker green curved shade; pairs of black spots on margin at the ends of veins; fringe dark green; cell spot blackish.

Hind wing.—Brownish fuscous: with black interrupted marginal line and whitish fringe. Under side pale straw color, with black marginal border interrupted between 3 and 4 and thinning out below; fore wing also with outer black band to vein 2, angled on vein 4; hind wing with a line only; cell spots black.
Head, thorax, and abdomen green; dorsum with pairs of dark tu-
cles on each segment; abdomen beneath the legs straw color, the 
tarsi mottled with black.

*Expansie of wings.*—30 mm.

*Locality.*—One male from Peru.

Distinguished by the straw-colored under side and black bands.

*Type.*—Cat. No. 11389, U.S.N.M.

**HAMMAMPTERA THETYDARIA,** new species.

*Fore wing.*—Dull sea-green, speckled with dark gray; the basal 
patch, central fascia, and prosubmarginal shade blackish-green; basal 
patch small, crossed by two or three darker lines, its edge crenulate; 
inner edge of central fascia concave, crenulate; outer edge from two-
thirds of costa to three-fourths of inner margin, forming three small 
subcostal teeth, one above vein 7, one on each side of vein 6, vertical 
from 5 to 4, then incurved. the teeth between 2 and 4 inconspicuous; 
the fascia is traversed by darker waved lines, most conspicuous at 
costa, where it is twice as broad as at inner margin; green space below 
fascia broad, traversed by three or four irregular gray lines; the 
green band beyond it traversed by a darker green, and limited by a 
blackish green lunulate line, the inward teeth of which form dark 
marks on the veins; submarginal line forming white interrupted 
lices, preceded by a dark shade containing three lines, broad above 
4, with a rufous tinge on vein 6, narrow and vertical below 2, and in-
terrupted between: pairs of black marginal spots at the vein ends; 
fringe dark and pale green.

*Hind wing.*—Dingy whitish, with a faint green tinge; a gray lunu-
late outer and submarginal line; a blackish cell spot; fringe like 
wing. Under side of fore wing blurred fuscous to outer edge of fascia, 
separated by a greenish whitish band from a quadrate apical dark 
blotch across which the submarginal lunules show as four whitish 
spots; anal region and whole of hind wing dingy whitish speckled 
with gray; a black cell spot and curved postmedian line.

Head, thorax, and abdomen pale green varied with blackish, the 
thorax and dorsum especially dark; under side and legs dingy whit-
ish; tarsi mottled dark and light.

*Expansio of wings.*—35 mm.

*Locality.*—One male from Lombani, Peru, 9,500 feet.

*Type.*—Cat. No. 11390, U.S.N.M.

**CENOCALPE ALBIPUNCTA,** new species.

Very much like *C. ignifera* Warren from Peru, for which it might 
easily be mistaken, owing to the white spot in submarginal line be-
tween veins 3 and 4, which is common to both. Instead, however, of
the bright orange of that species, the basal area and costal half of
wing are only dull wood-brown, hardly lighter than the inner mar-
ginal area; all the lines in the present species are more waved; the
edges of the central fascia are finely limited by a white line, and the
submarginal line itself is finely white. In the hind wing the lines
and bands are almost as distinct as in the fore wing, whereas they are
very obscure in C. ignifera, and the same applies to the under side.
The male, judging from the single specimen examined, is still more
somberly colored than the female, and the lines appear less wavy.

*Expanse of wings.*—26 mm.

*Locality.*—One male and one female from Orizaba, Mexico.

*Type.*—Cat. No. 11387, U.S.N.M.

**Hydriomena lineata**, new species.

*Fore wing.*—Whitish green, thickly powdered with olive scales,
so that the whole surface appears mealy; lines black, irregular; a
thick black line close to base; then four lines, irregularly parallel to
each other, all angled outward above median vein, incurved below it,
and again oblique outwards below submedian vein; of these the first
represents the edge of basal patch, the last the inner edge of central
fascia; the two middle ones are united at each end, outer line at two-
thirds, oblique outward and angled on vein 6, vertical to 3, then in-
curved; submarginal line parallel to it, both of those swollen at costa;
between them an interrupted gray line and another waved and den-
tate close before hind margin; marginal dashes black; fringe green.

*Hind wing.*—Semitransparent in basal half, greenish fuscous,
blackish toward hind margin. Under side dirty greenish gray, with
obscure dark markings.

Head, thorax, and abdomen pale green; palpi, patagia, metathorax,
and dorsum marked with black.

*Expanse of wings.*—26 mm.

*Locality.*—One male from Orizaba, Mexico.

*Type.*—Cat. No. 11391, U.S.N.M.

**Perizoma caeruleopicta**, new species.

*Fore wing.*—Olive brown, powdered with darker fuscous and fer-
ruginous scales from base to the outer edge of central fascia, the band
between basal patch and fascia not paler; the fascia is edged with
white, diffusely sprinkled with ferruginous and olive brown, not
broadly white, as in *P. emmelesiata* Snellen, which otherwise the
species much resembles; the two bottom lunules on the outer edge of
central fascia are filled up for half the width of fascia with pale
blue; the marginal area is varied with olive brown and ferruginous
scales, the submarginal line being irregularly preceded and followed by black lunulate and wedge-shaped markings, the veins being slightly paler; the costa throughout is marked with black spots; pairs of black spots at the vein ends; fringe brown checkered with darker, the apical intervals white.

**Hind wing.**—Glossy white with a few gray speckles; marginal line dark; fringe white. Under side of fore wing brownish fuscous, with white outer band; the costa dark, with ochreous yellow spots; fringe mottled brown and white, with white base: hind wing white, thickly brown specked, with dark cell spot and outer line.

Head, thorax, and abdomen olive brown, varied with ferruginous; the dorsum with dark spots; tibiae and tarsi all mottled with black.

**Expanses of wings.**—42 mm.

**Locality.**—One male from Peru.

Larger than *emmeclesiata* Snellen; distinguished at once by the bluish blotch.

**Type.**—Cat. No. 11392. U.S.N.M.

**PSALIOIDES OLIVARIA,** new species.

**Fore wing.**—With the dark shading olive green, the pale dividing lines slightly shining, whitish or cream color; basal patch olive, edged by a fine black line sharply angled on the subcostal vein, then oblique inwards and waved; central fascia dark olive green, edged with blackish, the inner edge irregularly indented, the outer sharply angled outwards between veins 5 and 6, then oblique inwards and irregularly crenulate; at costa and inner margin the fascia is darkened with blackish scales; band before fascia with two pale olive shades, the inner the broader; band beyond fascia with two similar shades, the outer the broader, except above vein 5, where it is interrupted by the pale preceding line, an olive triangular blotch marked with dark scales between apex and vein 4; fringe pale ochreous, its basal half olive checkered with black beyond veins, the olive shade darker from apex to vein 4 and anal at angle; a slight dark cell spot.

**Hind wings.**—Olive gray, with faint cell spot and traces of a postmedian line on inner margin; fringe ochreous dotted with dark.

Under side olive ochreous toward costa of fore wing, grayer below; a dark greenish apical triangle; fringe checkered with greenish fuscous; hind wing pale ochreous with some dark olive striae, a dark cell spot, and sinuous postmedian line.

Head, thorax, and abdomen olive ochreous; legs the same, but the tibiae and tarsi mottled externally with dark greenish.

**Expanses of wings.**—18 mm.

**Locality.**—One male from Castro, Parana, Brazil.
Distinguished by the neatness and clearness of the markings, and by the absence beneath of the orange subcostal streak of fore wings.

Type.—Cat. No. 11393, U.S.N.M.

**PTEROCYPHA PAULARIA, new species.**

*Fore and hind wing.*—Exactly like *Pterocypha chama* Schaus from Paraguay, on the upper side; under side likewise greatly resembling *chama*; the cell spots large and black; followed by three dark parallel lines of which the outermost is dentate; marginal area of fore wing with a blackish submarginal costal blotch reaching vein 4, and below simply gray, the whole hind margin grayish white, the marginal line black; in the hind wing the outer line is complete across wing, and the submarginal band is complete but quite narrow except toward costa.

Abdomen with a pair of divergent brown marks on the back of each segment.

*Expanse of wings.*—52 mm.

*Locality.*—One male from São Paulo, Brazil.

Type.—Cat. No. 11394, U.S.N.M.

**STREPSIZUGA, new genus.**

A development of *Triphosa*, from which it differs in the following points: The forehead is prolonged into an acute scale cone; the palpi are triangular, heavily scaled, procumbent; the retinaculum is very largely developed, hairy, bilobed, the membrane vitreous and in certain lights highly iridescent; the frenulum in the male has a vesicular rounded transparent base, beyond which it is dark brown, and ensiform in shape, ending in an acute point, but in the basal half ligulate, and near the base constricted and twisted.

Type.—*Strepsizuga aberrans*, new species.

**STREPSIZUGA ABERRANS, new species.**

*Fore wing.*—Brown, the lines darker, toward base and along costa varied in parts with pinkish ochreous; basal line dark brown edged with ochreous, rising close to base on both margins and prominently rounded in cell; inner edge of central fascia from two-fifths of costa to two-fifths of inner margin, acutely angled outwards below subcostal vein and less sharply on median and submedian, concave outwards between the angles; the broad space between it and basal patch paler brown with dark cross lines angled like the inner edge itself; outer edge lunulate-dentate, the teeth pointing basewards, outcurved from costa at two-thirds to vein 2, then vertical, preceded by three dark brown waved lines; the inner edge is succeeded by a blackish shade containing the black cell spot; marginal third dark
brown with several waved darker lines, containing on costa a large triangular pinkish ochreous blotch, the base of which on costa is occupied by an irregular brown blotch; submarginal line obscure, but marked by a large ochreous spot above submedian fold; marginal festoon velvety brown, interrupted on veins by a pale spot; fringe brown.

Hind wing.—Paler brown; with cell spot, antemedian line, and distinct waved postmedian line darker; submarginal lines marked by black dashes on veins, and only plain toward inner margin.

Under side dull smoky brown with mere traces of lines but distinct black cell spots. Palpi, face, prothorax, and a belt at base of abdomen black brown; thorax and patagia ochreous; the rest brown like wings.

*Expanse of wings.*—44 mm.
*Locality.*—One male from Jamaica.
*Type.*—Cat. No. 11395, U.S.N.M.

**Xanthorhoe veraria**, new species.

*Fore wing.*—Dark brownish fuscous; the basal patch, the outer half of central fascia, and a band preceding submarginal line darkest; basal patch small, edged by a gray line; inner edge of central fascia slightly concave basewards, at one-third; outer edge at two-thirds, outcurved from costa to vein 2, then vertical, dentate lunate, the teeth pointing inwards and marked by pale dots on veins; similar, but less conspicuous pale dots on veins along its inner edge and that of basal patch; a dull bluish gray waved band with darker center precedes the brown submarginal band, the outside edge of which is formed by the bluish gray submarginal line; a slight oblique bluish gray shade from apex; pairs of marginal black spots at ends of veins, alternating with pale ochreous dots; fringe brown, with paler tips; an indistinct large blackish cell spot; costa marked with many small yellowish dots at the commencements of the lines.

*Hind wing.*—Duller fuscous, without basal patch; the other markings as in fore wing. Under side grayer fuscous, speckled with pale scales; the lines darker; the outer edge of central fascia with conspicuous white dashes on veins; cell spots black.

Head, thorax, and abdomen dark fuscous varied with paler scales; antennae dark fuscous, with the basal segment pale ochreous.

*Expanse of wings.*—30 mm.
*Locality.*—One male from Rinconada, Vera Cruz, Mexico.

The discocellular of the hind wing is vertical in upper third, oblique in the lower two-thirds; the radial from well above the middle; in the fore wing more than the upper half is vertical, the shorter arm oblique.

*Type.*—Cat. No. 11396, U.S.N.M.
NOTHLOBA, new genus.

Fore wing.—In the male very broad, the hind margin longer than the inner; the lower two-thirds more oblique than the upper third; in the female the hind margin is not so long as the inner margin.

Hind wing.—Small, especially in the male, with a small flap at base of inner margin in that sex.

Abdomen stout, and in the males elongated; palpi porrect, hairy, the last segment drooping; antennæ as in Rhopalodes; tongue and frenulum present, hind tibiae with 4 spurs.

Neuration.—Fore wing, as in Physoloba; hind wing in female also as in Physoloba; in the male the subcostal is separate from costal, but united at end of cell by a bar; 6 and 7 stalked; 6 reaching hind margin below middle; no radial visible; only two veins from the lower end of cell; inner margin with a full fringe and somewhat thickened.

Type.—Notholoba schausi Warren.

The discocellular in hind wing of the female is slightly triangulate and the radial rises from the lower angulation.

NOTHOLOBA SCHAUSI, new species.

Fore wing.—Grayish white, tinged with brown in basal and marginal areas; basal patch very small, limited by a dark band between two lines angled on median; inner edge of central fascia sinuous at one-third, followed by a grayish brown band; outer edge at two-thirds, bluntly angled at 6 and 4, then incurved, lunulate-dentate, the teeth pointing baswards and well marked, preceded by two similar lines and below costa by a brown band, the teeth on the veins running in to the inner band; a blackish linear cell spot in the central pale area; interval before fascia with the center brown edged by pale bands with a gray line down them; band beyond narrow, with a gray middle line; submarginal line pale and waved, preceded by a brown tinge, which forms blotches at costa and beyond cell, with the lunules outwardly edged with blackish; pairs of blackish marginal spots at the vein ends; fringe mottled dark and light gray.

Hind wing.—Rufous gray, along the costa whitish.

Under side rufous gray, the fore wing whitish along inner margin; the markings all showing slightly.

Head, thorax, and abdomen pale gray; the metathorax with a pair of dark spots; the segments of dorsum with blackish pale-edged rings.

The female is paler, with the bands blacker, but the insect is not so fresh as the male, which probably accounts for the difference.

Expansion of wings.—Male, 36 mm.; female, 40 mm.
Locality.—One male and one female from Chili.

Type.—Cat. No. 11397, U.S.N.M.

Named for Mr. William Schaus.

**PHYSOLOBA**, new genus.

*Fore wing.*—Triangular; costa arched at base and apex, straight between; hind margin obliquely curved, as long as inner margin.

*Hind wing.*—Small; both angles rounded off, with a minute blistery lobe at base of inner margin.

Abdomen of male laterally tufted toward anus; antennae as in *Rhopalodes*; palpi short and thick, hairy beneath, the terminal segment minute; tongue slight; frenulum very fine.

*Neuration.*—Fore wing, cell half as long as wing; discocellular oblique, straight; first median nervule at two-thirds, second at eleven-twelfths; radials normal; areole double; hind wing of male with costal and subcostal anastomosing for three-fourths of cell; 6 and 7 stalked; radial from center of discocellular, which is oblique as in fore wing; first median nervule quite short from one-half to middle of inner margin, second well before third; the lobe quite small, pellucid.

*Type.*—Physoloba griseofasciata, new species.

**PHYSOLOBA GRISEOFASCIATA**, new species.

*Fore wing.*—Pale gray, speckled with darker; crossed by a succession of dark gray sinuous lines; those forming the edge of basal patch and the bands of central fascia, also the presubmarginal shade from costa to middle of wing filled up with dark gray; the paler bands with dark central lines; pairs of blackish spots along margin at the vein ends; fringe pale gray.

*Hind wing.*—White.

Under side of fore wing pale gray, darker toward costa with a pale postmedian band; hind wing white; cell spots dark.

Head and thorax dark gray; abdomen paler; fore legs black, with the joints pale.

*Expanse of wings.*—25 mm.

*Locality.*—One male from Castro, Parana, southeast Brazil.

*Type.*—Cat. No. 11398, U.S.N.M.

**CAMBOGIA ROSEOCINCTA**, new species.

*Fore wing.*—Pale yellow, slightly deeper along costa and hind margin; costa with many oblique rosy streaks, indicating the beginnings of cross lines, none of which, however, are continued clearly below subcostal vein, except the submarginal, which forms a complete deep rosy curved band to anal angle; fringe yellow; cell spot red.
Hind wing.—With the rosy submarginal band; a faint cell spot and outer line rosy; this last is faintly traceable also on fore wing.

Under side suffused with rosy, most densely along costa of fore wing and hind margins of both wings, where the band becomes marginal.

Head, thorax, and abdomen yellow dusted with rosy scales; vertex and antennal shaft white, the pectinations fuscous.

Expanse of wings.—105 mm.

Locality.—One male from Rockstone, Essiquebo, Dutch Guiana, September, 1904.

Type.—Cat. No. 11399, U.S.N.M.

CALLIPIA COSTINOTATA, new species.

Fore wing.—Dingy, cinereous, darker toward apex and hind margin, without any distinct markings, except along costa; costal area from base to middle bearing dark blotches, three near base and two at middle, of which the latter is broader, separated by pale ochreous spaces which toward base are tinged with deep red; the lines, of which these costal blotches indicate the commencement, are probably plainer in some examples; fringe concolorous.

Hind wing.—Wholly cinereous.

Under side of fore wing blurred cinereous, the apical area blackish, varied with reddish and pale vermiculations; costal blotches as above; hind wing wholly blackish fuscous, with thick pale vermiculations, and indistinct traces of a pale curved fascia beyond middle: a white cell spot on upper arm of discocellular; inner margin narrowly whitish; fringes of both wings glossy cinereous, mottled with pale.

Head, thorax, and abdomen cinereous; legs cinereous, the tibiae and tarsi mottled with pale.

Expanse of wings.—35 mm.

Locality.—One male from Peru.

Type.—Cat. No. 11400, U.S.N.M.

MARMOPTERYX ELUDENS, new species.

Fore wing.—Pale dirty gray, overlaid, especially toward costa and hind margin with olive gray scales, the whole wing having a blurred look; costa with several slight dark marks, indicating lines, none of which are visible except toward hind margin, where the interspaces between the veins are marked with a double row of elongate dark blotches; fringe slightly paler gray.

Hind wing.—Pale gray; the dark interspaces of under side showing through.

Under side of fore wing darker gray, the costal area olive gray, with slight darker shading between the veins; hind wing with the cell and all the interspaces charged with coarse dark green scales.
Head, thorax, and abdomen olive gray, sprinkled with dark green scales.

*Expanse of wings.*—40 mm.

*Locality.*—One male from Peru.

*Type.*—Cat. No. 11401, U.S. N.M.

**Subfamily NEPHODINAE.**

**NEPHODIA MARCIDA**, new species.

*Fore wing.*—Semitransparent, dull whitish; costa above subcostal vein dull gray; the whitish area is bounded by a curved dark gray shade from top of discocellular to three-fourths of inner margin, beyond which the wing is smoky gray, darkest along the hind margin, the space immediately beyond the curved limiting shade showing as a curved paler fascia; veins and fringe gray; a slight gray spot at middle of inner margin.

*Hind wing.*—Similar, but the dark marginal area narrower; the costal broader.

Under side like upper; the pale space in the darker margin at its center.

Head, thorax, and abdomen whitish; palpi and antennae blackish.

*Expanse of wings.*—30 mm.

*Locality.*—One male from Bolivia.

*Type.*—Cat. No. 11402, U.S. N.M.

**Subfamily SELIDOSEMINE.**

**CALVERTIA**, new genus.

*Fore wing.*—Costa nearly straight, with only a faint curve at base and apex; apex distinct; hind margin faintly curved; inner margin somewhat convex; anal angle distinct.

*Hind wing.*—Ample; both angles and the hind margin rounded.

Antennae simple, filiform; palpi porrect, the second segment hairy, the third smooth, spatulate, slightly decumbent; abdomen with slight lateral tufts; hind tibiae of male swollen, containing a large tuft of fluffy hairs.

*Neuration.*—Fore wing, cell half as long as wing; discocellular vertical above, oblique below middle; first median nervule just beyond middle, second at seven-eighths; radials normal; both subcostal and median veins bent inwards at extremity; 7, 8, and 9 stalked from the bend; 10 and 11 separate from cell; hind wing, costal and subcostal approximated for about half of cell; veins 3 and 7 before ends of cell.

A genus of stout and strongly built insects.

*Type.*—Calvertia fumipennis, new species.

*Asestra izquierdii* Bartlett-Calvert will be referable here.

The genus is named after William Bartlett-Calvert, author of the species just mentioned.
CALVERTIA FUMIPENNIS, new species.

Fore wing.—Dull olive-tawny, striated with black, this ground color being almost hidden by black shades and smoky brown suffusion; first line from about one-fifth of costa to one-third of inner margin, angled outwards above and below median, followed by a broad blackish band, which is limited externally by the median line, starting from a black costal blotch at two-fifths, bluntly projecting outwards in middle, and incurved below; outer line from three-fifths of costa, preceded by a black shade, forming a decided tooth externally on vein 6, then incurved parallel to hind margin and humulate-dentate, followed in places by a bright pale line; submarginal line waved, very obscure, preceded on costa by a black blotch, and followed throughout by a smoky brown shade, which encroaches upon it in the middle; large black marginal lunules between the veins, beyond which lunules the base of the brown black fringe is pale ochreous; cell spot black.

Hind wing.—Smoky brown-black, the tawny ground color being restricted to the cell and space beyond it; a dark cell spot, black thick postmedian line angled on vein 6, and edged with tawny; fringe paler, with dark brown mottlings.

Under side dull tawny, with all the markings olive brown; hind wing with the postmedian line double.

Head, thorax, and abdomen fuscous brown; abdomen beneath and legs paler; tarsi black with pale joints; tibial tuft pale ochreous.

Expanse of wings.—48 mm.

Locality.—One male from Chili.

Type.—Cat. No. 11403, U.S.N.M.

CENOPTILA SEPARATA, new species.

Fore wing.—Yellow, striated with fulvous orange and lilac gray; costal streak and cross lines lilac gray; first line thick, nearly vertical and straight, at one-third, followed by some orange fulvous scaling; outer line at two-thirds of costa, concave to vein 4, then humulate-dentate, to four-fifths of inner margin; the space between the two lines below median vein is partially filled up with orange and lilac shading, and contains a black cell spot and a dark median line, which is sinuous and much nearer outer than inner line; a broad lunate submarginal band followed by another less distinct close to margin.

Hind wing.—Without inner line; the median and dentate-lunate outer line meeting on inner margin; the rest as in fore wing; the whole wing with orange fulvous speckling.

Under side dull pale ochreous, with the markings just indicated.

Head, thorax, and abdomen yellow, speckled with orange fulvous; basal segment of abdomen fulvous.
CENOTHALIA INORNATA, new species.

Fore wing.—Uniformly fawn-colored, finly speckled with dark; cell spot black; no distinct lines, these being represented by black and white vein dashes; inner line nearly vertical at one-third, the dots white-tipped baseward; outer line oblique outward from fully two-thirds of costa to vein 4, and oblique inward from 3 to inner margin, the white tips of the dots exterior; fringe concolorous.

Hind wing.—With outer series of dots only.

Under side much paler, with clearer speckling; cell spot black in fore wing.

Head, thorax, and abdomen like wings; face and palpi brown.

Expanse of wings.—26 mm.

Locality.—One male from São Paulo, southeast Brazil.

Type.—Cat. No. 11405, U.S.N.M.

THYSANOPYGA FRACTIMACULA, new species.

Fore wing.—Pale ashy gray, the marginal third darker smoky gray, covered throughout with fine dark striations; the lines dark gray, somewhat diffuse, parallel to hind margin; first near base, bent in cell; second straight just before middle, followed by the simple black cell spot; outer line slightly projecting on vein 5 and submedian fold; submarginal marked only on costa by two black lunules, which are followed above vein 7 in the apex of the wing by a blackish blotch (absent in the male), and preceded between veins 7 and 5 by a blackish cloud; marginal line black, interrupted; fringe dark gray.

Hind wing.—With three dark lines, antemedian, postmedian, and submarginal; cell spot a black ring with small white center; the whole wing smoky gray.

Under side whitish gray with grayer speckles; both wings with dark gray marginal border, and dark cell spots.

Head, thorax, and abdomen pale gray; face slightly darker.

Expanse of wings.—30 mm.

Locality.—One male and one female from Jalapa, Mexico.

The description is taken from the female which is in better condition than the male.


Type.—Cat. No. 11406, U.S.N.M.

THYSANOPYGA PALLIATA, new species.

Fore wing.—Pink and lilac gray, crossed by shades of chocolate or purple-brown; the costa black-brown to submarginal line with a dark subcostal streak of black and gray scales mixed; basal area
chocolate-brown edged by a straight, thick, deeper brown shade from below one-third of costa to beyond one-third of inner margin; cell spot vertical, silvery white, followed by the median shade which is angled outward, on median and submedian veins, concave between; outer shade close beyond, parallel to but thicker than the median, forked below middle, the outer branch running to anal angle; submarginal line fine, dentate-lunulate, the teeth dark on the veins, touching the outer shade at vein 2; a whitish tooth-shaped apical blotch reaching vein 6 and not touching hind margin; fringe brown beyond a fine dark marginal line with white dots at the vein ends.

Hind wing.—With basal patch of fore wing produced along inner margin of uniform thickness to hind margin at vein 2, including the silvery white cell spot, and almost obscuring the two curved shades answering to the median and outer shades of fore wing; submarginal line with the teeth black; the apical area chestnut brown. Under side of both wings dull brick red with dark cell spots and submarginal lines. The apex of fore wing tinged with lilac gray.

Head, shoulders, and fore legs blackish-brown; thorax and abdomen chestnut-brown; under side of abdomen and legs gray.

Expanse of wings.—35 mm.

Locality.—One female from St. Jean, Maroni River, French Guiana, July, 1904. Nearest to T. nigricosta Warren, distinguished from it and apicitruscaria Herrich-Schaeffer and its allies by the transverse shades instead of distinct lines.

Type.—Cat. No. 11407, U.S.N.M.

THYSANOPYGA PRUNICOLOR, new species.

Fore wing.—Dull purplish brown, with an admixture of lilac gray toward base; the lines deeper brown, somewhat obscure; first curved close to base; second, just before middle, parallel to hind margin; third at two-thirds somewhat waved; submarginal blotched and very indistinct; an apical white blotch containing gray scales and with a small brown patch on its costal edge; cell spot marked by a few pale scales; fringe concolorous, beyond a fine dark marginal line.

Hind wing.—With three brown lines, antemedian, postmedian, and submarginal; cell spot oval, well-defined, snow white. Under side dull lilac gray, speckled with dark; marginal border diffusely darker.

Head, thorax, and abdomen dull lilac gray.

Expanse of wings.—30 mm.

Locality.—Two females from Rio Janeiro, Brazil.

Type.—Cat. No. 11408, U.S.N.M.

The second of these examples differs somewhat from the type: the lilac gray scaling is more predominant, and in consequence the brown lines, which seem to be thicker and more waved, are clearer than in the
type; the apical spot is larger, lilac gray and not white, and in neither wing is there any trace of white cell spot; these were probably lilac gray and worn off.

**Subfamily** ENNOMINAE.

**NEREIS**, new genus.

*Fore wing.*—Triangular; costa straight till shortly before apex, which is blunt; hind margin straight; anal angle well expressed.

*Hind wing.*—With both angles rounded; hind margin slightly curved; inner margin long.

Antennæ of male ciliated; palpi upcurved in front of face; tongue and frenulum present, the latter very fine, white; hind tibiae thickened, with four short spurs and apparently without hair tuft.

*Neuration.*—Fore wing, cell half of wing; discocellular vertically concave; postmedian nervule from just beyond middle, second close before third; radials normal; 7, 8, and 9 stalked from before end of cell; 10 and 11 coincident, anastomosing at a point with 12, 10, again anastomosing at a point with 8 and 9; hind wing, costal and subcostal quite shortly approximated near base, 7 and 3 from before angles of cell.

*Type.*—*Nereis opalina*, new species.

*Syllexis* Guenee, *Gonogala* Butler, and *Gonorthus* Butler are its nearest allies; from them all it is distinguished by the entire hind margins of both wings.

**NEREIS OPALINA**, new species.

*Fore wing.*—Subtransparent, very pale greenish white; the costa cream color; two broadish white lines; the first well curved, at one-third, the outer from two-thirds of inner margin, oblique, above vein 4 bent outwards toward hind margin, shortly retracted to costa before apex, where it ends in a short streak of crimson scales; beyond this is another, rather larger, spot of red and black scales which is apparently the commencement of a submarginal line; cell spot white, like the lines; fringe pale yellow.

*Hind wing.*—Without basal line; the outer straight from just before apex to just above anal angle. Under side whiter; costa of fore wing yellowish; marginal third of both wings beyond outer line denser white. Thorax and abdomen white; palpi white, externally black-brown; face and vertex white varied with deep red; fore legs in front and antennæ ferruginous.

*Expanse of wings.*—34 mm.

*Locality.*—One male from Santiago, Cuba, January, 1905. The species might easily be mistaken for a *Dichorda*.

*Type.*—Cat. No. 11409, U.S.N.M.
DESCRIPTION OF A NEW SPECIES OF HALF-BEAK HEMIRAMPHUS MIOPRORUS) FROM NAGASAKI, JAPAN.

By David Starr Jordan and Mary C. Dickerson.
Of Stanford University.

We here present a description of an interesting new species of Half-beak, obtained at Nagasaki in Japan, by Mr. Richard C. McGregor.

HEMIRAMPHUS MIOPRORUS Jordan and Dickerson, new species.

Head $4\frac{3}{4}$ in length (from end of upper jaw to base of caudal); head with beak $2\frac{3}{4}$ in same length measurement; depth $8\frac{1}{2}$. Mandible 9 in total (from end of mandible to tips of median rays); mandible from posterior angle of mouth equals distance from same point to edge of opercle. Upper jaw broad, rounded, its width greater than its length. Gill rakers $x+18$, the longest one-sixth diameter of eye.

Dorsal 16; anal 16. Dorsal and anal nearly equal in size and nearly opposite; anal slightly posterior to dorsal. Insertion of ventrals midway between tips of median caudal rays and middle of eye, between insertion of lower lobe of caudal and edge of opercle. Length of base of dorsal $1\frac{1}{2}$ times length of beak beyond end of upper jaw. Insertion of anal to ventrals equal to distance from tip of beak to anterior margin of eye. Caudal deeply forked, the lower lobe produced, its length (from insertion) equaling the distance between ventrals and anal. Length of middle caudal rays equal to the vertical diameter of the eye. Length of pectoral equal to length of mandible beyond the upper jaw.

Scale 56. Head scaled to tip of upper jaw. scales on occiput scarcely imbricated: 38 scales in a median series on back between occiput and front of dorsal.

Color in spirits brown, lighter below. Beak and top of head blackish, upper part of lobe of
dorsal black, tips of caudal edged with blackish. A narrow, dark lateral stripe without silvery stripe below it, there being no trace of the usual silvery band. Margins of all dorsal scales outlined by dark pigment spots in the skin. Pectoral pale.

_Type._—Cat. No. 61053, U.S.N.M. Described from a specimen 20 centimeters in length, from Nagasaki, Japan. (Collected November, 1901, by Richard Crittenden McGregor.)

The species is characterized at once in the genus by its short beak, large scales and robust form. It differs from _H. sajori_, the other member of the genus known from Nagasaki, especially in the very much larger scales, as well as in the much shorter beak. It differs also in a darker, less metallic coloration, in a rounded instead of an acute upper jaw and in the less elongate body.

_Hemiramphus kuroense_, from Chikugo River, in the same island of Kiusiu, is a fresh-water fish, also large-scaled, but slenderer, with much longer beak. _H. occipitalis_ Gill, from Shimoda, seems to be the young of _H. sajori_, although its scales are not described. _Hemiramphus japonicus_, from the Riu Kiu Islands, is a typical _Hemiramphus_ with short anal, inserted under middle of dorsal, and the ventrals farther back. _Hemiramphus mioporus_, with _sajori_ and _kuroense_, belongs to the subgenus _Hyphorhamphus_, characterized by the large size of the anal fin, which is as long as the dorsal, and by the anterior insertion of the ventral fins.
FORAMINIFERA COLLECTED NEAR THE HAWAIIAN ISLANDS BY THE STEAMER ALBATROSS IN 1902.

By Rufus Matther Bagg, Jr.,
Of the University of Illinois, Urbana, Illinois.

While the examination of this material was in progress, after about 100 species of Foraminifera had been identified and described, almost the entire collection was destroyed by fire and the original scale of the report thus had to be abandoned. It is possible to give only a summary of the results derived from a study of the material saved from the fire, which consists of 19 bottles containing chiefly typical Globigerina and Pulvinulina ooze. The species, over 200 in number, represent 54 genera and are mostly characteristic of warm waters in tropical oceans.

The following method was used in the examination of the material: On a fine-grained cloth of double thickness in a long porcelain tray were poured the contents of each vial. Additional alcohol was used to thoroughly wash this ooze, and the Foraminifera were spread out on the cloth, which was then lifted out and dried over a lamp. The shells were easily shaken from the dried cloth, not dried together in lumps, and a soft brush removed from the cloth the very finest portion of the ooze that might be left after shaking. The forms thus selected were clean and white and could be spread out on black cardboard for microscopic examination. The remainder of the alcoholic solution, with the finest mud and ooze, was allowed to settle in the tray, and, with the label, was returned to the bottle from which it had been taken. With this method any radiolaria or diatoms that may have been present were left in the solution and can be further studied. The mechanical sediment likewise was saved, and the fragments of any other organisms that might be present. It was found best to examine most of the material in reflected light, and the tests were most readily studied upon a black background, for which purpose I used thick glossy cardboard which had been glued to a glass slide.
The mounting and extraction of Foraminifera can be accomplished in many ways. An excellent description of such work is to be found in Chapman’s *The Foraminifera* (chap. xix, pp. 291-326). It is, however, rather expensive and tedious to mount on separate cover under glass every species recognized, and I therefore used the following method: The specimen to be preserved was fastened with strong glue upon a slip of heavy white paper which had been blackened with india ink where the specimen was to be mounted. On this slip of paper was put also the number and description of the dredging station and the name of the species mounted. Two specimens upon different surfaces are generally all that is required for future use, although it is desirable to have a side aspect of the test, and this requires some skill to keep the form in place until it is permanently fixed. If in future these forms are wanted for other purposes they can readily be detached by strong vinegar and washed quickly in alcohol and water. A wet brush enables one to pick up the tiny shells with considerable rapidity and to hold them in any desired position while studying them.

Only brief descriptions of species have been given in most instances in this report, but new forms and also some of the more important known types have been discussed quite fully. The new forms are bottled separately and marked “Type,” and have been deposited in the U. S. National Museum. While I have not separately mounted from every bottle of dredgings each species as it repeatedly occurred, every form identified has been selected and mounted by the method described, and in many instances a single form has been prepared again and again as particularly instructive and characteristic. In the arrangement of the classification of species given in this paper we have followed the order adopted by the British authorities on the Rhizopoda, W. K. Parker, T. R. Jones, W. B. Carpenter, and amended by H. B. Brady and the later writers, C. D. Sherborn and Frederick Chapman.

The first reference of each form listed is that of the original description of the species. Much valuable information has been obtained from the exhaustive monographs by Prof. H. B. Brady in the Challenger Report, and by Dr. Alexander Goes on Arctic and Scandianavian recent marine Foraminifera, and the excellent report on recent Foraminifera by Dr. James M. Flint. Mention should be made also of such invaluable works as Williamson’s *Recent Foraminifera of Great Britain* (Ray Society, 1858); Brady, Parker, and Jones on some Foraminifera from Abrohlos Bank (1888) Chapman’s *The*

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Foraminifera (1902); and d’Orbigny’s Foraminifera of the Vienna Basin (1846), which have been found indispensable.

There are some anomalies concerning the bathymetric range of a number of species mentioned in this report. The occurrence of few deep-water types in those stations beyond 1,000 fathoms is not easily accounted for, but it must be remembered that many of these Foraminifera are of almost universal distribution, and some that are recognized and described are not at all common or abundant and would not be considered as determining the probable depth of the ocean from whence they came. Systematists on the Foraminifera can not be too careful on this point. It is well known that the temperature of the great oceans is fairly constant below a few hundred fathoms, and the distribution of life is on the whole quite largely dependent upon the distribution of the food supply as well as upon temperature of the water in which these organisms live. Then again some forms are pelagic in habit and can easily be found after death in bottom material in an occasional specimen. It is but proper to state that we have considerable evidence of rather shallow water, say not over 500 fathoms, in the material studied, while the facts show that a number of the stations are considerably over 1,000 fathoms in depth. Those species which reach their maximum development and are most abundant in each station determine more safely the relative depth than do any occasional specimens obtained from the same locality. Bryozoa, Mollusca, both lamellibranchs and gastropods, are found in a number of bottles, also fragments of shells from stations below 200 fathoms, and this is rather hard to explain unless they have been carried outward by tidal or other ocean currents in rapid motion.

The greatest variety of forms was obtained at Station 4694, from which 62 species were determined. The smallest number (1) came from Station 4579, where the material was chiefly mechanical sediment. Mollusca were present in some of the dredgings, particularly tiny gastropods, with an occasional lamellibranch, often very beautifully colored. Ostracoda of several genera were quite prominent. Diatoms and radiolarians in a few instances were met with, also fragments of corals and bryozoans. In a few bottles small mouth plates of fishes were present. There were a large number of sponge spicules (siliceous), and in some bottles fragments of volcanic glass and land-derived sand grains with opalescent quartz. Phosphatic nodules which dissolve very readily in acids appear in some localities.

Most of the Foraminifera in this collection belong to calcareous types with perforate tests, but the Miololidae are well represented in some stations. The species Candeina nitida, Globigerina aquilatervalis, Globigerina bulloides, Orbulina universa, Pulvinulina menardii, and Pulvinulina micheliniana are present in nearly every station’s
The genus *Bolivina* is represented by many species and they are abundant in nearly all instances. The genera *Bigenerina*, *Bolivina*, *Pulvinulina*, *Sagraina*, *Urirgerina*, and *Virgulina* have each a new species.

**Stations represented in Foraminifera collections.**

[D. Dredging station; H. Hydrographic station.]

<table>
<thead>
<tr>
<th>Allatross station number</th>
<th>Depth in fathoms</th>
<th>No. of species</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>D. 1000...</td>
<td>104-213</td>
<td>55</td>
<td>Coarse concretionary shell material.</td>
</tr>
<tr>
<td>D. 4017...</td>
<td>206</td>
<td>47</td>
<td>Fine foraminiferal ooze.</td>
</tr>
<tr>
<td>D. 4025...</td>
<td>275-368</td>
<td>41</td>
<td>Fine Globigerina ooze, <em>Pulvinulina</em> of <em>menardii</em> type, not abundant.</td>
</tr>
<tr>
<td>D. 4174...</td>
<td>735-845</td>
<td>45</td>
<td>Typical Globigerina ooze.</td>
</tr>
<tr>
<td>H. 4230...</td>
<td>1,544</td>
<td>47</td>
<td><em>P. menardii</em> abundant and typical.</td>
</tr>
<tr>
<td>H. 4430...</td>
<td>1,250</td>
<td>31</td>
<td>Diatoms present, fine silt and ooze.</td>
</tr>
<tr>
<td>H. 4476...</td>
<td>438</td>
<td>25</td>
<td>Very coarse shell material, Globigerina few, Amphipectina abundant.</td>
</tr>
<tr>
<td>H. 4502...</td>
<td>1,542</td>
<td>36</td>
<td>Gray Globigerina ooze, <em>G. rubra</em> very abundant.</td>
</tr>
<tr>
<td>H. 4546...</td>
<td>485</td>
<td>52</td>
<td>Phosphatic nodules, <em>Urirgerina</em> common.</td>
</tr>
<tr>
<td>H. 4555...</td>
<td>1,398</td>
<td>41</td>
<td>Brown fine silt, <em>P. menardii</em> abundant.</td>
</tr>
<tr>
<td>H. 4566...</td>
<td>572</td>
<td>58</td>
<td>Typical Globigerina ooze, <em>Pulvinulina</em> abundant and beautiful.</td>
</tr>
<tr>
<td>H. 4567...</td>
<td>1,397</td>
<td>51</td>
<td><em>Pulvinulina</em> abundant.</td>
</tr>
<tr>
<td>H. 4568...</td>
<td>1,274</td>
<td>41</td>
<td>Diatoms; <em>Pulvinulina</em> not abundant.</td>
</tr>
<tr>
<td>H. 4571...</td>
<td>384</td>
<td>41</td>
<td>Gray Globigerina ooze, <em>G. macrospira</em> very abundant.</td>
</tr>
<tr>
<td>H. 4579...</td>
<td>387</td>
<td>4</td>
<td>A few gastropods and small shells.</td>
</tr>
<tr>
<td>H. 4585...</td>
<td>589</td>
<td>10</td>
<td><em>G. quadrilobata</em> abundant. Considerable black sand present.</td>
</tr>
<tr>
<td>H. 4590...</td>
<td>378</td>
<td>22</td>
<td>Fine silty ooze.</td>
</tr>
<tr>
<td>H. 4694...</td>
<td>365</td>
<td>62</td>
<td>Typical Globigerina ooze, Cristallaria abundant.</td>
</tr>
<tr>
<td>H. 4856...</td>
<td>357</td>
<td>47</td>
<td>Cristallaria abundant.</td>
</tr>
</tbody>
</table>

Illustrations of the new species described are shown on Plate V, which will be found at the end of the paper.

**DESCRIPTIVE LIST.**

**Family MILIOLIDÆ.**

**Subfamily NUBECULARIINÆ.**

**Genus NUBECULARIA.**

**NUBECULARIA INFLATA** Brady.

*Nubecularia inflata* Brady, Chal. Rept., IX, 1884, p. 135, pl. 1, figs. 5-8.

"Test consisting of a few misshapen, inflated segments, irregularly combined: aperture either single and simple, or more usually consisting of a number of rounded orifices variously placed."\(^a\)

What appears to be identical with the form above described was found at Station D, 4000.\(^b\) The *Challenger* specimens were from the Honolulu coral reefs, 40 fathoms, and various islands to the south and west.

\(^a\) Brady, Chal. Report, IX, p. 135.

\(^b\) All stations cited in this paper are those of the Bureau of Fisheries steamer *Albatross* unless otherwise mentioned.
Subfamily Miliolininae.

Genus Biloculina.

Biloculina bulloides d'Orbigny.


Thick-shelled globose test with highly inflated segments and circular aperture. The species belong to moderate depths and has been obtained in all the great oceans rather sparingly, but is more common in the North Atlantic.

Occurs as stated above, and is best developed at depths ranging from 300 to about 1,000 fathoms. In the neighborhood of the New Guinea Islands this foraminifer has been obtained in very shoal waters. It is present at Albatross Stations D. 4000, D. 4025, H. 4555, and H. 4696.

Biloculina comata Brady.


Similar to Biloculina bulloides, but with the surface covered by longitudinal striations, and the shell of large dimensions. Found with other biloculine forms in the North Atlantic and the Pacific oceans. Rare in the dredgings we have studied. Present only at Station D. 4000.

Biloculina depressa d'Orbigny.


Margin thin and angular, shell depressed as the name implies. The form is closely related to Biloculina ringens, but the latter has less sharply defined margin and a different aperture.

If the foraminifers described and figured by Terquem and Berthe- lin from the Lias of Essey-les-Nancy under the name Biloculina lias- sica are identical with the present form the species occurs much earlier geologically than any of its congenitors. Its recent distribution is similar to that of Biloculina bulloides given above. It was found at Stations D. 4000, D. 4174, H. 4430, H. 4502, H. 4566, H. 4567, H. 4568, H. 4585, and H. 4590.

Biloculina depressa var. Murrhyna Schwager.

Biloculina murrhyna SCHWAGER, Novara-Exped., Geol. Theil. II, 1866, p. 203, pl. vi, figs. 15 a-c.

A variety of Biloculina depressa characterized by two angular spinous projections near the base of the test and placed symmetrically apart from the median line.
This variety would appear to be rare, judging from the Challenger investigations, as Professor Brady mentions but four localities, two each from the North and South Atlantic and Pacific oceans. Dr. C. Schwager's specimens came from the Pliocene of Nicobar Islands. This form was found at Station H. 4502, and was abundant at Station H. 4555.

BILOCULINA IRREGULARIS d'Orbigny.


This species does not reveal the characteristic biloculine habit of growth in its adult stage, but the test is globose and there are two major segments in the final development which are similar to *Biloculina bulloides* in their shape and position. The asymmetry appears from the third segment, cutting one side obliquely like *Polymorphina* types and appearing as a faint line on the outer surface of the shell neither depressed nor elevated.

*Biloculina ventricosa* Reuss, is the same as this species, which can be distinguished from *Biloculina sphacra* by its milioline aperture and the extension of the ultimate chamber.

The Challenger dredged this foraminifer from the neighborhood of the Canaries in 1,125 fathoms; off Sombrero Island, 450 fathoms; south of Pernambuco, 350 fathoms, and in mid-ocean in the South Atlantic from 1,415 fathoms. It was also obtained near the Fiji, Tahiti, and Papua islands at depths of 610, 620, and 1,070 fathoms, respectively. The Albatross found it only at Station 4696, where it was rare.

The Septaria clays of Hermsdorf near Berlin and the salt beds of Wieliczka have furnished the species among other fossil Foraminifera.

BILOCULINA ELONGATA d'Orbigny.


Test resembling *Biloculina ringens* in outline and aperture but longer and much narrower, as the name implies. The species appears to be the equivalent of *Biloculina bougainvillei* and *B. patagonica* of d'Orbigny. The shell shows considerable variation, chiefly in amount of elongation and globosity.

Unlimited in distribution and depth, but most abundant in the South Pacific. Specimens were obtained at Stations D. 4017, D. 4025, and H. 4567.
Genus SPIROLOCULINA.

SPIROLOCULINA ACUTIMARGO Brady.

*Spiroloculina acutimargo* Brady, Chal. Rept., IX, 1884, p. 154, pl. x, fig. 12–15.

The carinate peripheral margin of this thin complanate foraminifer is its chief characteristic. It has been obtained at Bermuda, 435 fathoms, four stations in the South Atlantic, 350 to 1,425 fathoms, and three localities in the South Pacific, 15 to 255 fathoms, and also in shore sands of Madagascar. Present rarely at Stations D. 4174, D. 4025, and H. 4694.

SPIROLOCULINA GRATA Terquem.


A thin complanate *Spiroloculina* with striate surface and common in coral reef material down to 400 or 500 fathoms. First described in the Tertiary of the island of Rhodes. Occurs at Stations D. 4017, H. 4567, and H. 4694.

SPIROLOCULINA LIMBATA d’Orbigny.


Common in shallow water and found down to 400 fathoms in tropical and subtropical oceans. Known also from the Septaria Clay of Germany and in the later formations of Italy and Sicily. Found at Station D. 4017 only; depth, 305 fathoms.

SPIROLOCULINA NITIDA d’Orbigny.


Common in coral tropical sands and in the inland Japan and Mediterranean seas. Found at Station D. 4017 only; depth, 305 fathoms.

SPIROLOCULINA PLANULATA (Lamarck).


With the exception of two soundings mentioned by Parker and Jones, this species is limited to shoal waters in temperate and subtropical oceans. It is rather common also in coral shoal water sands in the Pacific and Indian oceans and Red Sea. Found at Stations D. 4025, H. 4508, and H. 4694.
SPIROLOCULINA TENUIS (Czjzek).

*Quinqueloculina tenuis* Czjzek, Haidinger's Nat. Abhandl., II, 1847, p. 149, pl. xiii, figs. 31-34.

Inhabiting all great oceans. Abundant in the South Pacific but less common in the North Pacific, and known from depths of a few fathoms down to 2,750. Professor Brady writes that the finest specimens come from moderate depths. Fossil in the Austrian Tertiary. Occurs at Stations D. 4000, D. 4017, H. 4440, H. 4571, H. 4590, and H. 4696.

Genus MILIOLINA.

MILIOLINA BICORNIS var. ELEGANS Williamson.


Diffsers from the type *M. bicornis* in the regular symmetry of its chambers and in the uniform size and regular parallelism of the surface grooves.

This striate form is rarely found at depths greater than 50 fathoms. The method of growth as shown by Schlumberger is in accord with that of d'Orbigny's genus *Adelosina*, in which the megasphere is completely enveloped by the first chamber, which becomes lenticular. It then passes through the biloculine, milioline, triloculine, quadriloculine, and quinqueloculine stages. Our form very closely represents this quinqueloculine form and the aperture is in the end on a considerably lengthened tube. Unfortunately we have but one broken specimen of this interesting species.

*Miliolina bicornis* is fossil in the London clay and the Paris Basin Eocene.

MILIOLINA CUVIERIANA (d'Orbigny).

*Quinqueloculina cuvieriana* d'Orbigny, Foram. Cuba, 1839, p. 164, pl. xi, figs. 19-21.

Test consisting of five segments with sharp or subcarinate margins and smooth unornamented surface. It is the same as *Q. lamarekiana* figured on the same plate (figs. 14, 15). A shallow tropical water species particularly known around the region of Japan, the Philippines, and the islands of the Eastern Archipelago. While it is one of the most common Miliolinae in the *Albatross* material, the number of specimens in each locality is small. Found at Stations D. 4000, D. 4017, D. 4025, H. 4555, H. 4590, and H. 4694.
MILIOLINA LINNÆANA (d'Orbigny).


"Under the name *Trioculina linnaea*, d'Orbigny depicts a modification or variety of *Miliolina pulchella*, which takes the place to a great extent of the typical form in tropical seas. It differs from *Miliolina pulchella* in its comparatively thin and outspread contour, which sometimes approaches that of *Spiroloculina*, the costae being few, thick, and well marked. A nearly identical form is described in the Vienna Basin memoir with the name *Quinqueloculina josephina*. Limited to shallow tropical waters. Occurs at Stations D. 4174 and H. 4568.

MILIOLINA OBLONGA (Montagu).


A cosmopolitan species known from all areas and depths, but best developed in shallow temperate seas. Found at Station D. 4000 only.

MILIOLINA PARKERI Brady.


Surface of the segments crenulated and sharply angled at their margins.

With the exception of forms from the Red Sea this species is a coral reef form in the tropical region of the Pacific Ocean. Occurs at Stations D. 4000, H. 4566, and H. 4694.

MILIOLINA SEPARANS Brady.


An anomalous wild-growing form like *Quinqueloculina linnaea* partly unrolled. Limited to very shallow water of the tropical Pacific. Found at Station D. 4174 only.

MILIOLINA SEMINULUM (Linnaeus).


\[a\] Foram. Cuba, 1839, p. 153.

\[b\] Brady, Chal. Rept., IX, p. 174.
MILIOLINA SEMINULUM var. DISCIFORMIS Williamson.


Resembling the typical form but more complanate and with broader, shorter segments, frequently emarginate at their umbilical borders and possessing transverse ridges of growth which are lacking in the typical species. Common along the English coast in shell sand. Occurs in every latitude and is known from all depths. Geologically its history dates from the early Eocene. Not very common, but present at Stations D. 4017 and H. 4694.

MILIOLINA TRICARINATA (d'Orbigny).


*Tricarinata miliolina* are not at all rare, but this species is more widely distributed than its related form *M. trigonula*. The carinate feature is in *M. tricarinata* limited to the peripheral portion, the intervening portion being more or less gibbous, but the species is subject to great variation and is perhaps easily confused with *Miliolina trigonula*. While having an almost unlimited geographical distribution the species is also of great bathymetric range and is known from a few fathoms down to 2,350 fathoms. As a fossil, it is recorded from the early Tertiary. Found at Stations D. 4000, D. 4025, D. 4174, and H. 4694.

MILIOLINA TRIGONULA (Lamarck).


Test regular triloculine, with smooth subspherical or elongate chambers and nearly circular end view. Distinguished from *M. tricarinata* by a difference in the roundness or angularity of the chambers. Of wide distribution in shoal waters, and more frequent in the temperate than in tropical regions. Absent in cold northern waters; found chiefly in temperate in-shore sands. Beyond 100 fathoms the form is said to be replaced by *Miliolina tricarinata*. Geological history, Tertiary to recent. Found at Stations D. 4000, D. 4017, D. 4025, H. 4568, and H. 4696.
Subfamily LAMININAE.

**Genus VERTEBRALINA.**

**VERTEBRALINA INSIGNIS** Brady.

*Vertebralina insignis* Brady, Chil. Rept., IX, 1884, p. 187, pl. xii, figs. 9-11.

This rare species is known from off the Friendly Islands, 18 fathoms, in Torres Strait, 155 fathoms, and off the West Indies, 390 fathoms. Occurs at Station H. 4694 at a depth of 865 fathoms, which is its deepest recorded occurrence.

Subfamily PENEROPLIDINAE.

**Genus CORNUSPIRA.**

**CORNUSPIRA FOLIACEA** (Philippi).


Test planospiral, with thin, flat, rapidly widening whorls, and while the surface has no decoration there are frequently curved transverse lines of growth as in many of the Gasteropoda. An allied form with carinate margin is *Cornuspira carinata* (Costa).

Rare in Scandinavian waters and Greenland (Goes), not uncommon in the Pacific, and ranging from shallow depths down to about 1,500 fathoms. Professor Brady states that the best specimens come from depths between 300 and 600 fathoms.

Present in the Eocene and later Tertiary. Recognized at Station D. 4017 only, but is not common.

**CORNUSPIRA INVOLVENS** Reuss.

*Cornuspira involvens* Reuss, Sitzungh. Akad. Wiss. Wien, XLVIII, 1863 (1864), Pl. 1, p. 39, pl. 1, fig. 2.

Recognized by its rounded tubular whorls, which closely embrace each other and yet allow each whorl to be seen on either surface.

Geological history from Tertiary to recent. Has probably been confused with Jurassic and Cretaceous Ammodisci, which it resembles. Dr. A. Goes records the form in the Arctic and Norwegian waters at depths ranging from 30 to 180 meters. A shallow water cosmopolitan species. Observed at Stations D. 1017 and D. 4174.

**Genus PENEROPLIS.**

**PENEROPLIS PERTUSUS** (Forskal).


The genus *Peneroplis*, like *Orbiculina*, represents great variety of form and degree of compression and elongation of chambers without altering the segment arrangement or method of growth. For this reason and because of the transitional forms, it becomes necessary to separate the genus into several distinct types around which must
cluster the larger varieties of the type. The test of the genus *Peneroplis* is a planospiral, crozier-shaped, imperforate calcareous (porcellaneous) shell, and bilaterally symmetrical. An elaborate treatment of the genus is given by Dr. W. B. Carpenter in the Introduction to the Study of the Foraminifera (pp. 84–92, pl. vii). The surface of the shell is beautifully marked by transverse striae closely set and covering the entire surface, as a rule, but there are also occasional pits in the shell substance which resemble pores, though the shell is nevertheless imperforate. The genus can be well subdivided into the following types:

A. *Peneroplis pertusus* (Forskal). Nautiloid moderately compressed, involute shell with dendritic aperture.

B. *Peneroplis planatus* (Fichtel and Moll). Broad complanate forms, striated surface and with a single row of pores on the septal face.


D. *Peneroplis cylindraceus* (Lamarck). Test less compressed than in *P. arietinus* and more nearly nodosarian.

E. *Peneroplis litinus* (Gmelin). Chambers few, cylindrical, nodosarian, but slightly irregular and of uneven size.

F. *Peneroplis carinatus* d'Orbigny. Near variety *P. pertusus* but more involute and with sharp periphery and less decorated surface.

G. *Peneroplis levigatus*. Karrer. This is the most compressed type, somewhat resembling *Orbiculina adunca*, and the latter whorls embrace nearly two-thirds of the shell.

I find two types of the above genus, *P. pertusus* and *P. planatus*, the former occurring at Station 4017, the latter at Station 4694.

*Peneroplis pertusus* var. *planatus* (Fichtel and Moll).

*Nautilus planatus* Fichtel and Moll. Test. Microsc., 1803, p. 91, pl. xvi, figs. 1 d, e, f.

Found only at Station H. 4694 and is rare. The genus is usually found at less than 30 fathoms. Tropical and subtropical waters at many localities. Its geological history dates from the lower Tertiary (Eocene of Paris Basin, etc.).

*Genus Orbiculina.*

*Orbiculina adunca* (Fichtel and Moll).


A tropical species usually in shoal waters. Its earliest appearance is in the early Tertiary. Found at Stations D. 4000 and H. 4694.
Genus **ORBITOLITES**.

**ORBITOLITES COMPLANATA** Lamarck.


An inhabitant of shallow tropical waters, occasionally so abundant that it becomes an important factor in the building of tropical coral islands. Occurs rather sparingly at Stations D. 4000, H. 4476, and H. 4566.

**ORBITOLITES MARGINALIS** (Lamarck).

*Orbitolites marginalis* Lamarck, Anim. sans Vert., II. No. 1, 1816, p. 196.

Not quite so widely diffused as the species *Orbitolites complanata*, it is extensively found in warmer seas, and it is said by Doctor Carpenter to be more abundant where *Orbiculina* is rare, and the opposite. It obtained its maximum development in the early Tertiary, where specimens of enormous size and abundance are found. Not very common, but present at Stations D. 4000, H. 4476, and H. 4694.

Family **ASTRORHIZID.E**.

Subfamily **RHABDAMMININAE**.

**Genus RHABDAMNINA**.

**RHABDAMMINA DISCRETA** Brady.


Occurs only at Station H. 4502.

Family **LITUOLID.E**.

Subfamily **LITUOLINAE**.

**Genus REOPHAX**.

**REOPHAX FUSIFORMIS** (Williamson).

*Protconina fusiformis* Williamson, Recent Foram. Gt. Britain, 1858, p. 1, pl. 1, fig. 1.

Considered by Professor Brady to be a starved shallow-water variety of *Reaphax scorpiurus*. Found in arctic and cold temperate zones and with sporadic occurrence in the Tropics at moderate depths down to 1443 fathoms. Found at Station H. 4585.

**REOPHAX NODULOSA** Brady.


Cosmopolitan in area and bathymetric range. Found at Station H. 4585.
REOPHAX SCORPIURIUS Montfort.


This species has a universal distribution and bathymetric range. Its geological history goes back to the Oolite. Found at Stations H. 4508, H. 4567, and H. 4694, but not very common at any of the three.

**Genus HAPLOPHRAGMIUM.**

**HAPLOPHRAGMIUM AGGLUTINANS** (d'Orbigny).

*Spirolina agglutinans* d'Orbigny, Foram. Foss. Vien., 1846, p. 137, pl. vii, figs. 10–12.

A cosmopolitan species and with correspondingly wide distribution in depth. Obtained only from Station D. 4174.

**HAPLOPHRAGMIUM CANARIENSE** (d'Orbigny).

*Nonionina canariensis* d'Orbigny, Foram. Canaries, 1839, p. 128, pl. ii, figs. 33, 34.

Known from all oceans and at all depths. Found as a fossil but not earlier than the Pleistocene. Specimens obtained at Stations H. 4566 and H. 4696 are rather more symmetrical and possess more chambers than some of the figured types of the species. The arenaceous test, rounded periphery, depressed umbilici, and complanate character of the chambers are sufficient to distinguish this from allied forms.

**HAPLOPHRAGMIUM GLOBIGERINIFORME** (Parker and Jones).

*Lituola nautiloides globigeriniformis* Parker and Jones, Phil. Trans., CLV, 1865, p. 407, pl. xv, figs 46, 47.

This species is described with some doubt. There are only a few specimens, from Station 4585, which appear to belong here. They do not possess so many Globigerina-like segments and these are not so distinct, but the growth appears trochoid and the forms are conditionally placed here. Essentially a deep-water foraminifer of universal distribution.

**HAPLOPHRAGMIUM LATIDORSATUM** (Bornemann).

*Nonionina latidorsata* Bornemann, Zeitschr. deutsch. geol. Gesell., VII, 1855, p. 339, pl. xvi, figs. 4, a, b.

So abundant in the north deep sea explored by G. O. Sars that it is said to constitute one-fifth of the entire weight of the dredged material. While of universal distribution and more abundant in deep water, the form is also present in depths of 300 fathoms or less.
Known in the European Tertiary. In our dredgings this form, with *Haplophragmium scitulum*, is the most common species of the genus and was found at Stations II. 4502, II. 4566, H. 4567, and H. 4696.

**HAPLOPHRAGMIUM NANUM** Brady.


Somewhat similar to *H. canariense*, but with the segments more distinct and lobulated, and in its inequilateral development only upon the upper surface are all the segments visible. Recorded in the *Challenger* report as characteristic of cold northern and southern latitudes and at depths of from about 50 to near 2,000 fathoms. Found only at Station II. 4694.

**HAPLOPHRAGMIUM SCITULUM** Brady.


Test closely involute, nautiloid with depressed umbilici, arenaceous dark-brown test and rough exterior. Segments numerous, narrow, straight, but slightly depressed septa. Forms somewhat resembling *Cyclammina cancellata* occur at Station 4508 and the septal lines are not quite so regular as in the type-specimens. This species is closely related to *H. latidorsatum*, which is, however, less symmetrical, and has a thicker, coarser test and a more lobulated margin.

Eleven localities for this species are reported in the *Challenger* records, eight of which were in the North Atlantic, 530 to 1,445 fathoms, one in the South Atlantic, one in the South Pacific, and one from very deep water in the North Pacific. Present at Stations II. 4430, II. 4508, H. 4585, and H. 4696. Doctor Flint mentions it from the west coast of Cuba and the west coast of Patagonia, 93 to 541 fathoms.

**Genus CRITHIIONINA.**

**CRITHIIONINA PISUM** var. **HISPIDA** Flint.

*Crichtionina pisum* var. *hispida* Flint, Recent Foraminifera, 1889, p. 267, pl. vi, fig. 2.

The genus *Crichtionina* was established recently by A. Goes and made to include minute Foraminifera, which are largely constructed of sponge spicules and exceedingly fine gray arenaceous matter, and with a labyrinthic or cavernous, more or less spherical chamber. This is undivided and the aperture is indistinct and divided. The hispid variety is even smaller than *Crichtionina pisum* and is easily distinguished by its spinous sponge-spicule surface. There is apparently no visible aperture.
Recorded by Dr. J. M. Flint from Georges Bank, Gulf of Mexico, and coast of Oregon, at depths of from 93 to 1,813 fathoms. Found at Stations H. 4440 and H. 4502.

Genus HAPLOSTICHE.

HAPLOSTICHE SOLDANII (Jones and Parker).


Test stoutly built, nodosarian-like and of arenaceous coarse material. The internal subdivisions of the chambers do not appear on the surface. Without sectioning the aperture is the only means of distinguishing this species from Clarulina cylindrica, as stated under the description of that species.

This is the only living representative of the genus and is best developed in the warm waters of the West Indies at shoal depths. It is also found in the Gulf of Mexico, 196 and 210 fathoms (Flint), and around many islands of the Pacific. It is variously recorded in the European Tertiary. We find it only at Stations D. 4000 and H. 4590.

Subfamily TROCHAMMININAE.

Genus TROCHAMMINA.

TROCHAMMINA LITUIFORMIS Brady.


Previously recorded at only three stations in the Atlantic Ocean. An example of this species present at Station D. 4000.

TROCHAMMINA PAUCILOCULATA Brady.


Of wide areal distribution, this species is more typically developed in deep water, often below 1,000 fathoms. Found at Station H. 4502, 1,302 fathoms; Station H. 4555, 1,398 fathoms; Station H. 4585, 689 fathoms, and Station H. 4590, 978 fathoms.

TROCHAMMINA PROTEUS Karrer.


Four localities furnished specimens of this species in the Challenger expedition, at depths varying from 390 to 2,350 fathoms. Fossil in the middle Tertiary. Found at Station H. 4566, rare; depth 572 fathoms.
TROCHAMMINA RINGENS Brady.

*Trochammina ringens* Brady, Quart. Journ. Microsc. Sci., XIX, n. s., 1879, p. 57, pl. v, figs. 12, a, b.

Test nautiloid, biconvex, depressed, and composed of but few chambers, usually about one-half the number of those present in *Trochammina fusilla*. It is much more rare than the latter species, is of a dark gray or brown color, and there is no punctuation of the inner surface of the shell. Not before recorded beyond the Atlantic Ocean, and said to occur at depths of from 1,675 to 2,750 fathoms. Found at Station H. 4590, 978 fathoms, rare.

Genus WEBBINA.

*Webbina clavata* Jones and Parker.


This adherent species was later described under the genus *Webbina*. The latter is always adherent on its lower surface without a definite body wall inclosing the surface of attachment, while in *Trochammina* the tube is complete and walled on all sides. The species is of wide areal distribution and of almost unlimited bathymetric range. Several examples were found at Stations D. 4000, D. 4174, H. 4476, H. 4566, H. 4590, and H. 4696.

Subfamily LOFTUSIINÆ.

Genus CYCLAMMINA.

*CYCLAMMINA CANCELATA* Brady.


The genus *Cyclammina*, established by Brady in 1876, includes the entirely arenaceous, large, compressed, convoluted Foraminifera whose walls are finely cancellated. These are often so highly developed that the inner portion of the chambers is greatly reduced. Externally the surface is smooth and the aperture either a series of pores on the septal face or an arched fissure at the inner margin of the final segment. The periphery in *C. cancellata* is rounded. I have identified this species in the New Jersey Miocene but am not aware of its further occurrence in the fossil state. In existing oceans it is of very great bathymetric range (75 to 2,900 fathoms) and has a wide geographical distribution. It is present at Stations D. 4174 and H. 4508, at the latter with *Haplophragmium scitulum*, which the above somewhat resembles.


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Family TEXTULARIDÆ.

Subfamily TEXTULARINÆ.

- Genus TEXTULARIA.

TEXTULARIA AGGLUTINANS d'Orbigny.

*Textularia agglutinans* d'Orbigny, Foram. Ciba, 1839, p. 136, pl. 1, figs. 17, 18, 32 to 34.


TEXTULARIA ASPERA Brady.


This species was established by Brady to include very coarsely arenaceous dark colored *Textularia* characterized by oblong, compressed form composed of few segments. Obtained by the *Challenger* from five stations in the North Atlantic, 390 to 530 fathoms; three in the South Atlantic, 250 to 1,435 fathoms; and two in the South Pacific, 175 and 210 fathoms. Found at Station D. 4000, depth 104 to 213 fathoms.

TEXTULARIA FOLIUM Parker and Jones.

*Textularia folium* Parker and Jones, Phil. Trans., Cl.V. 1865, pp. 370, 420, pl. xviii, fig. 19.

The depths recorded in the *Challenger* report for this species vary from shore sand at Melbourne to 255 fathoms off the Fiji Islands. Our specimen comes from Station D. 4017, at a depth of 305 fathoms. The species is not known in the fossil state, and its present distribution is apparently quite restricted.

TEXTULARIA GRAMEN d'Orbigny.

*Textularia gramen* d'Orbigny, Foram. Foss. Vieu., 1846, p. 218, pl. xv, figs. 4 to 6.

TEXTULARIA QUADRILATERA Schwager.

TEXTULARIA quadrilaterea Schwager, Nova Acta Expedit., Geol. Theil, II, 1856, p. 253, pl. vii, fig. 103.

Test, long, slender, compressed, tapering, generally acuminate and quadrilateral. Typical specimens come from Tahiti at 420 fathoms, but the form is known also from a small number of localities in the South Atlantic and Pacific oceans. This form is rare at Stations H. 4430 and H. 4568; depths 1,544 and 1,274 fathoms, respectively.

TEXTULARIA RUGOSA (Reuss).

Plecanium rugosum Reuss, Sitzungsber. Akad. Wiss. Wien, LIX, 1869, p. 453, pl. i, figs. 3, a, b.

This coral-reef species makes its first appearance in the Oligocene. Occurs at Station H. 4568 only.

TEXTULARIA SAGITTULA Deprance.


One of the most abundant of all the Textularia whether recent or fossil, and while chiefly affecting shallow waters of temperate seas is known at depths of near 2,700 fathoms. Not rare at Stations D. 4025, H. 4430, H. 4694, and H. 4696.

TEXTULARIA SIPHONIFERA Brady.


Previously recorded from the Honolulu coral reefs, 40 fathoms, and at a few other stations of the Pacific at depths of less than 50 fathoms. Station H. 4567, at 1,307 fathoms.

TEXTULARIA TROCHUS d'Orbigny.


Distribution, universal. Fossil from the Cretaceous. Occurs only at Station D. 4000.

Genus VERNEUILINA.

VERNEUILINA PROPINQUA Brady.

VERNEUILINA propinqua Brady, Chal. Rept., IX, 1884, p. 387, pl. XLVII, figs. 8-14.

At five stations where this species was dredged by the Challenger in the North Atlantic the depths with but one exception were between 1,000 and 2,435 fathoms. Similarly three stations in the
Pacific were in depths of 95, 2,050, and 2,900 fathoms respectively. The species is therefore a deep-water form. It is not known as a fossil. Rare at Station H. 4567, depth 1,307 fathoms.

**VERNEUILINA SPINULOSA** Reuss.


This species, known first from the Cretaceous chalk, is best developed in tropical and subtropical shallow waters. Its bathymetric range, however, is from a few fathoms down to 2,300. Examples of this interesting foraminifer were at Stations D. 4017, D. 4025, H. 4508, H. 4694, and H. 4696.

**Genus BIGENERINA.**

**BIGENERINA ARENACEA** Bagg, new species.

Test very large, sometimes measuring nearly an eighth of an inch in length, strongly compressed and complanate, built of coarse arenaceous and glauconitic material of a prevailing gray color.

The segments are at first biserial, later nodosarian. There are four or five of these uniserial segments and they comprise about one-half the shell in length. The test is symmetrically developed with nearly straight even sides obtusely rounded and with the aboral end broadly rounded, the entire form resembling in a general way *Bigenerina pennatula* (Batsch), but lacking the angular keeled margin and also being somewhat more compressed. The segmentation is regular, much more regular than in *Bigeneria capreolus* (d'Orbigny), and in the uniserial portion is as symmetrical as in typical *Frondicularia* types. The chambers are narrow and even, separated by broad thick slightly raised septa which are curved or arched upward at the center and at the oral end form a wedge-shaped extremity. The aperture is a median, oval, and narrow slit. The best specimens of this large arenaceous species were from stations between D. 3900 and D. 4000. (See Plate V. figs. 4–6.)

The type is Cat. No. 8196, U.S.N.M., from hydrographic Station 4508, *Albatross*. I also recognize the species at Stations D. 4174 and H. 4566.

**Genus PAVONINA.**

**PAVONINA FLABELLIFORMIS** d'Orbigny.


Pavonina is an interesting unusual genus represented by a single species. The early chambers are small and textularian and later become uniserial and unfolded, forming a fan-like test. The aperture
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is porous. This beautiful form is an inhabitant of rather shallow water and has been obtained in the West Indies, Torres Strait, Malay Archipelago, Mauritius, Ceylon, Admiralty Islands, Cocos Island, coast of Korea, and the Honolulu coral reefs. Found only at Station D. 4174. Not known in the fossil condition.

Genus GAUDRYINA.

GAUDRYINA FILIFORMIS Berthelin.


With its limited number of triserial segments and its long textularian development, the above species might easily be mistaken for one of the Textularia. It was dredged by the _Challenger_ at four stations at moderate depths and from both Atlantic and Pacific oceans. The fossil forms described by Berthelin were from the Gault of northern France. Not common at Station H. 4568.

GAUDRYINA PUPOIDES d'Orbigny.


This common deep-water variety is a frequent Cretaceous fossil and is not rare in some Eocene and later Tertiary deposits. Found at Stations H. 4430, H. 4555, H. 4568, and H. 4571.

GAUDRYINA QUADRANGULARIS Bagg, new species.

The test is very large, measuring about one-eighth inch in length, sharply tapering to a trihedral distal end. The oral extremity is quadrangular in outline, resulting from compression upon two sides, and this compression does not correspond with any of the triangular portion below. The shell substance is unusually coarse and the surface very rough. The oral end is abruptly truncated and is sunken in the center to the straight slit-like aperture somewhat protected by a marginal thickening and slightly notched. (See Plate V, fig. 1.)

The type is Cat. No. 8198, U.S.N.M., Station D. 4000. It is rare.

Genus CLAVULINA.

CLAVULINA ANGULARIS d'Orbigny.


Test long, nodosarian, triangular with arched septal depressions. The triserial portion of the test is confined to the lowest portion of the shell and does not much enlarge the distal end as in _Clavulina_
CLAVULINA CYLINDRICA Hantken.

*Clavulina cylindrica* Hantken. Mitt. d. Jahrb. m. geol. Anstalt, IV, 1875, p. 18, pl. 1, fig. 8.

With *Haplostichae sohlenii*, which it resembles, this species is found in the coral sands of tropical waters. The two are separable by their difference in aperture, *Clavulina cylindrica* always having a valvular opening, while the other is always simple or perforate. Abundant in the Clavulina-szaboi strata of Hungary and also from the Tertiary of Italy. Rather rare in the South Atlantic, less so in the North Atlantic, and variously recorded in shoal waters of the South Pacific. Rare in the Glebigerina ooze of Station D. 4000.

Subfamily BULIMININAE.

Genus BULIMINA.

*Bulimina affinis* d'Orbigny.

*Bulimina affinis* d'Orbigny, For. Soc. Cuba, 1829, p. 100, pl. ii, figs. 25, 26.

Equivalent probably to Reuss's *Bulimina orulam*, described in Cretaceous deposits and present in the North and South Pacific oceans of to-day. It is separated from *B. orulata*, which it closely resembles, only by its acute apical aboral extremity. Some specimens obtained from Stations D. 4017, D. 4025, and D. 4174.

D'Orbigny obtained his types from the shore sands of Cuba. Distribution much more limited, however, than that of the types of *B. orulata* and *B. papoides*, which it resembles.

*Bulimina aculeata* d'Orbigny.


With the smooth upper portion of the test and the lower rough spinous portion, the above is one of the peculiar surface ornamentation forms found among the Buliminae. The spines often project from the edges of the chambers as in *B. marginata*, but in the former they are never lengthened into spines.

Abundant in the North Atlantic and South Pacific and its bathymetric range extends from shallow depths down to 2,740 fathoms.

It has been recognized in the glacial clays of Norway. Present at Station H. 4567 only.
BULIMINA BUCHIANA d'Orbigny.


Test triserial, short, strongly built, with well-defined ribs which extend to the lower margin of the ultimate chamber. Said to affect moderately deep water; Professor Brady reports it as abundant in the North Atlantic, rare in the South Atlantic, and common in the South Pacific. Not recorded from the North Pacific. Ranges from less than 100 down to over 2,000 fathoms. Occurs at Station II. 4568, where it is not rare, and at Station II. 4585.

BULIMINA CONTRARIA (Reuss).


It is no wonder that this little form has been described under various genera—such as *Ataxophragmium*, *Patelinula*, and *Cassidulina*—for it possesses marked similarity of growth to all the above. It has, however, been rightly placed among the *Bulimina*, and its aperture alone justifies this as well as its buliminine method of growth.

Most common in shoal waters of the South Pacific, but also known in the North Pacific and the North Atlantic. Present at Stations D. 4000, H. 4430, and H. 4555. Described among the fossil Foraminifera of the Oligocene (Septaria clay) of Hermsdorf and the Miocene of Kostej, in the Banat.

BULIMINA INFLATA Seguenza.

*Bulimina ovata* d'Orbigny, *Foram. Foss. Vien.*, p. 185, pl. xi, figs. 107, pl. 1, fig. 10.

An intermediate type between the costate *Bulimina buchiana* and the spinous *B. aculeata* and having a distribution similar to the former, but less common. It is widely distributed in the South Pacific and is present in waters of from less than 100 to over 2,400 fathoms. We note this form from four stations, namely, H. 4566, H. 4567, H. 4568, and H. 4571. Reported in the Septaria clays of Germany and the later Tertiary of Italy.

BULIMINA OVATA d'Orbigny.


*Bulimina ovata*, *B. affinis*, and *B. pupoides* belong to one closely related group distinguishable by such minor features as length and outline of the test, and in the relief of the chambers forming the
These forms are widely distributed in existing oceans and *B. ovata* is common in shallow waters of the British coast. It is present in waters of the Pacific at depths ranging from a few up to 580 fathoms. Its geological history begins with the Eocene. Obtained at Stations D. 4017, D. 4025, H. 4508, and H. 4568.

**BULIMINA PUPOIDES** d'Orbigny.

*Bulimina pupoides* d'Orbigny, Foram. Fossili. Vien., 1846, p. 185, pl. xi, figs. 11, 12.

Similar to above, but with more inflation and separation of segments. With its congeners it is frequently described from the Tertiary beds of Europe and its present distribution is cosmopolitan. Found at Stations D. 4025 and H. 4174.

**BULIMINA WILLIAMSONIANA** Brady.


The tests of *Bulimina williamsoniana* is a cylindrical twisted spire with strong costae running the entire length of the shell. The anterior end is obliquely truncated and the aperture central. Limited to shoal South Pacific waters. Found at Station H. 4694 only.

**Genus VIRGULINA.**

**VIRGULINA SQUAMOSA** d'Orbigny.


Not rare in the North Atlantic; found in the South Atlantic more rarely: also in the North and South Pacific and in the Red Sea and Mediterranean. It is frequently with the related species *Virgulina subsquamosa*. Ranges in depth from 30 to 3,000 fathoms. Found at Stations D. 4025, H. 4430, H. 4555, H. 4566, H. 4568, H. 4571, H. 4585, and H. 4696, and in the *Albatross* dredging much more abundantly than *Virgulina subsquamosa*.

**VIRGULINA SUBSQAMOSA** Egger.


While frequently occurring with the preceding, this species is best known at depths ranging from 345 to 620 fathoms. Found less commonly than the preceding at Stations D. 4025, H. 4430, H. 4440, H. 4555, H. 4566, H. 4568, and H. 4590.
Similar to the well-known species *Virgulina squamosa*, but distinctly striated. (See Plate V, fig. 7.)

Type.—Cat. No. 8202, U.S.N.M., Station D. 4025, depth 275 to 368 fathoms.

Genus BOLIVINA.

**BOLIVINA ÀNARIENSIS** (Costa).

*Brizalina anariensis* Costa, Atti dell' Accad. Pontina, VII, 1856, p. 297, pl. xv, figs. 1, a, b.

This neatly tapering, striate *Bolivina*, with or without its spinous aboral end, is cosmopolitan, and we found it at Stations D. 4174, H. 4440, H. 4502, H. 4508, H. 4555, H. 4567, H. 4571, H. 4585, and H. 4696.

Best developed types come from the North Atlantic Ocean at depths of a few fathoms down to 1,630 fathoms. Professor Brady records the species from off the Philippines at 95 fathoms, off the south coast of Japan at 15 fathoms, and the La Plata River, South America, at 13 fathoms. It occurs as a fossil in the Tertiary beds of the island of Ischia.

**BOLIVINA DILATATA** Reuss.


The test of *Bolivina dilatata* is broad, depressed, composed of numerous long narrow chambers and possessing an acute periphery.

Prof. H. B. Brady states that the species is confined to the North Atlantic, but we find it present, and in some cases abundant, at nearly every station studied. These are: D. 4017, D. 4025, D. 4174, H. 4430, H. 4502, H. 4508, H. 4555, H. 4568, H. 4571, H. 4694, and H. 4696. The average depth is below 400 fathoms. The geological occurrence dates from the Cretaceous.

**BOLIVINA HANTKENIANA** Brady.


Test depressed and nearly equally convex on each surface, consisting of numerous broad inflated segments arranged alternately and provided at their margin with a delicate keel. The surface is usually faintly striate. Probably limited in distribution to islands of the Pacific. Present at Station D. 4017, fine specimens at H. 4440, also found at H. 4555 and H. 4585. The depths at which the form is recorded vary from 130 to 800 fathoms. Not recorded as a fossil.
This interesting little species is said to be abundant in the waters south of Japan, and it is not uncommon in the South Pacific. Found only at Station H. 4567, where it was quite rare.

BOLIVINA LIMBATA Brady.

"The twisted varieties of Bolivina with nearly even margins and limbate sutures, on which this species has been founded, affect the comparatively shallow water of tropical seas. They are abundant south of the island of Papua, occurring at almost every station in its immediate vicinity at which the depth does not exceed 200 fathoms. The same forms occur off the Sandwich Islands, 40 fathoms; in Hongkong Harbor, 7 fathoms; on the south shores of Japan, 15 fathoms; off the Fiji Islands, 12 fathoms; on the Australian coral reefs, 14 to 17 fathoms; in the shore sands of Madagascar; off Ascension Island, 7 fathoms; and off the Cape de Verde Islands, 11 fathoms."  

The Albatross obtained this foraminifer at Station H. 4694 only.

BOLIVINA NOBILIS Hantken.


Perhaps confined to the South Pacific and to depths of less than 40 fathoms. Occurs at Stations H. 4567, H. 4696.

BOLIVINA PPLICATA d’Orbigny.

Bolivina plicata d’Orbigny, Foram. Amer. Merid., 1839, p. 62, pl. viii, figs. 4-7.

Test moderately compressed, with sinuous or, as it were, plicate septal lines, rough surface, as if arenaceous, pores not very distinct, and shell opaque in transmitted light. Well figured by Goes.  

Found only at Station H. 4567.

BOLIVINA PUNCTATA d’Orbigny.

Bolivina punctata d’Orbigny, Foram. Amer. Merid., 1839, p. 61, pl. viii, figs. 10-12.

This well-known cosmopolitan form is present at every station except H. 4000, H. 4430, H. 4776, H. 4555, H. 4571, H. 4579, and H. 4590. In some instances, as at Station D. 4025, it is abundant.

a Brady, Chal. Rept., IX, p. 419.
b Arctic and Scand. Foram., 1894, p. 51, pl. ix, figs. 487, 488.
BOLIVINA ROBUSTA Brady.


Thirteen of the twenty-two localities given in the *Challenger* report, where the above species is found, were in the South Pacific. Abundant at some stations and present at D. 4025, H. 4555, H. 4566, H. 4568, H. 4571, and H. 4585. The species is generally confined to shallow waters, but in one instance it was obtained at 1,900 fathoms in the South Atlantic.

A. Goes considers this form only a variety of *B. dilatata*, but I believe it should be regarded as a distinct species.

BOLIVINA SEMI-ALATA Bagg, new species.

The nearest approach to this Foraminifer of which the writer has knowledge is *Bolivina hantkeniana*. The forms we have, however, are extremely narrow and stoutly built, with numerous chambers extending to nearly one-half the length of the shell. The ultimate chambers are exceedingly broadly expanded and widely keeled, the flange extending even over and around the aperture. The lower end is acuminate. Two of these types were observed at Station H. 4555. The shell is large for the genus Bolivina. (See Plate V, fig. 3.)

*Type.—*Cat. No. 8197, U.S.N.M., Station H. 4555.

BOLIVINA TEXTILARIOIDES Reuss.


More important from the fossil standpoint than any *Bolivina* unless perhaps *B. punctata*, and widely represented in existing seas. Its bathymetric range is also very extensive, but it is best developed on shallow bottoms. It is one of the best known Cretaceous Bolivinas. Found at Stations H. 4017, fine examples at H. 4025, also present at H. 4430, H. 4440, H. 4508, H. 4566, H. 4568, H. 4585, H. 4694, and H. 4696.

Subfamily CASSIDULININAE.

Genus CASSIDULINA.

CASSIDULINA CRASSA d'Orbigny.


Synonymous with *Cassidulina oblonga* Reuss. Characterized by its obtuse periphery, oval outline, and small number of short inflated segments, which distinguishes the species from *C. laevigata*.

Common over wide areas in the North Atlantic and at depths as great as 2,760 fathoms. A long list of localities given by Professor
Brady in the *Challenger* report includes numerous localities in the North and South Pacific and the South Atlantic, and the form is present in the Mediterranean. Its geological history dates from the Miocene. Found by the *Albatross* at Stations H. 4440 and H. 4694.

**CASSIDULINA SUBGLOBOSA** Brady.


"Test subglobular, somewhat compressed on the two lateral faces, inequilateral; segments few, slightly inflated; alternation irregular. Aperture an oblique or nearly erect loop-like slit on the face of the projecting terminal segment." Essentially a deep-water species, the above is known from all the large oceans, but the localities are not very numerous. Found at three *Albatross* stations, namely, H. 4430, H. 4571, and H. 4585.

**Genus EHRENBERGINA.**

**EHRENBERGINA SERRATA** Reuss.


The genus *Ehrenbergina* is closely related to *Cassidulina*, but differs in the arrangement of the biserial chambers and less involuted growth. *Cassidulina* has the segments both biserial and convolute, and resembles a bolivine shell longitudinally folded and then rolled in this suture from end to end and possessing a bulimine aperture. The typical species of *Ehrenbergina* are longer than *Cassidulina* and the margins are frequently serrate or spinous.

Living representatives of the genus belong to southern oceans, and the bathymetric range is from several to over 2,000 fathoms. This species is well known from the Miocene. We find it rather abundant at several stations—H. 4430, H. 4476 (common), H. 4567, H. 4694, and H. 4696.

**Family LAGENIDÆ.**

**Subfamily LAGENINÆ.**

**Genus LAGENA.**

*LAGENA FAVOSO-PUNCTATA* Brady.


Previously reported from the shores of New Guinea. Rare at Stations H. 4590 and H. 4694.

\[a\] Brady, Chal. Rept., IX, p. 430.
LAGENA GLOBOSA (Montagu).


This cosmopolitan species of to-day has a long geological record, dating possibly from the Carboniferous, but certainly from the Oolite. Found only at Station II. 4567.

LAGENA HISPIDA Reuss.


The test of Lagena hispida varies in shape, but always shows a hispid surface, which is its distinguishing characteristic. Like the preceding, this species has a long geological history, dating from the Lias. In recent waters it is not limited in distribution or depth, but it is not abundant wherever found. Present at Station II. 4585.

LAGENA LÆVIS (Montagu).


One of the simplest unornamented unicellular hyaline Foraminifera. On account of its variability in form it has been described under many names, a long list of which is given in any complete synonymy of the species. It is unquestionably one of the earliest Foraminifera known, occurring in Upper Silurian deposits. Its distribution and bathymetric range are unlimited at the present time. Obtained only at Station II. 4585.

LAGENA LAGENOIDES (Williamson).

Entosolenia marginata lagenoides Williamson. Recent Foram. Gt. Britain, 1858, p. 11, pl. 1, figs. 25, 26.

Test oval elongate, compressed and bordered by a decorated keel which surrounds the entire shell. Lagena formosa Schwager has a wider similarly striated margin but the distal portion is notched and wing-like. Found in comparatively shoal waters in the South Pacific (38 to 410 fathoms), and of rather wide geographical distribution elsewhere and at greater depths. Most frequent in the Atlantic. Known in the Miocene of Sicily (Seguenza). Obtained from Albatross Station II. 4566 only.

LAGENA MARGINATA (Walker and Boys).

Serpula marginata Walker and Boys. Test. Min., 1784, p. 2, pl. 1, fig. 7.

The above broadly oval, smooth-shelled Lagena is distinguished from other forms by its peripheral margin which is extended into a wide keel. Universally known in every ocean and at every depth,
its geological history dating from the chalk beds of the Cretaceous. Present most commonly of all the *Lagenia* noted at Stations D. 4017, D. 4174, H. 4430, and H. 4696.

**LAGENA QUADRATA** (Williamson).

*Entosolenia marginata quadrata* Williamson. Recent Foram. Gt. Brtitain, 1858, p. 11, pl. 1, figs. 27, 28.

Present in various localities in both Atlantic and Pacific, but always at depths of less than 150 fathoms. Known in the Miocene of Italy and the Post-Tertiary of Ireland. Occurs at *Albatross* Stations II. 4440 and H. 4694.

**LAGENA STRIATA** (d'Orbigny).

*Oolina striata* d'Orbigny, Foram. Amer. Merid., 1859, p. 21, pl. v, fig. 12.

An oval, frequently bottle-shaped *Lagena* with elongated tubular neck and striate surface. Of world-wide distribution the form is found equally with *Lagena sulcata*, which it resembles, but the species belongs to shallow waters. It is present in the Septaria clays of Germany and in the Miocene elsewhere. Noted at three stations, H. 4566, H. 4567, and H. 4694.

**Subfamily NODOSARIOIDEAE.**

**Genus NODOSARIA.**

**NODOSARIA CALOMORPHA** Reuss.


One of the simplest smooth *Nodosaria* and of only two or three segments. North and South Atlantic, South Pacific, and elsewhere in off-shore deposits at less than 100 fathoms. Reported, however, at depths of over 2,000 fathoms. Fossil in the Septaria clay of North Germany. Station H. 4508, rare.

**NODOSARIA COMMUNIS** (d'Orbigny).

*Dentalina communis* d'Orbigny, Mem. Soc. Geol. France, IV, 1840, p. 13, pl. 1, fig. 4.

Smooth surface, oblique septa, and slender build are the three leading characteristics of the species. The synonomy as at present understood and published in monographs on Foraminifera is very extensive. As a recent Foraminifer it has a universal distribution. Its geological history dates from the beginning of the Mesozoic. The most common nodosarian in the material examined, and present at Stations D. 4000, D. 4025, H. 4430, and H. 4566. The specimens obtained are most excellent representatives.
NODOSARIA CONSOBRINA var. EMACIATA Reuss.

_Dentalina emaciatu_ Reuss, Zeitschr. deutsch. Geol. Gesell., 111, 1851, p. 63, pl. iii, fig. 9.

Professor Brady records the above variety of the typical _N. consobrina_ at depths of from 290 to 725 fathoms in the North Atlantic and 330 fathoms in the South Atlantic; in the South Pacific from 129 to 1,375 fathoms. Found in the Cretaceous chalk and subsequent formations. Occurs at Station D. 1000 only.

NODOSARIA GUTTIFERA (d'Orbigny).


This species must not be confounded with _Nodosaria guttifera_ (Parker and Jones), which is unquestionably to be regarded as _Nodosaria soluta_. In the form figured by d'Orbigny in the Vienna Basin memoir the segments of _Nodosaria guttifera_ are gracefully oval, bulbous at base and connected to the next succeeding chamber by a very slender neck. In _Nodosaria soluta_ the segments are smooth and the distal chamber usually mucronate, but the segments are more closely joined and the sutures are not as deeply depressed or constricted as in _Nodosaria guttifera_. Fragments only at Station H. 4566.

NODOSARIA LÆVIGATA (d'Orbigny).


There appear to be three well-defined types of _Nodosaria_ belonging to the _Glandulina_ type, best represented by _Nodosaria laevigata_ with its sharp distal and generally mucronate and its relatively large development of the ultimate chamber; second, the form _Nodosaria rotundata_, with its more bluntly rounded nonspinous primordial margin and slightly greater elongation of the chambers; and third, _Nodosaria aequalis_, with its still greater elongation and wider segments. Some of the specimens we find in the three stations, D. 4025, H. 4555, and H. 4696, are not distinctly mucronate but they are decidedly pointed at the distal end and may better be considered as varieties of this exceedingly varied species.

The relationship of the various types belonging to this group are well described by Professor Reuss in his paper on Von Schlicht's drawings of Tertiary Foraminifera." The distribution of the species is world-wide. Its bathymetric range is generally less than 1,000 fathoms.

NODOSARIA PAUPERATA (d’Orbigny).


Geographic and bathymetric range unlimited. Fossil from Lias to Recent. Stations D. 4000 and D. 4025.

NODOSARIA ROEMERI (Neugeboren).


Occurs at Station H. 4566 only. More common in the North Atlantic at depths of less than 400 fathoms. Fossil from Cretaceous (lower) to Recent.

NODOSARIA SCALARIS (Batsch).

*Volutus scalaris* Batsch, Conchyl. des Seasandes, No. 4, 1791, pl. II, figs. 4, a, b.

Distribution and range in depth not limited, but the form is more frequent in shoal water. A well-known Tertiary fossil. Occurs only at Station H. 4566.

NODOSARIA SOLUTA Reuss.

*Dentalina (Nodosaria) soluta* Reuss. Zeitschr. deutsch. Geol. Gesell., III, 1851, p. 60, pl. III, figs. 4, a, b.

Occurs at moderate depths but preferably in shallow waters in many localities. It is recorded as a fossil in the Cretaceous. Present at Station H. 4964, but not common.

NODOSARIA VERTEBRALIS (Batsch).

*Volutus vertebralis* Batsch, Conchyl. des Seasandes, No. 6, 1791, p. 3, pl. II, figs. 6, a, b.

Distribution mostly confined to the North Atlantic and South Pacific at depths of less than 500 fathoms. We have recorded the species from the New Jersey Cretaceous. It is, however, more common in the Tertiary. Found at Station D. 4000 only.

Genus LINGULINA.

LINGULINA CARINATA d’Orbigny.


The noncostate variety of this species appears to be rare and was obtained by the *Challenger* expedition at only three stations, off KI Islands, 580 fathoms, off the Honolulu coral reefs, 40 fathoms, and off Nightingale Island, 100 to 150 fathoms. Reported as a fossil from the English Lias. Rare at Station H. 4508.
Genus FRONDICULARIA.

FRONDICULARIA ROBUSTA Brady.

Frondicularia robusta Brady. Chrl. Rept. IX, p. 523, pl. lxvi, figs. 1, 2.

This is the only species of the genus Frondicularia noted in the stations dredged and it is rare at Station 4508. Professor Brady observed it at only two localities, one near Ki Islands, 129 fathoms, the other on the coral reefs of the Hawaiian Islands, 40 fathoms. The form is characterized by its robust test, with surface strongly costate, but less regularly so than in Nodosaria.

Genus RHABDOGONIUM.

RHABDOGONIUM MINUTUM Reuss.

Rhabdogonium minutum Reuss, Sitzungsber. Akad. Wiss. Wien, LV, 1867, p. 84, pl. v, figs. 4, 5.

The only specimens of this species dredged by the Challenger came from off Ki Islands at a depth of 129 fathoms. The form was noted rather frequently at Stations D. 4000, H. 4430, H. 4508, H. 4555, H. 4695, and H. 4696.

RHABDOGONIUM TRICARINATUM (d'Orbigny).


Rhabdogonium tricarinatum has a wide distribution in the fossil world and is frequently recorded in Tertiary strata. A variety of this form (acutangulum) is known in the Lower Cretaceous. In living condition the form is met with in the North Atlantic from shoal water down to over 1,300 fathoms. It comes also from the Mediterranean and the Pacific, and is very abundant in the Albatross dredgings, being found in all stations except H. 4476, H. 4502, H. 4567, H. 4579, and H. 4590.

Genus VAGINULINA.

VAGINULINA LEGUMEN (Linnaeus).


A cosmopolitan form with universal distribution and at all depths found sparingly. Has a long geological history and is known at least as early as the Trias. In later formations it becomes more frequent and I have recorded it from the New Jersey Cretaceous, where it is by no means rare. Found at Stations D. 4174 and 4567.

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Genus CRISTELLARIA.

CRISTELLARIA ARTICULATA REUSS.


This species was described by Reuss in 1870 under the genus Cristellaria, although he had previously placed it under the genus Robulina, a name now in disuse. The shell is stoutly built, thicker and with more angular margin than Cristellaria rotidata. There is also a smaller number of segments in typical specimens.

Fine examples of Cristellaria articulata occur in the dredged sands from off Culebra Island, 390 fathoms, and off Nightingale Island, Tristan da Cunha, 100 to 150 fathoms. In the latter locality the species is very abundant, and what is more remarkable the species assume wild-growing forms, such as are represented by figs. 1-4, pl. lxix. Found by the writer in the New Jersey Cretaceous and variously recorded in Tertiary deposits. Cristellaria are not abundant in any of the material we have here studied, but there are as many species represented as there are occurrences. We find this species typically developed at Station II. 4696.

CRISTELLARIA CALCAR (Linnaeus).


As now used the species designated as Cristellaria calcare comprises those smooth-shelled involute nautiloid types with a spinous periphery. The spinous and flange-like border is exceedingly variable. Of cosmopolitan distribution at moderate depths. Geologically recorded in the Tertiary. Present at Station D. 4000.

CRISTELLARIA CREPIDULA (Fichtel and Moll).


The above may well serve as the type of complanate elongate-oval Cristellaria with segments at first involute and later drawn out and separated by straight septa. The periphery is not carinate, although thin and round. A shallow water form and more frequent in temperate than in tropical seas. It has a long geological history and has been described by the author from the Cretaceous marl of Vincetown, New Jersey. It is the most common species of the genus in the 19 bottles of Albatross dredgings. Occurs at Stations D. 4000, H. 4430, H. 4508, and H. 4694.

Brady, Chal. Rept., IX, p. 547.
CRISTELLARIA CULTRATA (Montfort).


Distinguished from Cristellaria rotulata by its carinate border. Occurs with the latter less frequently but is usually in somewhat deeper water. Cretaceous to Recent. Present at Stations D. 4000, H. 4566, and H. 4696.

CRISTELLARIA ELEGANTISSIMA (Costa).


I think I am right in ascribing to the above species the form described below. The test is much compressed and rather strongly striate with smooth ultimate chamber slightly prolonged. The outline is quadrangular and the periphery bluntly rounded without keel. There are about seven chambers visible in the last convolution, the inner ones but faintly visible, the latter clearly marked by the slightly depressed septa. The aperture is fissurine, somewhat prolonged but not tubular. The shell we find of a grayish-white color and large for the genus. In general growth the test strongly resembles Cristellaria crepidula, but it is more stoutly built, and there is a difference in the method of extension of the chambers forming the last convolution. There is a figured form of Cristellaria in Professor Williamson's Monograph on the Recent Foraminifera of Great Britain which roughly resembles the present form (fig. 55, pl. 11), but the latter is provided with a well-defined flange. Present at Station H. 4508 of the Albatross.

Our one specimen is comparable to the figured specimen of A. Goes.\(^a\)

CRISTELLARIA GIBBA d'Orbigny.

Cristellaria gibba d'Orbigny, Foram. Cuba, 1839, p. 63, pl. vii, figs. 20, 21.

"Sublenticular, equally biconvex, smooth, characterized by the somewhat inflated and protuberant final segment, and its contracted septal face."\(^b\)

Cosmopolitan, but usually at depths of less than 500 fathoms. Cretaceous to Recent. Found at Stations D. 4000 and H. 4694, but not common.

\(^a\) Arctic and Scand. Recent Foram., p. 64, pl. xi, fig. 642 b.

\(^b\) Flint, Recent Foram., p. 317.
Cristellaria orbicularis (d'Orbigny).


Differs from Cristellaria vortex in its flange, or keeled border. West Indies, 450 fathoms, numerous localities in the South Pacific, and fossils in the Sub-Apennine of Italy and the Vienna Basin Miocene. Rare at Station H. 4508.

Cristellaria rotulata (Lamarck).

Lenticulites rotulata Lamarck, Annales du Mus., V, 1804, no. 3, p. 188; Tab. Encycl. et Method, pl. cccclxvi, fig. 5.

This species is the type of the group and is probably the most generally distributed and at greater variety of depths than any form of the genus. Its geological history is also long and dates from the Upper Trias of Derbyshire, England. Not uncommon at Station D. 4000 and present at H. 4430.

Cristellaria vortex (Fichtel and Moll).

Nautilus vortex Fichtel and Moll, Test. Microsc., 1803, p. 33, pl. 11, figs. 3-4.

Chambers very long and narrow and separated by exceedingly curved septa, which sweep backwards a long portion of the shell. Test moderately vaulted and umbonate. Mentioned by Brady from four stations in the South Pacific, 125 to 420 fathoms, and off Bermuda, in North Atlantic, 435 fathoms. Parker and Jones record the species in the Mediterranean, 90 to 360 fathoms. Flint mentions it from the Caribbean. Observed only at Station H. 4508. It is known as a Tertiary fossil.

Subfamily POLYMORPHININÆ.

Genus POLYMORPHINA.

Polymorphina amygdaloïdes Reuss.

Polymorphina amygdaloïdes Reuss, Sitzungsber. Akad. Wiss. Wien, XVIII, 1855, p. 250, pl. viii, fig. 84.

A depressed variety of the more common species Polymorphina lactea. Occurs rarely at Stations D. 4017, D. 4174, and H. 4567.

Polymorphina angusta (Egger).


We find what appears to be a variety of the above species at Station 4017. The form is of wide distribution, and while known in shallow dredgings is usually found at considerable depths. Fossil in the Bavarian Miocene.
POLYMORPHINA COMMUNIS (d'Orbigny).


Occurs at Station 4585 only of the *Albatross* cruise, but is of universal distribution, with almost unlimited bathymetrical range, and is fossil in the early Mesozoic (Lower Lias), becoming more common in Cretaceous strata and succeeding formations.

POLYMORPHINA COMPRESSA d'Orbigny.

*Polytmorphina compressa* d'Orbigny, Foram. Foss. Vien., 1846, p. 233, pl. xii, figs. 32-34.


POLYMORPHINA GIBBA (d'Orbigny).


Test almost globular with three chambers visible on one of the surfaces and flush suture lines. Occurring first in the Oolite, this form is known in many succeeding formations and has a wide distribution in existing oceans. Found at Station H. 4430 only, and rare.

POLYMORPHINA LACTEA (Walker and Jacob).

*Serpula lactea* Walker and Jacob (according to Kuhnacher), Adam's Essays, 1798, 2d ed., p. 634, pl. xxiv, fig. 4.

One of the most widely known forms of the genus in both fossil and living condition and occurring as early as the Jurassic. Found at Station H. 4579.

POLYMORPHINA OBLONGA d'Orbigny.


More restricted in its distribution than *Polytmorphina lactea* and generally at depths of less than 500 fathoms. Found at Station H. 4694 only.

POLYMORPHINA REGINA Brady, Parker, and Jones.

*Polytmorphina regina* Brady, Parker, and Jones, Trans. Linn. Soc. 1870, p. 211, pl. xli, figs. 32, a, b.

This is one of the few *Polytmorphina* with surface ornamentation. The costae are regular and equidistant. The original specimens were from Storm Bay, Tasmania. The other localities are in shallow water in the tropics. A less regular costate form occurs in the Cre-
taceous, and has been described under the name *Polymorphina semicoastata* Marsson. *P. regina* was found at Station H. 4694, but was rare.

**Genus UVIGERINA.**

**UVIGERINA ANGULOSA** Williamson.

*Uvigerina angulosa* Williamson. Recent Foram. Gt. Britain, 1858, p. 67, pl. v, fig. 140.

This small foraminifer we find quite abundantly at many stations. It is reported to be very widely distributed and at depths from 50 to 1,630 fathoms. Found at Stations D. 4000, D. 4017, D. 4174, H. 4440, H. 4502, H. 4508, H. 4567, H. 4568, H. 4571, and H. 4694.

**UVIGERINA ASPERULA** Czjzek.

*Uvigerina asperula* Czjzek. Haidinger’s Nat. Abhandl., II, 1847, p. 146, pl. xiii, figs. 14, 15.

Rather widely distributed in nearly all oceans and at depths varying from a few fathoms down to over 2,000. Known as a fossil in the Baden Miocene. A very abundant form in nearly every *Albatross* station, and absent at Stations D. 4000, D. 4017, D. 4174, H. 4476, H. 4579, and H. 4696 only.

**UVIGERINA ASPERULA var. AMPULLACEA** Brady.

*Uvigerina asperula var. ampullacea* Brady, Chal. Rept., IX, 1884, p. 579, pl. lxxxv, figs. 10, 11.

The average depth for this species is not far from 500 fathoms. Not so common as the preceding, but rather abundant in many localities. Found at Stations D. 4174, H. 4440, H. 4508, H. 4555, H. 4566, H. 4567, H. 4568, H. 4571, and H. 4694.

**UVIGERINA ASPERULA var. AUBERIANA** d’Orbigny.

*Uvigerina auberianna* d’Orbigny, Foram. Cuba, 1839, p. 110, pl. xx, figs. 23, 24.

Less abundant than the typical species, the *Challenger* specimens were obtained at depths of 580 fathoms, Ki Islands; 610 fathoms, off Kandava; and 630 fathoms, Rockhall Bank, and from shore sands of the West Indies. The variety is not rare at several stations of the *Albatross*, but is not quite so well represented as the variety *ampullacea* and still less than *Uvigerina asperula*. It occurs at Stations D. 4174, H. 4508, H. 4566, H. 4567, H. 4568, and H. 4571.

**UVIGERINA CANARIENSIS** d’Orbigny.

*Uvigerina canariensis* d’Orbigny, Foram. Canaries, 1839, p. 138, pl. t, figs. 25-27.

The distribution of this species is somewhat peculiar. It is known from very shoal waters as well as from depths of nearly 2,000 fathoms. Found at Stations D. 4000, D. 4025, and H. 4571.
UVIGERINA CANARIENSIS var. STRIATA Bagg, new subspecies.

Notwithstanding that Professor Brady has mentioned the fact that some forms of *UVIGERINA CANARIENSIS* are very weakly striated in their lower portion and that such forms are synonymous with d'Orbigny's *UVIGERINA ARNULFI*, I find at Station 4566 a form which has definite striations extending in groups clear and well-defined, though not closely set down, and over the last chamber as well as over the earlier segments as in *UVIGERINA PYGMAEA*. The inflation of the segments is marked and the septa are depressed. This form seems to be sufficiently marked to be considered distinct, although Professor Brady has treated such specimens as varieties only of the more widespread type, *UVIGERINA CANARIENSIS*. (See Plate V, fig. 2.)

Type.—Cat. No. 8201, U.S.N.M.

UVIGERINA INTERRUPTA Brady.


The original specimens of this species came from a few localities in the South Pacific, at depths varying from 37 down to 1,375 fathoms. Present but not very common at Stations II. 4430, II. 4440, and II. 4508.

UVIGERINA PYGMÆA d'Orbigny.

*UVIGERINA PYGMÆA* D'ORBIGNY, Ann. Sci. Nat., VII, 1826, p. 263, pl. xii, figs. 8, 9, model No. 67.

This is a widely distributed form both recent and in the Tertiary fossil beds, and its bathymetric range in existing oceans appears to be practically unlimited. It is not at all common in the *Albatross* material, but we find examples at Stations II. 4502, II. 4508, II. 4571, II. 4694, and II. 4696.

UVIGERINA TENUISTRIATA Reuss.


Reported from off the Philippines in 95 fathoms, off Heard Island, 75 fathoms, and off Raine Island, 155 fathoms; also off coast of Patagonia, 140 fathoms. Not common at Stations D. 4017, II. 4476, II. 4583, and II. 4696.

Genus SAGRAINA (SAGRINA).

SAGRAINA COLUMELLARIS Brady.


The name of this genus is by some authors spelled *Sagrina* after Reuss, although *Sagrina* appears to be also in use. This handsome
species is larger than *Sagraina dimorpha*, the segments are smooth with the sutures flush, and the walls are not prominently perforated. It has been recorded at a limited number of localities in the Atlantic and Pacific in both shallow and deep waters. Rather common at Stations D. 4000, D. 4017, D. 4025, II. 4430, II. 4508, II. 4585, and II. 4694.

*Sagraina dimorpha* Parker and Jones.

*Urigerina (Sagraina) dimorpha* Parker and Jones. Phil. Trans., CLV. 1865, p. 420, pl. XVIII, fig. 18.

A cosmopolitan species at moderate depths and more abundant than other species of the genus. Occurs at stations II. 4440, II. 4566, and II. 4694.

*Sagraina irregularis* Bagg, new species.

Test elongate with irregularly set stout segments separated by septa which are but little depressed, giving a nodosarian aspect to the shell. The distal end is narrowly rounded without being acuminata, the anterior abruptly truncated with an invaginated siphonal tube at the end of which is the circular flaring aperture. This peculiar inset effect of the apertural tube, together with the irregularly set chambers, affords a ready means of separation of the form from *Sagraina striata* Schwager, which the species somewhat resembles. The striations of the surface are sinuous, delicate and fairly persistent, but they branch in some places. The texture of the shell is fine semitranslucent hyaline calcareous matter and the tests are rather large and well built for the genus. Found in material from Stations D. 4025 and II. 4571 and common at the former station. (See Plate V, figs. 8-10.)

Type.—Cat. No. 8200, U.S.N.M., Station 4025.

Family GLOBIGERINIDÆ.

Genus GLOBIGERINA.

*Globigerina æquilateralis* Brady.


This symmetrically but loosely built *Globigerina* is one of the most abundant forms in all the material dredged in the 19 stations we examined. The forms are large and beautiful and in various stages of growth. This is less common perhaps than *Globigerina bulloides*, but is of larger size. Not likely to be confused with *G. cretacea*, which is more involute, trochoid in its growth, and less common. Present in surface waters only of both the North and South Pacific; in bottom material also in the South Atlantic. Geological range, Cretaceous (?) to Recent. Abundant at every station except II. 4579, where it is apparently absent.
GLOBIGERINA BULLOIDES d'Orbigny.


The most abundant form in Recent oceans at all latitudes and at all depths, constituting the bulk of Globigerina ooze. A very common fossil from the Cretaceous through the Tertiary. Abundant at every locality of the 19 stations here described.

GLOBIGERINA BULLOIDES var. TRILOBA Reuss.


Regarded as only an unimportant variety of G. bulloides, always associated with the latter, but less common. This form was found at six stations only—D. 4174, II. 4502, II. 4508, H. 4566, H. 4567, and H. 4568—although it is probably present in others where Globigerinae are abundant.

GLOBIGERINA CONGLOBATA Brady.


Equally abundant, with other Globigerina types, in every dredging except D. 4000, H. 4440, H. 4508, and H. 4579.

Common in surface collections in the great oceans, but most frequent in warmer latitudes and in the Tropics. Professor Brady in the Challenger report limits it to latitude 40° north and 35° south in the Atlantic, and a still more restricted area in the Pacific. Not recorded in the fossil world.

GLOBIGERINA CRETACEA d'Orbigny.


There can be no doubt but that this widely distributed Cretaceous foraminifer is still living in existing seas. The test closely resembles G. dubia Egger, but is more complanate. Abundant in Cretaceous chalk beds of both Europe and America. Present in the Carribean Sea at 500 meters (Goes).a Observed at Stations H. 4502, H. 4566, and H. 4567, but not very abundant.

GLOBIGERINA DIGITATA Brady.


The great elongation of one, two, or even three final chambers into digit-like tubes from a small closely set body whorl are the remark-

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able characteristics of this *Globigerina*. Professor Brady does not mention it as a pelagic organism and believes its distribution to be very limited. Found rather frequently at some stations and present at H. 4174, H. 4440, 4585, H. 4566, H. 4571, H. 4585, H. 4590, and H. 4694.

**GLOBIGERINA DUBIA** Egger.

*Globigerina dubia* Egger, Neues Jahrbuch für Min., 1857, p. 281, pl. ix, figs. 7-9.

"The *Globigerina dubia* of Egger can only be accepted as a varietal modification of *Globigerina bulloides*, representing perhaps the best development of the typical characters. The test attains somewhat larger dimensions, is stout and compactly built, distinctly rotuline in general conformation, and with a well-marked umbilical cavity. It has frequently as many as fourteen or fifteen segments. Pelagic specimens of this variety have been taken in the South Atlantic and in the North and South Pacific; and in bottom ooze it has been found also in the North Atlantic. Its northern limit appears to be about latitude 56° north, a little to the south of the Rockhall Bank; whilst in the opposite hemisphere it reaches as far as about latitude 46° south in the Southern Ocean."*a* Doctor Egger's fossils were from the Miocene of Bavaria. Obtained at Stations D. 4174, H. 4430, H. 4502, H. 4508, H. 4555, H. 4566, H. 4568, and H. 4571.

**GLOBIGERINA HELICINA** d'Orbigny.


Reported to be rare in both the North and South Atlantic and the South Pacific. Known as a fossil in the Italian Tertiary. Rare and found only at Station H. 4696.

**GLOBIGERINA RUBRA** d'Orbigny.

*Globigerina rubra* d'Orbigny, Foram. Cuba, 1829, p. 94, pl. iv, figs. 12-14.

Most abundant in Tropical oceans. Rather less common in our material than other *Globigerina* and found at all stations save D. 4000, H. 4440, H. 4508, H. 4555, H. 4571, and H. 4590.

**GLOBIGERINA SACCULIFERA** Brady.

*Globigerina sacculifera* Brady, Geol. Mag., Dec. 11, IV, 1877, p. 535.

Next to *Globigerina bulloides* this is the most abundant species of the genus *Globigerina* in our material, and we find it very plentiful and present in every station except H. 4585. Its range is similar to that of *G. conglobata*.

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*a* Brady, Chal. Rept., IX, pp. 535-536.
Genus **ORBULINA**.

**ORBULINA UNIVERSA** d’Orbigny.

*Orbulina universa* d’Orbigny, *Foram. Cuba*, 1830, p. 3, pl. 1, fig. 1.

One of the most wide-spread Foraminifera in existing oceans and of unlimited bathymetric range. Fossil in the Lias and later formations. Abundant in every *Albatross* station examined.

Genus **PULLENIA**.

**PULLENIA OBLIQUILOCULATA** Parker and Jones.

*Pulinea obliquiloculata* Parker and Jones (Introd. *Foram.*, 1862, p. 183); Phil. Trans., CLV. 1865, pp. 368, 421, pl. xix, fig. 4.


**PULLENIA SPHÆROIDES** (d’Orbigny).


Genus **SPHÆROIDINA**.

**SPHÆROIDINA BULLOIDES** d’Orbigny.


**SPHÆROIDINA DEHISCENS** Parker and Jones.

*Sphæroidina dehiscens* Parker and Jones, Phil. Trans., CLV. 1865, p. 369, pl. xix. figs. 5, a, b.

Genus CANDEINA.

CANDEINA NITIDA d'Orbigny.

*Can*de*ina nitida d'Orbigny*, Foram. Cuba, 1839, p. 111, pl. ii, figs. 27, 28.

Test trochoid with globose segments, along the junction of which are a series of pores which cover in a regular manner the entire sutural depressions. Shell white and shining and resembling *Glo*bigerina*, but the pores so minute that they can not be seen except under very high power; the shell in this respect resembling *Sphaero*idea*. The genus is represented by only this one species, and it is present both in surface and bottom material, with the thinner shell cover in the surface specimens.

Reported not rare in dredgings from Funafuti, in the South Pacific, at depths of 50 to 200 fathoms. Abundant along with *Glo*bigerina* in every ooze we have studied, except at Stations D. 4017 and H. 4579. Not known in the fossil condition.

Family ROTALIID.E.

Subfamily ROTALID.E.

Genus CYMBALOPORA.

CYMBALOPORA POEYI (d'Orbigny).

*Rosalind poeyi d'Orbigny*, Foram. Cuba, 1839, p. 100, pl. iii, figs. 18-20.

This peculiar rotaliform genus has its most typical representation in the above species. It is known in two distinct types, one high and vaulted form the other strongly depressed. The first we observe frequently in several of our dredgings, particularly at Station 4025. The species is common in tropical coral sands. Found at Stations D. 4000, D. 4017, D. 4025, H. 4476, and H. 4696. Not known in the fossil state.

DISCORBINA OBTUSA (d'Orbigny).

*Rosalind obtusa d'Orbigny*, Foram. Foss. Viel., 1846, p. 179, pl. xi, figs. 4-6.

Test plano-convex, with superior surface, but little elevated. Sutures depressed, slightly curved on the superior surface and the margin somewhat lobulated. The inferior surface shows but few chambers, with straight depressed septa reaching to the umbilicus. The striate aspect of this lower surface is not constant.

Recorded and figured by Goes from material collected near Spitzbergen at a depth of 40 meters. Parker and Jones record it as plentiful off the Hunde Islands, Davis Straits, 28 to 70 fathoms. Professor Brady reports it from off Ascension Islands, 420 fathoms.
D'Orbigny described it from the Vienna Basin Miocene at Nussdorf. *Discorbinae* are uncommon in the material we examined, and this species was present only at Station II. 4568.

**DISCORBINA TURBO (d'Orbigny).**


Cretaceous to Recent. Shoal waters, tropical oceans. Rare at Station II. 4694.

**DISCORBINA VILARDEBOANA (d'Orbigny).**


Recent only. Universal distribution in existing oceans. Limited to shallow waters. Not uncommon at Stations II. 4440 and H. 4568.

Genus **TRUNCATULINA.**

**TRUNCATULINA AKNERIANA (d'Orbigny).**


Present at Station II. 4590 only.

**TRUNCATULINA CULTER (Parker and Jones).**

*Planorbulina culter* Parker and Jones, *Phil. Trans.*, CLV, 1865, p. 421, pl. xix, figs. 1, a, b.

The original specimens of this species were from a depth of 1,080 fathoms in the tropical Atlantic. Found at Stations II. 4502 and II. 4567 of the *Albatross*.

**TRUNCATULINA DUTEMPLEI (d'Orbigny).**


This foraminifer is apparently not uncommon in the middle European Tertiary, but is rare and at depths of over 1,000 fathoms in existing oceans. Station II. 4571, 384 fathoms, not common.

**TRUNCATULINA HAIDINGERII (d'Orbigny).**


Not common in existing oceans, but known in nontypical specimens at depths of from 90 to 1,776 fathoms chiefly in the South Pacific. Found in the Upper Cretaceous and best developed in the Tertiary formation. Occurs sparingly at Station II. 4508.
TRUNCATULINA LOBATULA (Walker and Jacob).

_Antilus lobatus_ Walker and Jacob, Adam's Essays, Kaumacher's ed., 1798, p. 642, pl. xiv, fig. 36.

One of the most widely diffused Rotaline types known and occurring frequently in all formations where Foraminifera are present from the Carboniferous to Recent. Found at all stations except H. 4430, H. 4502, H. 4555, H. 4566, H. 4579, H. 4585, and H. 4590.

TRUNCATULINA MUNDULA Brady, Parker, and Jones.


The authors state that this form, common at 250 fathoms off the Abrolhos Bank, South America, is intermediate between _Truncatulina hailingeri_ and _Truncatulina ungeriana_. It is more compressed than the former, with about double as many chambers in each convolution, and they consider _Pulvinulina karsteni_ its nearest isomorph. Specimens agreeing closely with the description and figure of this species we find at Station D. 4000, depth 104 to 213 fathoms.

TRUNCATULINA_PRAECINCTA (Karrer).


Of this coral reef species no typical representatives occur in the Albatross collections, but what perhaps is a variety of the form occurs rarely at Station H. 1476.

TRUNCATULINA PYGMAEA Hantken.

_Truncatulina pygmaea_ Hantken, Mittheil. Jahrb. ung. Geol. Anstalt, IV, 1875, p. 78, pl. x, fig. 8.

This is a very deep-water species, being found at depths of 1,570 to 3,125 fathoms. Represented at Station H. 4502, 1,342 fathoms.

TRUNCATULINA REFULGENS (Montfort).


_Truncatulina refugens_ occurs at depths ranging from about 50 to 2,500 fathoms and is typically represented in the temperate-zonal waters outside the Tropics. Found rather unfrequently at Stations D. 4000, D. 4174, H. 4430, H. 4476, H. 4566, and H. 4696. It is a well-known fossil from the Cretaceous and later formations.
TRUNCATULINA WUELLERSTORFI (Schwager).


This species is very abundant in nearly all of the Albatross material examined and is wanting only at Stations D. 4000, D. 4476, H. 4555, H. 4566, and H. 4579. Its earliest appearance dates back to the Cretaceous.

Genus ANOMALINA.

ANOMALINA AMMONOIDES (Reuss).

Rosulina ammonoides Reuss. Verstein. holm. Kreid., Pt. 1, 1845, p. 36, pl. xiii, fig. 60; pl. viii, fig. 53.

Easily recognized by its depressed involute nautiloid form with rounded margin and median aperture. The species is, however, liable to considerable minor varieties. It is chiefly found in the South Pacific, and in waters of moderate depths. As a fossil it is well known in the Cretaceous of both this country and Europe. It is not abundant in the material studied but occurs at Stations D. 4000, D. 4025, D. 4174, H. 4430, H. 4440, H. 4476, H. 4508, H. 4566, H. 4567, H. 4579, and H. 4694, and is rather common at D. 4025.

ANOMALINA ARIMINENSIS (d'Orbigny).


Differ from *A. ammonoides* in the greater compression of the test and the more squarely built periphery, together with a stronger limiation of the sutures.

Widely found in the North Atlantic, at moderate depths; rare in the South Atlantic, and also in the South Pacific; abundant in the Mediterranean. Found also at the Abrohlos Bank from 47 to 940 fathoms, and in Hongkong Harbor. In the fossil state it is known from the Cretaceous, and has been found in the Tertiary and later deposits in many localities. Rather rare at Stations H. 4430 and H. 4567.

ANOMALINA CORONATA Parker and Jones.


The above species is coarsely constructed, like *Anomalina grosserugosa*, but the segments are more or less angular along each side of the peripheral border and sharply marked off from the depressed umbilici. The perforation of the shell is coarse and the test large. Rare within the Tropics but abundant in many temperate zone dredgings from the North and South Atlantic oceans. Geologically known from the Eocene through the later Tertiaries. It is usually found
at shoal water depths, although 1,630 fathoms have yielded specimens. We recognize the species at Stations D. 4000, H. 4566, H. 4571, and H. 4696. Perhaps the largest and most typical are from Station H. 4566.

ANOMALINA GROSSERUGOSA (Gumbel).


Resembles Anomalina ammonoides, but is larger, more stoutly built and has only a few chambers in the last convolution. The perforation is coarse but there are fewer pores upon the superior surface.

The Challenger expedition obtained this form from only a few localities in the North and South Atlantic and in the North and South Pacific. The depths were from 345 to over 2,000 fathoms. I am inclined to think, however, that it is much more common than these results would indicate. I find excellent specimens at Station D. 4502 and it is present at the following localities: Stations D. 4174, H. 4430, H. 4440, H. 4502, H. 4508, H. 4555, H. 4571, and H. 4696.

I have recorded the form in the New Jersey Cretaceous and it has been variously recorded in the European Tertiary. A very similar form is found in the Vienna basin Miocene near Baden, and described by d'Orbigny under the name Anomalina badzensis.²

ANOMALINA POLYMORPHA Costa.

Anomalina polymorpha Costa, Atti dell' Accad. Pontan., VII, 1856, p. 252, pl. xvi, figs. 7-9.

A large coarsely built form with extensions of the chambers at the periphery irregularly into stout spines. The perforation is very large and the pores few, and the species is somewhat like Anomalina grosserugosa, but is less thick. It is considered isomorphous with Rotalia calcare and Pulvinulina spinimargo.

Present at shallow depths in both Atlantic and Pacific oceans. Recorded by Costa from the Miocene of Italy. Occurs at Stations D. 4017, H. 4476, H. 4508, H. 4568, H. 4579, H. 4590, and H. 4696.

Genus PULVINULINA.

PULVINULINA CANARIENSIS (d'Orbigny).

Rotalina canariensis d'Orbigny, Foram. Canaries, 1839, p. 130, pl. 1, figs. 34-36.


² For. Foss. Vienna, p. 171, pl. x, figs. 1-3.
PULVINULINA CRASSA (d'Orbigny).


Described in the Cretaceous but not in succeeding formations. Occurs in bottom dredgings at great depths as well as in shallower waters and over a wide area of distribution. Stations II, 4130, H. 4555, H. 4566, H. 4571, H. 4585, and H. 4590 of the Albatross cruise.

PULVINULINA ELEGANS (d'Orbigny).


One of the most beautiful of all Pulvinulina and of very large size. It is a comparatively shallow-water type, while its related form, Pulvinulina partschiana, is a deep-water species. Found rather abundant at Stations D, 4174, II. 4130, II. 4502, II. 4508, H. 4555, H. 4567, H. 4571, H. 4585, and H. 4696.

PULVINULINA GILBERTI Bagg, new species.

From the dredging of Station 4567 I find two specimens of Pulvinulina which appear to be new. The test is highly vaulted upon the inferior side, with deeply sunken septa which extend from the margin to the umbilicus in an almost straight line, as in Pulvinulina canariensis d'Orbigny, which this species somewhat resembles. The segments are, however, more compactly built and the aperture, a neatly shaped arch, lies midway between the periphery and the umbilicus upon the inferior surface. The superior surface, instead of being vaulted as in P. canariensis, is almost complanate and the periphery is almost keeled, being quite sharp and distinct, although somewhat lobulated on the last two chambers of the ultimate whorl. There are five segments visible in the last convolution and they are equally distinct upon both surfaces. (See Plate V, figs. 11–15.)

The shell is very minute and firmly built. It has a slight resemblance to Transvatulina datemplei (d'Orbigny), but the margin is sharp and more angular in the present form, and the septal lines upon the inferior surface are much more depressed and the chambers more inflated. It is somewhat doubtful whether the present form should be considered a distinct species or only a variety of Pulvinulina menardii, which it resembles. It is much smaller than P. menardii, much more vaulted upon the inferior surface, and a little more closely involute. The septal depressions also are strong, deeply sunken on the lower side, and extend straight to the center. Upon the superior side they are strongly curved as in P. menardii. There are five of these chambers in the final convolution. The ultimate chamber is largest and in its outline reminds one of the auriculate

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type of *Pulvinulina*, but it is not so extended from the whorl. It is not a young form of *P. menardii*. Present and rather common at Station H. 4555.

Named for Professor Charles H. Gilbert, of Stanford University, California.

*Type.—Cat. No. 8199. U.S.N.M., Station H. 4555.*

**PULVINULINA MENARDII** (d'Orbigny).


This is the most abundant *Pulvinulina* found in the *Albatross* material, and it is typically developed and present at every station but one, H. 4579. Its geological history dates from the Cretaceous. In existing oceans the distribution is world-wide and ranging down to 2,750 fathoms or more.

**PULVINULINA MENARDII** var. FIMBRIATA Brady.

*Pulvinulina menardii* var. *fimbriata* Brady, Chal. Rept., IX, 1884, pp. 691, 692, pl. clxi., figs. 3, a, b.

Stations H. 4567, H. 4571, and H. 4694, but not common at any of them.

**PULVINULINA MICHELINIANA** (d'Orbigny).


This species, while never abundant in our material, is not at all rare and in some localities it is rather plentiful. The forms are typical specimens and rather large.

Obtained at all Stations except at D. 4025, where *Pulvinulina* are not abundant, and at H. 4579.

**PULVINULINA PARTSCHIANA** (d'Orbigny).


A deep-water variety of *Pulvinulina elegans*, as stated above. Occurs only at Station H. 4568.

**PULVINULINA PATAGONICA** (d'Orbigny).

*Rotalina patagonica* d'Orbigny, Foram. Amer. Merid., 1839, p. 36, pl. ii., figs. 6-8.

A common constituent of bottom dredgings, but rare in surface material. Present at Stations H. 4502 and H. 4566.
PULVINULINA PROCERA Brady.


This species closely resembles Pulvinulina schreibersii, but the test is higher and more conical. Found only at Station II. 4508.

PULVINULINA PUNCTULATA (d'Orbigny).


Station D. 4017, but rare. Prof. H. B. Brady in the Challenger Report (p. 686) writes that with the exception of one occurrence near the west coast of Patagonia the species is limited to the North Atlantic, and we may be wrong in placing the few specimens we have under this species. The characters agree tolerably well, however, and the identification may be conditionally made as above.

PULVINULINA REPANDA (Fichtel and Moll).

Nautilus repandus Fichtel and Moll, Test. Microsc., 1803, p. 35, pl. iii., figs. a–d.

We do not find good representatives of the above species in our dredgings, but the form occurs at Stations D. 4017 and H. 4694.

PULVINULINA SCHREIBERSII (d'Orbigny).


Occurs in the Middle Tertiary. Reported from seven stations in the South Pacific. Found sparingly at Stations H. 4476 and H. 4566.

PULVINULINA MENARDII var. TUMIDA Brady.

Pulvinulina menardii var. tumida Brady, Geol. Mag., Iv. 1877, Dec. 11, p. 294.

Chiefly tropical and generally from bottom dredgings. Frequent at all stations, in common with P. menardii, except D. 4017, D. 4025, H. 4440, H. 4579, and H. 4696.

Genus ROTALIA.

ROTALIA SOLDANII (d'Orbigny).


A common species of wide distribution and most frequent at depths below 1,000 fathoms. Eocene to Recent. Rare at Stations H. 4508, H. 4555, and H. 4585.
Family NUMMULINIDÆ.

Subfamily POLYSTOMELLINÆ.

Genus NONIONINA.

NONIONINA DEPRESSULA (Walker and Jacob).


Widely distributed at the present time and common in the European Tertiaries. Found at Stations D. 4025, H. 4430, H. 4440, and H. 4466.

NONIONINA ORBICULARIS Brady.


I think I am right in placing the small Nonionina found at Station H. 4566 in this species. The form resembles Nonionina pompilioides in outline, but the former has more segments, thicker umbilici, and less regular arrangement of the segments. This species has been dredged off the cold waters of Spitzbergen, off the Canaries, off Patagonia, and elsewhere, but at very shallow depths. It is obtained in the Eocene and later Tertiary of Europe. Station H. 4566.

NONIONINA POMPILIIOIDES (Fichtel and Moll).

Vautilus pompilioides Fichtel and Moll. Test. Microsc., 1803, p. 31, pl. 11, figs. a–c.

Test thicker and more involute than Nonionina umbilicatula, which this species resembles, and the septa less distinct. Reported to be less common than similar species. Chiefly confined to deep water and generally below 1,000 fathoms. Fossil in the Miocene and later formations. Station H. 4567 only, and not common.

NONIONINA SCAPHA (Fichtel and Moll).


The elongate oval segments and depressed chambers which rapidly enlarge from the umbilicus make the form easily recognizable. Frequent in dredgings from many regions and common as a fossil in the Tertiary. It does not appear to be limited in depth. Stations D. 4000, D. 4025, H. 4440, H. 4567, and H. 4696 afford specimens of this species. It appears to be the most common Nonionina in our dredgings.
NONIONINA UMBILICATULA (Montagu).

Nonionina umbilicatula may be regarded as occupying an intermediate position between N. depressa and N. pomplinoides. It is found at all depths from a few to over 3,000 fathoms. Its geographical distribution is equally extensive. Its geological history commences with the Eocene. Occurs at Stations II. 4508 and II. 4555.

Genus POLYSTOMELLA.

POLYSTOMELLA MACELLA (Fichtel and Moll).

A compressed variety of the more abundant type Polystomella crispa. Chiefly in shallow, tropical waters, but it is the earliest known fossil belonging to the genus and occurs in the Middle Jura. Found at Stations D. 4000 and II. 4430.

POLYSTOMELLA SUBNODOSA (Münster).

This occurs but twice in the Challenger dredgings, off Booby Island, and southwest of Papua at from 6 to 28 fathoms. Rare at Station II. 4508.

POLYSTOMELLA STRIATOPUNCTATA (Fichtel and Moll).

One of the most abundant species of Polystomella whether recent or fossil. Depth and range unlimited. Fossil in the early Eocene. Found at Station D. 1174.

Subfamily NUMMULITIDAE.

Genus AMPHISTEGINA.

AMPHISTEGINA LESSONII d’Orbigny.


The recent types of Amphistegina are very difficult to separate even in varieties on account of the great variation of form they exhibit. Professor Brady a separates the species Amphistegina lessonii into three divisions, namely: (1) compressed lenticular form (=A. vulgaris Parker, Jones, and Brady), (2) thick variety, more often in-

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a Challenger Report, IX, p. 740.
equilateral (= H. gibbosa Williamson), and (3) thick forms, still more inequilateral (= H. rugosa d'Orbigny). In the material studied there are two well-developed types: one rather small, shining, white, nearly equilateral, moderately vaulted, with all the segments visible in the final volition, the other very gibbous, opaque, larger than the first, with some granulations around the aperture near the margin, with the chambers uniformly curved, and without the sinuosity of the smaller types. It is possible that this second form represents a new type, but since so much latitude has been granted the original H. lessonii I prefer to consider these two types as one and refer to the average symmetrical form as H. lessonii and the other as the globose variety. The species is unusually abundant in the Hawaiian dredgings. It was recognized in the following stations of the 19 examined: D. 4000, D. 4023, D. 4174, H. 4430, H. 4440, H. 4476, H. 4508, H. 4566, H. 4567, H. 4579, and H. 4694. The typical globose type is abundant at Station 4476.

Abundant in the tropical waters of the great oceans. It is best developed on bottoms of less than 30 fathoms, and is rare below 400 fathoms.

Genus HETEROSTEGINA.

HETEROSTEGINA DEPRESSA d'Orbigny.


Like Haplosteche, this genus has but a single living representative. It is a shallow-water tropical form found around many coral islands. But two specimens of this well-known species were obtained at Station H. 4566.

Genus NUMMULITES.

NUMMULITES CUMINGII Carpenter.

Amphistegina cumingii Carpenter. Phil. Trans., 1839, p. 32, pl. v, figs. 13-17.

The classification of recent Nummulites is to the mind of the writer in an entirely unsatisfactory condition. The difficulty has come from considering under one species many marked varieties with not only more chambering in each volition but also from a difference in vaulting or thickness of contour, which results in altering the entire figure of the shell. Under Amphistegina were mentioned several varieties, and the same might be done with the Nummulites series. The multiplication of chambers, however, is, I think, important and a form with twice the segmentation in a given whorl ought not to be regarded as belonging to a species with only one-half as many.

Again the asymmetry of the test is one of the chief features which serve to distinguish the genus Nummulites from Amphistegina, and even Carpenter later referred the present form to Nummulites after
previously classifying it with *Amphistegina*. However that may be, there is a considerable amount of variation among these forms which in the fossil state would be sufficient to cause their separation into several species or at least important varieties of the typical form. This matter can not be properly entered into here, but we have purposely kept *Nummulites radiata* separate from *Nummulites camingii*, notwithstanding that it is considered synonymous by Prof. H. B. Brady.

The species *Nummulites camingii* is confined to tropical and subtropical latitudes and is found only in very shallow waters. In specimens from Station D. 4000 there are fourteen chambers in the final convolution. In *Nummulites radiata* the number is much greater (nearly double), and they are more sinuous. Also the shell is of a dark brown color in *Nummulites radiata* and somewhat smaller. Stations D. 4000, H. 4476, H. 4566 (?), and H. 4590. Not as abundant as *Amphistegina* at any of the above stations.

**Nummulites Radiata** d'Orbigny.


Test compressed, discoidal, smooth, and composed of over twenty segments in the final convolution, separated by flexed septa, somewhat irregular. Considered by d'Orbigny as related to *Nummulina lenticularis*, but with its chambers more inflected. D'Orbigny's specimens were from the Nussdorf Miocene. Two examples of this type were taken at Station H. 4476.
**EXPLANATION OF PLATE V.**

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DESCRIPTIONS OF NEW CURCULIONID BEETLES OF THE TRIBE ANTHONOMINI.

By W. Dwight Pierce.

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In the search for available parasites to use in the fight against the boll weevil (\textit{Anthonomus grandis}), numerous new species have been found and records of hitherto unknown breeding habits made. A few interesting species contained in the U. S. National Museum are here described, either because they were collected in Texas or because of records accompanying them. This paper is published by consent of the officials of the Bureau of Entomology. The immature stages of the bred species will be described later.

\textbf{MACRORHOPTUS \textit{SPHAERALCIAE}, new species.}

Numerous specimens were bred from the fruit capsules of \textit{Sphoeraphis angustifolia} from material collected May 4, 1907, at Devils River, Texas, by F. C. Bishopp.

Length 1.25 to 1.75 mm. Oblong, black, with elytra, legs, antennae and tip of beak, ferruginous. Densely clothed with elongate pale scales, which are somewhat concave, and are mixed with inclining clavate bristles. Vestiture of prothorax densest at posterior angles. This species is readily separated from either of the described species by its light color (when unrubbed), its small size, and the inclining bristles.

\textit{Type.—Cat. No. 10054, U.S.N.M.}

\textbf{SMICRAULAX, new genus.}

Claws toothed; middle coxae separated by mesosternum; posterior tibiae mucronate; scrobes short, almost reaching eyes, directed beneath eyes; elytra quadri-tuberculate at base. The genus belongs near \textit{Cionistes}.

Name derived from \textit{σμικρός}, signifying short, and \textit{ἀνάλωτος}, signifying furrow, referring to the short scrobe.

\textit{Type of genus.—Smicraulax \textit{tuberculatus}.}

SMICRAULAX TUBERCULATUS, new species.

Described from one specimen in the Hubbard and Schwarz collection from San Diego, Texas, May 3, which is the type of the genus.

Length 2 mm. Elongate oblong, black, with beak, apical margin of prothorax, posthumeral spots, apex of elytra, antennae, trochanters, base and apex of femora, the tibiae and tarsi reddish or rufo-piceous; vestiture composed of white squamiform bristles, mainly placed one to a puncture above, very sparse, with condensed patches on scutel and a subbasal line on elytra, and on side of mesothorax and metathorax below, abdomen very sparsely pubescent with minute hairs, legs sparsely pubescent with elongate scales.

Beak short, very stout, not longer than prothorax, dorsally flattened, compressed about middle, very shining, minutely and remotely punctured. Scrobes beginning about middle of beak, broad, extending straight, but beneath eyes, and not quite reaching eyes. Scape short, clavate, slightly curved; funicle and club almost as long as beak; funicle seven-jointed, first joint stout, clavate, about twice as long as second, which is a little longer than third, joints three to seven transverse, becoming broader toward club; club elongate, pubescent. Eyes large, much closer together than breadth of beak with a shallow depression or fovea between them. Head remotely and finely punctate, concentrically rugulose. Prothorax about as long as broad at base, apex and base straight, sides convex, bulging behind middle; apex narrower than base; closely and coarsely punctured. Elytra straight at base, a little wider than thorax, angles slightly rounded, sides parallel, evenly rounded behind to apex, the two elytra rounded together; striately punctate, the striae not greatly impressed except at the sides, punctures large, round but rather shallow; humeri and a rounded tubercle at base of third interspace, prominent. Prosternum laterally oblique, very short in front of coxae; middle coxae widely separated. Femora clavate, all armed with a sharp tooth, that of the first pair being largest; tibiae bisinuate on inner margin, anterior and median unguiculate, posterior mucronate; tarsi long, first joint longest, claws armed with very long teeth. Abdomen flat, very sparsely and minutely punctate; first and second ventral segments united, the suture being almost entirely erased; last three segments subequal, the third slightly the longer; pygidium concealed.

The type specimen was collected by E. A. Schwarz on black persimmon.

Type.—Cat. No. 10060, U.S.N.M.

ANTHONOMUS (TRICHOBAROPSIS) TEXANUS Dietz.

One specimen was bred from buds of Sphaeralcea angustifolia, May 16, 1907, from material collected at Devil's River, Texas, May 4, 1907, by F. C. Bishopp.
This specimen answers the description of A. texanus perfectly, but differs from two specimens labeled in manuscript A. pilosus, in the handwriting of Dr. Eugène Dugès, of Guanajuato, Mexico, in the following minor characters: The Mexican specimens are 4.5 mm. long and the Texas is 3.25 mm. in length. The ground color of the Mexican specimens is black and of the Texan rufopiceous. In the Mexican the first funicular joint is longer than the two following and in the Texan it is equal to the two following.

ANTHONOMUS PALLIDUS Dietz.

A. texanus signatus Say var. pallidus Dietz.6

Numerous specimens were bred between May 9 and 13 from crataegus buds collected March 27, 1907, at Shreveport, Louisiana, by R. A. Cushman and W. D. Pierce. These are quite distinct from the A. texanus signatus bred from rubus buds collected in the same vicinity.

Head and beak black, tip of beak reddish, antennae yellowish with club dark. Prothorax, elytra, legs, and abdomen light yellowish-brown. Thorax ventrally darker. Dark denuded spots on elytra, as in A. signatus. Vestiture white, sparse above, except around denuded spots on elytra, and on scutellum, where it is very compact. Body beneath more densely clothed with white squamiform pubescence. The difference in thoracic structure as mentioned by Dietz is constant.

ANTHONOMUS HICORIAE, new species.

A large number of specimens were collected on hickory trees at Texarkana, Texas, March 26, 1907, by R. A. Cushman and W. D. Pierce.

This species belongs in the saturalis group near flavicornis.

Length 2.7 mm. Black. Sparsely pubescent above, more closely pubescent beneath. Pubescence above and on abdomen beneath bristle form, on sides of thorax mixed with elongate scales, thorax beneath clad entirely with elongate scales. Beak not very slender, opaque, roughly striate punctured. Antennae testaceous; second joint of funicle not much longer than third; club dusky. Head convex, finely and remotely punctured, concentrically rugulose, frontal puncture not very deep. Prothorax a little wider than long, posterior angles straight, slightly constricted at apex, strongly transversely impressed in front; sides parallel at base, rounding in front; surface very coarsely and closely punctured, punctures confluent at sides and in front, with a slight indication of minute dots over

entire surface. Elytra one-fourth wider at base than prothorax, and two-thirds longer than wide; humeri rounded, sides nearly straight, separately, but not greatly so, rounded at apex; striae impressed; punctures elongate, approximate; interspaces shining, flat at base concave on remainder of disc and at sides, not rugose; scutel densely white pubescent. Anterior and middle tibiae bisinuate internally, posterior straight; femora and tibiae rufo-pieceous, tarsi testaceous.

This species differs from subguttatus, which also has the thorax very minutely dotted, by the coarser punctuation, which is more or less confused; it differs from floricornis and subguttatus by the coarser punctuation of the beak, and from the former by the not elongate second funicular joint. There are several distinct species in this group, but which should not be defined until the host plant is limited.

_Type._—Cat. No. 10054. U.S.N.M.

**ANTHONOMUS CALLIRRHOAE, new species.**

Numerous individuals were bred from young buds of Callirrhoes involucrata at Victoria and Dallas, Texas, in April, 1907, by J. D. Mitchell and W. D. Pierce.

This species belongs in the _squamosus_ group near _ochropilosis_.

Length 2 mm. Oval, black, upper and under surface densely clothed with truncato-clavate white or brown scales. Beak black, evenly curved, slightly widened at apex, surface shining, finely punctate, each puncture bearing a small scale, the scales becoming very minute toward the apex; mandibles testaceous. Antennae very light ochreous; second joint of funicle longer than third. Eyes somewhat convex, less widely separated above than the base of the beak. Head punctured and densely pubescent, frontal fovea elongate. Prothorax about one-third wider than long strongly narrowed anteriorly, apex not constricted, base bisinuate, sides rounded; surface densely and deeply punctured. Elytra oval, rufo-pieceous, about one-fourth wider than prothorax at base; humeri rounded, sides gradually rounded to apex; striate and punctured, punctures concealed by scales; interspaces wide, convex shining. Color pattern mottled above, entirely white beneath; prothorax with brown vittae on each side of middle and on sides; scutel white; elytra clad with brown scales with a white intrahumeral spot, a long lateral line at middle of elytra, and two transverse medially interrupted fasciae and a small lateral white spot between these. Legs light ochreous, pubescent; femora clavate, anterior armed with a small, acute tooth; tibiae stout almost straight; last tarsal joint elongate. The posterior tibiae are distinctly unguiculate but the species can not be separated from _Anthonomus_ for that reason.
Type.—Cat. No. 10053, U.S.N.M.

Specimens less plainly marked were collected at Victoria, Texas, June 10, 14, 1903, May 29, 1905, April 17, 1907, by W. E. Hinds. Four gray colored specimens with a like colored pattern were taken April 8, 1907, at San Antonio, Texas, by F. C. Pratt.

ANTHONOMUS HETEROTHECAE, new species.

Bred in large numbers from heads of *Heterotheca subaxillaris* at Jacksonville, Texas, October 11, 1905, Tyler, Texas, Palestine, Texas.

This species belongs in the *squamosus* group near *tectus*.

Length 2.2 mm. Oval, pitchy brown, densely clothed with truncate or ovate white and brownish scales. Beak curved, punctato-striolate, shining at apex; median carina and striae distinct; pubescent at base. Antennae rufotestaceous, club dusky; first joint of funicle elongate, second less distinctly so. Eyes feebly convex, closer together than width of beak at base. Head scaly, frontal fovea hardly evident. Prothorax one-half wider than long, narrowed from base to apex, latter not constricted, sides feebly rounded; base feebly bisinuate; surface densely and rather coarsely punctate, punctures not completely concealed by the scales, which are white along the median line and on the sides forming three narrow vittae; scutel densely pubescent with white scales. Elytra very little wider than prothorax at base, humeri sloping; rufotestaceous, clothed mainly with brownish scales, with white scales on the suture, a white vitta on the fourth interspace almost from the base, on the sixth interspace from base for a short distance, and an indistinct white spot at sides near middle on eighth to last interspaces; striae impressed, punctures obscured by scales; interspaces flat. Legs rufotestaceous, pubescent, anterior femora armed with distinct tooth, middle and posterior very indistinctly toothed.

This species has been called *Anthonomus disjunctus* by myself in previous papers, from which it is quite distinct.

Type.—Cat. No. 10052, U.S.N.M.

ANTHONOMUS SUBFASCIATUS Le Conte.

Two specimens of this species were collected on cornus flowers at Dallas, Texas, April 24, 1907.

ANTHONOMUS (CNEMOCYLLUS) APHANOSTEPHI, new species.

Large quantities of this species were bred from the heads of *Aphanostephus skirrobasis* collected at Calvert, Texas, in May, and from the heads of a blue aster collected at Dallas, in June. One specimen also was collected by F. C. Pratt May 10, 1906, at San Antonio, Texas.

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This species belongs, among those with six-jointed antennae, in the subgenus Cnemocyllus, the light forms belonging near canus and the dark forms near ligatus. The great variation displayed by individuals bred from the same material issues a warning against using color pattern in a table for separation of species.

Length 1.5 to 2.2 mm. Elliptic, pitchy brown, very densely clothed with large scales, which on the elytra and thorax beneath are round, on the prothorax above a little longer, and on the abdomen ovate. They are greatly condensed on the sides. The scales form a more or less distinct pattern: on the thorax the median line is light with broad dark bands on each side of it, with light lateral vittae, darger sublateral vittae, and a lighter underside; scutel light; basal margin of elytra, basal quarter and apical half of first interspace, second and last quarters of third interspace, third eighth of fourth interspace, basal three-eighths of fifth interspace, third eighth of sixth interspace, last three interspaces and greater part of apex, light. Head with an impressed frontal line extending upon the base of the rostrum. Beak about three-fourths longer than prothorax. Prothorax over one-third wider than long, sides almost parallel in basal half, strongly narrowed and distinctly, though not suddenly, constricted at apex. Elytra wider at base than prothorax, slightly rounded on sides, subparallel, gradually rounded to apex behind; striae prominent, but punctures concealed by scales. Anterior femora armed with a sharp distinct tooth; posterior tibiae of male regularly curved.

The colors are quite variable and may be given in combinations as found in the typical material: (1) Purplish red with lemon yellow and brown; (2) dark brown and purple with creamy yellow; (3) greenish black and purple with creamy yellow and pink; (4) greenish black, purple and brown with creamy yellow and pink; (5) purple and brown with greenish white; (6) dark brown with light brown and creamy yellow; (7) light brown and pale yellow; (8) pale brown and creamy yellow; (9) pale brown and bright white; (10) pale purple and bright white; (11) pale purple and pale brown with bright white.

Type.—Cat. No. 10055, U. S. N. M.

ANTHONOMUS (CNEMOCYLLUS) BACCHARIDIS, new species.

Several specimens taken on Baccharis species in Madera Canyon, Santa Rita Mountains, Arizona, May 26, from the Hubbard and Schwarz collection.

This species belongs near aphanostephi, but differs by having the beak only about two-sevenths longer than the prothorax, the prothorax not more than one-third wider than long, and by the scales being less densely placed and condensed along the median line and on
the sides of thorax and elytra. The scales are large, oval, and cream or pinkish colored. The posterior tibiae of the female are slightly concave, and of the male are very strongly curved. The color pattern is as in *aphanostephi*.

*Type.*—Cat. No. 10057. U. S. N. M.

**ANTHONOMUS (CNEMOCYLLUS) LIGATUS** Dietz.

Breeds in the stems of *Leuccosyris spinosus* forming gall-like swellings. Numerous specimens were bred between May 11 and 21 from galls collected May 8, 1907, at Del Rio, Texas, by E. A. Schwarz, F. C. Pratt, and F. C. Bishop.

This species varies considerably in size and color; in some the color is very dark and the vittae are indistinct, while in others the color is so light that the dark pattern disappears.

**MECYNOPYGA, new genus.**

The abdominal structure of this genus separates it from all other Anthonomines. Claws toothed, middle coxae separated by mesosternum; scrobes long, directed beneath the eye; funicle six-jointed. Prosternum long in front of the coxae; pygidium elongate, almost horizontal, transversely depressed. The genus belongs near *Pseudaanthonomus* in the Dietz tables.

Name derived from *μυκρή* (to elongate) + πτυγυ (hind end).

*Type of the genus.*—*Mecynopyga texana.*

**MECYNOPYGA TEXANA,** new species.

One specimen collected by E. A. Schwarz at San Diego, Texas, May 5.

Length 1.7 mm. Elongate, elliptical, black; beak, antennae, and legs rufo-piceous. Densely clad with oval to elongate truncate, capitate scales, which on the elytra occur only on the interspaces and alternate with linear scales on the striae; scales below white, except on apical half of abdomen, which is clad with rich ocherus brown scales; above, the predominant color is ocherus brown, with white on head, a broad white fascia on each side of the middle on the prothorax, becoming obsolete before apex, a small white post-scuteellar spot, a longitudinal white fascia from humeri to middle of elytra, thence transverse, a white sutural line beginning on the transverse band and extending to the apex and a short distance on the apical margin.

Beak about as long as head and thorax, slightly tapering toward apex, shining, finely punctate, striolate, pubescent at base. Scrobes long, directed beneath the eye; scape clavate; funicle six-jointed, first and second joints elongate, second longer than first, following
joints shorter, but longer than broad, each clad with a whorl of elongate linear scales; club oval, pubescent, very compact. Head very minutely punctate, concentrically rugulose. Prothorax slightly longer than wide, sides converging from base to apex, very feebly convex; apex straight, base very slightly convexly angled, slightly notched in front of scutel. Elytra one-half wider at base than thorax, humeri rounded, sides straight, a little more than one-half longer than wide, individually rounded at apex, striae and interspaces indicated by difference in scales, striae not greatly impressed. Pygidium greatly exposed, elongate, subtruncate at apex, horizontal, transversely impressed.

Thorax beneath long in front of coxae; middle coxae moderately separated. First abdominal rather short behind coxae, but long at sides; second elongate; third short; fourth presumably short, but so closely united to fifth that the suture has almost disappeared; fourth and fifth almost as long as three preceding, transversely impressed opposite impression of pygidium, the apices of pygidium and venter thus greatly diverging.

_Type._—Cat. No. 10059, U.S.N.M.

**PSEUDANTHONOMUS CRATAEGI** Walsh.

This species was found very abundant in crataegus trees at Natchitoches and Shreveport, Louisiana, March 27 and 28, 1907, by R. A. Cushman and W. D. Pierce.

**PSEUDANTHONOMUS HAMAMELIDIS**, new species.

One specimen bred August 30, 1907, from witch hazel fruit collected at Afton, Virginia, by F. W. Foster (Hopkins, No. 6329).


This species is of about the same size and general appearance as _crataegi_ and _validus_, but differs from both by having the prothorax less constricted at apex, by its coarse, long, evenly distributed and denser yellowish pubescence, and by its rather lighter color.

Length 2 mm. Oblong-oval, rufo-testaceous, rather closely clothed with long yellowish pubescence. Scrobes oblique, scarcely directed against lower margin of eyes. Prothorax not much wider than long, rounded to apex, slightly constricted before apex; strongly, densely, and deeply punctured; pubescence very slightly condensed on median line at base. Elytra one-third wider at base than prothorax; striae deeply impressed, punctures large and distinct; interspaces convex, shining, equal in width except at base where the third and fifth are longer, the intervening striae being confluent; the seventh, eighth, and ninth interspaces are confluent to form the humeri.

_Type._—Cat. No. 10058, U.S.N.M.
PSEUDANTHONOMUS KRAMERIAE, new species.

Numerous specimens were bred from the buds of *Krameria secundiflora* taken at Dallas, Texas, May 15, 1907, College Station, Texas, May 16.

This species belongs close to *validus* and *hamamelidis*, having the pubescence arranged densely as in the latter. It is considerably smaller however.

Length 1.5 mm. Prothorax wider than long. Differs mainly from *hamamelidis* by having the sixth to tenth elytral interspaces form the humeri, by the very prominently raised third interspace. The humeri are more densely pubescent, the elytral striae are less impressed. The two species are very similar, but the radical difference in breeding habit shows them to be greatly removed.

The pupae will probably show greater differences and those of *hamamelidis* are therefore greatly desired for comparison with *krameriae*.

*Type.*—Cat. No. 10056, U.S.N.M.

ANTHONOMOPSIS MIXTUS Le Conte.

This species was found very abundant on plum trees at Texarkana, Texas, March 26, 1907, by R. A. Cushman and W. D. Pierce.
ON THREE EXISTING SPECIES OF SEA-TURTLES, ONE OF THEM (CARETTA REMIVAGA) NEW.

By Oliver P. Hay.
Of Washington, District of Columbia.

To the authorities of the United States National Museum the writer is indebted for the privilege of examining and describing most of the specimens mentioned in the following paper. It is hoped that this communication will throw some light on the bastard-turtle, *Colpochelys kempi* Garman, until recently supposed to be a rare animal of the western side of the Atlantic and on the new species described from the Pacific coast of Mexico.

**Colpochelys kempi** and **Caretta caretta**.

Plates VI-IX, Plate XI, figs. 1-4.

The bastard-turtle, *Colpochelys kempi* Garman, appears to be a rather common reptile on the coasts of the Gulf States east of the mouth of the Mississippi River and of the South Atlantic States as far north as Beaufort, North Carolina. It is also known to come as far north as Atlantic City, New Jersey, and it will probably be found to be dispersed throughout the Gulf of Mexico.

Garman was the first naturalist to recognize the species as distinct from the loggerhead, *Caretta caretta*. His description dealt almost wholly with the external characters, no osteological features being mentioned except the union of many of the hinder peripheral bones with the costals. The species is said by him to be distinguished from the loggerhead by the short round body, the low humps over the shoulder and the pelvis, the marginal plates, the narrowness of the occiput, and the swollen jaws. The hooked beaks are noted.

Dr. George Baur was the next who mentioned the species. Being interested in establishing his views of the relationships of *Dermochelys* he noted the presence of an unusual number of neural bones, 13 or 14, the freedom of most of these from the vertebrae, the presence

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of two large suprapygals, and 13 or 14 peripherals. Baur again referred to this species in 1850, assigned it to the genus Lepidochelys; but it fails to meet the requirements of this genus, as he defines it, in having the frontals entering the rim of the orbit and in having the descending processes of the prefrontals in contact with the palatines.

Dr. G. A. Boulenger recognized the species, relying not on the characters given by Doctor Garman in his original description, but on information furnished him by Garman and Baur to the effect that there is present on each alveolar surface of the upper jaw a ridge of bone and that the inner nostrils are not covered by the alveolar borders.

Up to 1906 no figures of the species had been published since it had been recognized as distinct from the loggerhead. In that year Dr. R. E. Coker furnished views reproduced from photographs, of a specimen as seen from above and from below. His description, limited to external characters, was based on four specimens, the largest of which had a carapace 15 inches long; the smallest, a carapace 12.5 inches long. The latter furnished the photographs, and is now in the herpetological division of the U. S. National Museum as a stuffed specimen, having the Catalogue Number 36108.

From Coker's description it appears that the fishermen in the region about Beaufort distinguish this species from the loggerhead by means of the more hooked jaws, miscalling it therewith the "hawksbill turtle." From Garman we learn that the Florida fishermen give it the name "bastard-turtle." It is interesting to note that the latter name has been applied to probably this turtle for more than a hundred years, it having been mentioned by Lacépède as long ago as 1788.

The writer has had the opportunity to study various specimens of this species, most of them in the U. S. National Museum. These specimens are as follows: (1) The skull of the specimen Cat. No. 29244, U.S.N.M., which furnished the figures published by the writer, and which was taken off Cape Hatteras, by Dr. F. W. True in 1888; (2) a complete skeleton, with carapace 278 mm. long, Cat. No. 29015, U.S.N.M., locality unknown; (3) the skull, limb bones, and shell of a specimen having the carapace 680 mm. long, Cat. No. 29323, U.S.N.M., of unknown locality; (4) the stuffed and dried specimen sent from Beaufort by Doctor Coker, Cat. No. 36108, U.S.N.M.; (5) a similarly prepared specimen taken at Atlantic City.

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a Amer. Naturalist, XXIV, p. 487.
b Cat. Chelonians, 1889, p. 186.
e Fossil turtles of N. Amer., p. 9, pl. 1, figs. 1, 2; pl. II, fig. 1.
New Jersey, Cat. No. 29699, U.S.N.M.; (6) a second similarly prepared specimen of unknown origin, Cat. No. 36085, U.S.N.M., with carapace 260 mm. long; (7) a carapace and plastron of medium size at the American Museum of Natural History, New York. There is no doubt that all these specimens were secured somewhere along the eastern or southern coasts of the United States.

A result of the writer's investigations is the conviction that externally this species resembles closely the loggerhead, while it is very different in its osteology.

It seems doubtful whether any of the external characters that have been mentioned by Garman and Coker as distinguishing this species from the loggerhead are applicable in all cases. The width of the carapace of the bastard-turtle doubtless is usually greater than that of the loggerhead, but there appear to be exceptions. A bastard-turtle may have the carapace as wide as it is long, or even wider; but No. 29699, with carapace 210 mm. long, has the width only 92% of this; while the loggerhead, No. 29013, with carapace 855 mm. long, has the width 94% of the length.

It is true that the jaws of the bastard-turtle are arched outward, or swollen in the larger specimens, while those of the loggerhead are straight; but these differences are hardly to be observed in the smaller individuals. While the upper jaw of the bastard-turtle is usually more hooked than that of the loggerhead, this appears not always to be the case, as shown by the specimen of the former from Atlantic City and by the horny upper beak of No. 29013, a loggerhead. In the former the cutting-edge of the jaw is very little excavated on each side behind the tip, so that this descends little below the rest of the border; in the latter specimen the border is considerably excavated. Plate VIII, fig. 4, represents the buccal surface of the horny sheath of the upper jaw of the specimen last mentioned. It will be seen that the outline of the front is broad and rounded. Fig. 4, Plate VII, shows the sheath of the upper jaw of the large specimen of the bastard-turtle, No. 29323. In this the tip of the snout is more contracted from side to side and a sort of keel descends along the midline. In younger specimens of the two species these differences are less obvious.

The size of the anterior and posterior humps is subject almost certainly to great variations in the loggerhead. The horny ridges in the roof of the mouth of well-developed specimens of the two species appear to be greatly different. In the large individual of the bastard-turtle, No. 29323 (Plate VII, fig. 4, there is seen to be a prominent ridge on each side, and this runs nearly parallel with the cutting-edge of the jaw. The ridges converge forward, but each diminishes in height as it approaches the other, so that there is a deep notch between them. Each ridge diminishes in height also backward. Each is really a long-based horny tooth. These teeth show
no wear in the large specimen mentioned. In a loggerhead, No. 29372, the horny ridges grow broader forward and join along the midline, there being hardly any notch between them. A smaller specimen shows similar ridges. In the older individuals of the loggerhead the ridges are often strongly worn, as is seen in No. 29013 (Plate VIII, fig. 4). In the smaller specimens of the bastard-turtle the anterior ends of the ridges may not be so well defined as in the larger ones.

On the buccal surface of the lower horny jaw-sheath there is, in the bastard-turtle, a broad groove, bounded in front and at the sides, by the cutting edges of the jaw, posteriorly by a sharp ridge which, starting from a prominent triangular tooth, runs backward and outward on each side (Plate VII, fig. 3). Its hinder slope is very short. In the loggerhead (Plate VIII, fig. 3) there is a corresponding ridge, but the median tooth is wanting, the groove in front is not so deep, and the hinder slope is longer.

It is believed that specimens of the two species may be distinguished by differences in the form of the lateral borders of the carapace. If we will examine this border below the third costal scute (counting the small anterior one) of the loggerhead we shall find that the upper face makes about a right angle with the lower, or outer, face and that the latter is quite narrow, about one-third the length of the marginal scutes of that region. In the bastard-turtle the upper and the lower faces make an angle of about 45° between them and the width of the lower face is from one-half to two-thirds the length of the neighboring marginal scutes.

It appears, further, that the bastard-turtle has four inframarginal scutes on each bridge (Plate VI, fig. 2), while the loggerhead has only three. In the figure cited these scutes show most distinctly on the left side.

Mention has been made above of the relation between the length and the width of a specimen of the bastard-turtle. Another individual, No. 29015, has the carapace 278 mm. long and as many millimeters wide. The largest individual in the U. S. National Museum, No. 29323 (Plate VI), has the carapace 680 mm. long and 664 mm. wide. One of Garman's specimens had the length and the width nearly equal, about 652 mm. The other was 703 mm. long and 728 mm. wide.

The carapace of the bastard-turtle appears to differ constantly from that of the loggerhead in having several supernumerary neural bones. In the latter species there are normally 7 or 8. No. 15259 has an imperfect extra neural behind the first, while No. 29013 has a complete one in the same place. In the bastard-turtle the number of neurals may vary from 11 to 14. Doctor Baur, as cited, noted the presence of 13 and 14 neurals. No. 29015 has 13 and the specimen in the American Museum of Natural History has the same number.
No. 29323 has only 11 (Plate VI, fig. 1). The sizes and the forms of the various neurals are extremely variable and it is often impossible to determine whether any particular bone belongs to the regular series or whether it is intercalated.

The costal bones are, of course, the same in number as in the loggerhead—8 pairs. On account of the large number of neurals, several of the costals articulate proximally with three of the former bones. In the smaller individuals there are extensive fontanels between the outer ends of the costal plates and the projecting ribs, quite as in the loggerhead. These disappear wholly or almost wholly in the largest individuals.

The number of peripheral bones in the bastard-turtle varies between 12 and 13 pairs. There may be 12 on one side and 13 on the other. Baur states that there are 13 peripherals, in one case 14; but it seems probable that there is some error here. In the small individual mentioned above, No. 29015, there are 12 peripherals on the right side, 13 on the left. The large specimen, No. 29323, has 12 on each side (Plate VI, fig. 1). A stuffed specimen, No. 29699, possesses 14 marginal scutes on each side, from which it is inferred that there are 13 peripherals. When there are 12 peripherals the rib of the first costal bone enters a pit in the fourth peripheral, as in the loggerhead; when there are 13 peripherals the rib enters a pit in the fifth. The extra peripheral, therefore, probably results from a division of the normal fourth. As in the loggerhead, all the peripherals succeeding the normal fourth have shallow pits for the rib-ends, except the tenth, the rib of the seventh and eighth costals having swung back so as to enter respectively the eleventh and twelfth peripherals.

In the smaller specimens of the bastard-turtle, as in the loggerhead, none of the peripherals are sutured articulated to the outer ends of the costal plates. In the large individual, No. 29323 (Plate VI, figs. 1, 2), all the peripherals have come into close sutural contact with the outer ends of the costal plates, and the fontanelles are closed up as completely as in most Emysidae. Garman states that in his large specimens 8 or 10 of the posterior peripherals are joined by suture to the costals, making for the hinder half of the carapace nearly solid bone. On the other hand, the carapace of the loggerhead No. 29013 is larger than any of the specimens just described and there are in it no unions between the costals and the peripherals, and considerable fontanelles still occupy the borders of the carapace. It appears probable that the bastard-turtle does not reach the large size attained by the loggerhead in its old age.

Mention has been made above of differences in the lateral peripherals of the bastard-turtle and corresponding ones of the loggerhead. It may be said that all the peripherals of the one species differ
from corresponding ones of the other. In general, those of the loggerhead are thicker and have a greater angle between the upper and the lower faces, when these faces are distinguishable. A fair comparison may be made between those of the large specimen of the bastard-turtle and the large loggerhead, No. 29013. The latter is a disarticulated skeleton, the carapace of which is about 855 mm. long and 810 mm. wide. The bastard-turtle has therefore about four-fifths the length of the loggerhead. The second peripheral of the loggerhead is 18 mm. thick; that of the bastard-turtle is 12.5 mm. In both species there is, from the fourth peripheral backward, a sharp edge which separates the upper face of each peripheral from the lower face. The rib-pits are in the inner, or visceral, face. Let us compare the sixth peripheral of each species, that one which receives the rib of the third costal bone. In the loggerhead (Plate XI, fig. 1) the upper face is slightly convex. The lower face, here more properly the outer, makes a right angle with the upper and is only 27 mm. wide. In the bastard-turtle (Plate XI, fig. 2) the upper face is concave, the angle between the two faces is about 45°, and the width of the lower face is as much as 45 mm. The eighth peripheral of the loggerhead has the upper face nearly plane, the angle between the two faces is about 75°, and the width of the lower face is about 27 mm. In the bastard-turtle the upper face is somewhat concave, the angle between the two faces is less than 30°, and the width of the lower is 60 mm. The upper face of the eleventh peripheral of the loggerhead is convex above, the lower more strongly so, the angle between the two about 45° at the border, still less at some distance from it, and the lower is about 30 mm. wide. In the bastard-turtle the upper face is decidedly concave, the lower convex, the angle between the two about 40°, and the lower is 63 mm. wide.

There appear to be in all specimens of the bastard-turtle two suprapygal bones. In the large individuals the anterior is bifurcate, as in most species of Testudo, receiving the hinder suprapygal and sending a branch on each side to the eleventh peripheral. The hinder suprapygal becomes naturally joined to the pygal in the smallest known specimens, and it is crossed near the middle of its length by the sulcus between the fifth vertebral scute and the two hindermost marginals.

The second suprapygal of the loggerhead does not so early join the pygal. However, in the large loggerhead mentioned, it has become as completely sutured to the pygal and twelfth peripherals as it is in the bastard-turtle. The posterior lump mentioned by Garman is on this bone. The first suprapygal is bifurcate, as in the bastard-turtle, but it has not contracted sutured union with any peripheral. If later it should do so, it would be with the twelfth peripheral, not with the eleventh, as in the bastard-turtle. The pygal
is a thicker bone than in the bastard-turtle, being 31 mm., instead of 23 mm., where it joins the twelfth peripheral.

As regards the horny scutes of the carapace of the bastard-turtle, we find that they differ not greatly from those of the loggerhead. There are nearly always five vertebrales. In the specimen figured by Coker there is a small extra one behind the fourth. Irregularities in the scutes of the carapace are common in the loggerhead, as has been noted by several writers. The length of the sulcus between the marginal scutes of the hindermost pair is usually longer in the bastard-turtle than in the loggerhead. In the former it is usually about two-thirds as long as the fifth vertebral, and the sulcus between the two marginals mentioned and the vertebral runs in a straight line across the second suprapygal. In the loggerhead the sulcus between the marginals in question may be only about one-half as long as the fifth vertebral, and the sulcus between the marginals and the vertebral makes an angle backward at the midline. However, the large loggerhead, No. 29013, does not differ in the respects named from the bastard-turtles.

The plastron of the bastard-turtle resembles closely that of the loggerhead. The large individual mentioned above, No. 29323 (Plate VI, fig. 2), has the anterior and the posterior lobes broader and more rounded than those of the loggerhead, but such differences do not seem to exist in the smaller specimens of the two species. In the large individual the fontanelles usually found on each side between the outer end of the hypoplastron and of the hypoplastron are filled up. The median fontanelles also are much reduced. In this specimen the plastron is 515 mm. long. The anterior lobe is 230 mm. wide at the base; the posterior 220 mm. The bridge has a width of 165 mm., of which the hypoplastron occupies 90 mm.

The scutes of the plastron of the bastard-turtle are, in general, like those of the loggerhead. Both have small intergulars. As already stated, there are, on each bridge, four inframarginals, of which the hindermost is the shortest, fore and aft (Plate VI, fig. 2). In such loggerheads as the writer has examined there are only three inframarginals and the hindermost is the largest.

Striking differences are found when we compare skulls of the bastard-turtle with those of the loggerhead. For comparison there are presented below three sets of measurements, one from the skull of the large specimen of the bastard-turtle, No. 29323 (Plate VII, fig. 2; Plate VIII, fig. 2; Plate IX, fig. 1; Plate XI, fig. 4), another from the loggerhead skull No. 13822, and a third from the loggerhead skull No. 29206. The length of the skull of the bastard-turtle, from the snout to the occipital condyle (cranial axis), is 147 mm.; that of No. 13822 is 182 mm.; that of No. 29206 is 175 mm. In the table there are presented under each of these specimens two columns of figures. In
the first column are given the actual distances between the points indicated, as obtained by calipers. In the second column under each specimen, opposite each dimension, there is given the percentage which this dimension is of the cranial axis, whose length stands at the head of the first column under each specimen.

Table of measurements.

<table>
<thead>
<tr>
<th>Part measured</th>
<th>Colpochelys kempi.</th>
<th>Caretta caretta.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Dimensions</td>
<td>Dimensions</td>
</tr>
<tr>
<td></td>
<td>mm</td>
<td>mm</td>
</tr>
<tr>
<td></td>
<td>Percent of cranial axis</td>
<td>Percent of cranial axis</td>
</tr>
<tr>
<td>Snout to occipital condyle</td>
<td>147</td>
<td>182</td>
</tr>
<tr>
<td>Width from outside to outside of quadrate</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Snout to end of supraoccipital process</td>
<td>120</td>
<td>153</td>
</tr>
<tr>
<td>Snout to extremity of squamosal</td>
<td>102</td>
<td>129</td>
</tr>
<tr>
<td>Front of tympanic cavity to extremity of squamosal</td>
<td>62</td>
<td>76</td>
</tr>
<tr>
<td>Snout to line joining hinder borders of articulation for lower jaw</td>
<td>123</td>
<td>164</td>
</tr>
<tr>
<td>Length of orbit</td>
<td>34</td>
<td>44</td>
</tr>
<tr>
<td>Height of orbit</td>
<td>11</td>
<td>26</td>
</tr>
<tr>
<td>Depth of cutting-edge of maxilla below orbit</td>
<td>32</td>
<td>26</td>
</tr>
<tr>
<td>Interorbital space</td>
<td>50</td>
<td>54</td>
</tr>
<tr>
<td>Height of roof of skull above articulation with lower jaw</td>
<td>103</td>
<td>137</td>
</tr>
<tr>
<td>Height of front of prefrontals above cutting-edge of maxilla</td>
<td>62</td>
<td>53</td>
</tr>
<tr>
<td>Least width of combined pterygoids</td>
<td>15</td>
<td>27</td>
</tr>
<tr>
<td>Distance of choanal opening behind snout</td>
<td>36</td>
<td>57</td>
</tr>
<tr>
<td>Width of choanal opening behind</td>
<td>36</td>
<td>59</td>
</tr>
<tr>
<td>Distance between hinder ends of maxilla</td>
<td>100</td>
<td>110</td>
</tr>
<tr>
<td>Length of rami of lower jaw</td>
<td>115</td>
<td>140</td>
</tr>
<tr>
<td>From tip of lower jaw to coronoid process</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Length of symphysis</td>
<td>68</td>
<td></td>
</tr>
<tr>
<td>Tip of lower jaw to mental foramen</td>
<td>65</td>
<td></td>
</tr>
<tr>
<td>Thickness of rami of lower jaw below coronoid process</td>
<td>15</td>
<td></td>
</tr>
</tbody>
</table>

Attention may be directed to some of the above comparative measurements. The first of these pertain to the form of the skulls seen in profile. The skull of the loggerhead (Plate VII, fig. 1: Plate VIII, fig. 1: Plate IX, fig. 2: Plate XI, fig. 3) starts with a greater posterior elevation and descends rapidly, so that the height at the rear of the nasal opening is considerably less than in the bastard-turtle. From rear to front, but especially from side to side, the skull of the loggerhead is much more convex than that of the other species. As seen from above, the outlines of the upper jaws are straighter in the loggerhead than in the bastard-turtle, those of the latter being arcuate. In the loggerhead there is a rather abrupt widening of the outlines just behind the maxillae; in the bastard-turtle the curves are continuous from near the snout backward.

It will be observed that the line joining the posterior borders of the articulations of the quadrates for the lower jaw is considerably
farther from the snout in the loggerhead than in the other turtle. The pedicels of the quadrates of the loggerhead are swung backward from 15 to 25 mm. farther than in the bastard-turtle. One result of this is to bring the occipital condyle of the loggerhead on a line with the hinder faces of the pedicels in the loggerhead, while in the bastard-turtle it projects considerably behind the pedicels. Another result is to make the upper anterior end of the quadrates, at its union with the proötic (Plate VIII, fig. 1), project much farther in front of the pedicels in the loggerhead than they do in the bastard-turtle (Plate VIII, fig. 2). This advanced position of the quadrates and proötic appears to become accentuated with age in the loggerhead.

The greater breadth of the maxillæ of the bastard-turtle below the orbit is to be noted.

The measurements show that the posterior nares of the loggerhead are much narrower than in the bastard-turtle. The pterygoids of the two species differ greatly. Where the palate is most constricted the pterygoids of the bastard-turtle (Plate VIII, fig. 2) are much narrower than in the loggerhead (Plate VIII, fig. 1), while in front they broaden greatly. Moreover, in the loggerhead there are only vestigial ectopterygoid processes, while in the bastard-turtle these are strongly developed.

As might be expected from the backward position of the pedicels of the quadrates, the rami of the lower jaw of the loggerhead (Plate XI, fig. 3) are considerably longer than those of the bastard-turtle (Plate XI, fig. 4); the coronoid processes are likewise thrown farther backward. The rami are less arcuate, and thinner. On the other hand, the mental foramina lie considerably nearer the tip of the jaw.

Returning to the upper surface of the skull, we find that the frontal bones of the bastard-turtle (Plate VII, fig. 2) enter the rim of the orbit for a short distance, while in the loggerhead (Plate VII, fig. 1) they are normally widely excluded therefrom. Boulenber has noted the fact that occasionally in the loggerhead the frontal on one side or the other enters the rim of the orbit. Doubtless it will be found that sometimes the frontals of the bastard-turtle are excluded from the orbit; but such variations hardly affect the specific value of the character.

The roof of the mouth of the bastard-turtle (Plate VIII, fig. 2) presents on each side a prominent, rounded, bony ridge, which runs along the suture between the maxilla and the palatine. This ridge supports the ridge of the horny alveolar surface which has been described above. Only occasionally and in the smaller individuals of the loggerhead is there seen any trace of a similar ridge. Masticatory ridges —

corresponding to these are found in many turtles of several families. Among the Cheloniidae they are found in *Eretmochelys* and *Chelonia*; among the Emydidae, in *Trachemys, Pseudemys*, and *Batagur*; all the species of the genus *Testudo* are provided with similar ridges; and the writer has found a well-developed masticatory ridge in an extinct trionychid genus from the Bridger Eocene of Wyoming. Such ridges, often strongly tuberculated, appear to have been developed as substitutes for teeth, lost probably by the ancestors of the earliest turtles; and these ridges probably mark modifications of food-getting and food-preparation somewhat as do the variations in the teeth of other reptiles.

The structure of the roof of the mouth in front of the choanae is quite different in the two species here discussed. In the loggerhead (Plate VIII, fig. 1) the maxillae meet each other on the midline, below the vomer; in the bastard-turtle (Plate VIII, fig. 2) the maxillae are wholly separated by the vomer.

Some statements regarding the lower jaw have already been made. To these it may be added that the lower jaw of the bastard-turtle (Plate IX, fig. 1; Plate XI, fig. 4) is shorter, heavier, more strongly upturned toward the tip and more bent outward at the sides than in the loggerhead. The bony alveolar surface (Plate IX, fig. 1; Plate XI, fig. 4) is more deeply channeled on each side, and there is, at the hinder end of the symphysis, a triangular elevation, corresponding to that already mentioned as occurring on the horny sheath of the jaw.

The scutes which cover the upper surface of the skull of the bastard-turtle appear to differ somewhat from those of the loggerhead. The frontal scute and those which join it at the sides and in front are alike in the two species. The fronto-parietal of the loggerhead is much larger, nearly twice as long as the frontal, while the parietals are short, little, if any, more than half as long as the fronto-parietal. On the contrary, the fronto-parietal of the bastard-turtle is not much longer than either the frontal or the parietals. These scutes are not shown on the figures presented here.

It appears that, in the case of the bastard-turtle, the head becomes relatively smaller as age comes on. In No. 29015 the length of the head is contained in the length of the carapace 3.6 times; in the large individual, No. 29323, the head is contained in the length of the carapace 4.6 times. The same statement is true regarding the loggerhead. In No. 29372, with carapace 453 mm. long, the length of the skull is 108 mm.; therefore it enters the length of the carapace 4.2 times. In the large individual, No. 29013, the length of the skull is contained in the length of the carapace 4.75 times.

As to the size attained by the skull of the loggerhead, the largest known to the writer is in the U. S. National Museum. The length
from the snout to the occipital condyle is 232 mm. It came from Swan Island, in the Caribbean Sea. The next largest is in the American Museum of Natural History, New York, and was found on the coast of New Jersey. The length from the snout to the occipital condyle is 230 mm. Neither of these specimens is accompanied by the shell.

The shoulder girdle and the fore limb of the bastard-turtle are not greatly different from the same structure in the loggerhead. It is found, however, that the distal end of the coracoid of the bastard-turtle is distinctly broader than that of the loggerhead, the breadth being in the former 0.43 of the length, in the latter 0.32.

The following table presents the length of the whole fore limb and of various parts of it in two specimens each of the bastard-turtle and of the loggerhead.

**Measurements of the fore limb.**

<table>
<thead>
<tr>
<th>Measurements</th>
<th>Colpochelys kempi</th>
<th>Caretta caretta</th>
</tr>
</thead>
<tbody>
<tr>
<td>Whole limb from head of humerus to end of third digit</td>
<td>mm. 167</td>
<td>mm. 157</td>
</tr>
<tr>
<td>Humerus from head to radial articulation</td>
<td>mm. 135</td>
<td>mm. 105</td>
</tr>
<tr>
<td>Ulna</td>
<td>mm. 78</td>
<td>mm. 52</td>
</tr>
<tr>
<td>Carpus from ulna to base of third digit</td>
<td>mm. 47</td>
<td>mm. 37</td>
</tr>
<tr>
<td>Third digit</td>
<td>mm. 206</td>
<td>mm. 169</td>
</tr>
</tbody>
</table>

Judging from the figures presented, the humerus and the ulna of the young of the bastard-turtle are shorter in comparison with the whole limb than in the adult; while the third digit is longer. The head of the humerus of the bastard-turtle is more flattened in section than is that of the loggerhead, the short axis being nearly 0.6 that of the longer, while in the loggerhead the short axis is 0.8 the length of the longer.

In the bastard-turtle the thumb and the fifth digit are relatively slightly longer than those of the loggerhead. In the former the ungual phalanx is more acuminate in outline.

The pelves of the two species are greatly alike. However, the ischiopubic foramen of the bastard-turtle is more pointed in front, being thus more heart-shaped.

**Measurements of the hind limb.**

<table>
<thead>
<tr>
<th>Measurements</th>
<th>Colpochelys kempi</th>
<th>Caretta caretta</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length of whole limb to tip of third digit</td>
<td>mm. 416</td>
<td>mm. 262</td>
</tr>
<tr>
<td>Length of femur</td>
<td>mm. 141</td>
<td>mm. 90</td>
</tr>
<tr>
<td>Length of tibia</td>
<td>mm. 105</td>
<td>mm. 57</td>
</tr>
<tr>
<td>Length of tarsus to base of third digit</td>
<td>mm. 33</td>
<td>mm. 20</td>
</tr>
<tr>
<td>Length of third digit</td>
<td>mm. 127</td>
<td>mm. 95</td>
</tr>
</tbody>
</table>

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An examination of the figures presented above shows that the various segments of the hinder limb of the bastard-turtle undergo little change in relative length during growth.

It appears that all naturalists, who have had occasion to write of the sea-turtles of America, from the earliest times down to the time of Garman’s description of Colpochelys kempi, have confounded the species with the loggerhead, Caretta caretta. However, the first author who figured a supposed loggerhead, after Linnaeus had bestowed the specific name, gave figures of the bastard-turtle. This was the German naturalist Schoepff. His figure of the plastron shows that there were present four inframarginals, a character betraying the bastard-turtle. Holbrook’s figure is that of the true loggerhead.

The writer wishes to make note that on pages 8, 9, and 10 of his Fossil Turtles of North America, he has referred the bastard-turtle to the genus Lepidochelys. He was influenced to do this by Dr. George Baur, but there now appears to be no sufficient reasons for this disposition of the species.

CARETTA REMIVAGA, new species.

Plate X, figs. 1-3; Plate XI, fig. 5.

The supposed new species, Caretta remivaga, is based on a skull which is in the U. S. National Museum and has the catalogue number 9973. It is labeled as having been collected by Prof. F. Sumichrast, in Ventosa Bay, Mexico. The record shows that it was received by the museum in 1870. Ventosa Bay is on the western coast of Mexico, and is a part of the Gulf of Tehuantepec.

This species, apparently, belongs to the genus Caretta, inasmuch as the skull has essentially the structure found in C. caretta of the Atlantic Ocean. It differs from the latter species, however, in many important respects. The skull (Plate X) is flatter and the snout more pointed. The frontal bones enter the rim of the orbit. The maxillae are widely separated by the vomer. The pterygoids possess conspicuous ectopterygoid processes. The free border of the pterygoid, when followed backward, becomes a ridge which disappears before it reaches the pedicel of the quadrate; while the ridge which ascends from the inner end of the articulation for the lower jaw passes forward and upward to join a ridge which ascends on the descending plate of the parietal. The occipital condyle stands distinctly behind the pedicels of the quadrates. Also the proötic bones project but little in front of the pedicels. The horny scutes overlying the occiput are much different from those of Caretta caretta, especially

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a Historia Testudinum, pl. xvi, lower figure.

b N. Amer. Herpetology, II, 1842, pl. iv.
the median ones. The frontal scute is about as long as the fronto-parietal; the latter is not so long as are the parietals. In *C. caretta* the fronto-parietal is long, and the parietals very short. *Chelonia olivacea* Eschscholtz has been, by some authors, referred to the genus *Lepidochelys*. The type of the species was found in Manila Bay and it possessed six pairs of costal scutes. If this number of costals shall be found to be constant it may serve to establish the genus mentioned. Possibly when the carapace of *Caretta remigata* shall have been secured it will be found to have a like number of costal scutes. Baur places this skull in the genus *Lepidochelys*; but it does not conform to his definition of the genus, inasmuch as the frontals enter the orbits and the descending processes of the prefrontals connect with the palatines.

The following measurements and percentages are given in order that comparisons may be made with the skulls of *Caretta caretta* and *C. polocholelys kempi*, whose dimensions and percentages are given on page 190.

<table>
<thead>
<tr>
<th>Table of measurements.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parts measured.</td>
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<tr>
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<td></td>
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<td></td>
</tr>
<tr>
<td>Snout to occipital condyle</td>
</tr>
<tr>
<td>Width from outside to outside of quadrates</td>
</tr>
<tr>
<td>Snout to end of supraoccipital process</td>
</tr>
<tr>
<td>Snout to extremity of squamosal</td>
</tr>
<tr>
<td>Front of tympanic cavity to extremity of squamosal</td>
</tr>
<tr>
<td>Snout to line joining hinder borders of articulations for lower jaw</td>
</tr>
<tr>
<td>Length of orbit</td>
</tr>
<tr>
<td>Height of orbit</td>
</tr>
<tr>
<td>Cutting-edge of maxilla below orbit</td>
</tr>
<tr>
<td>Interorbital space</td>
</tr>
<tr>
<td>Height of roof of skull above articulations for lower jaw</td>
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<tr>
<td>Front of prefrontals above cutting-edge of maxilla</td>
</tr>
<tr>
<td>Least width of combined pterygoids</td>
</tr>
<tr>
<td>Distance of choanae behind snout</td>
</tr>
<tr>
<td>Width of choanal opening behind</td>
</tr>
<tr>
<td>Distance between hinder ends of maxilla</td>
</tr>
<tr>
<td>Length of rami of lower jaw</td>
</tr>
<tr>
<td>From tip of lower jaw to coronoid process</td>
</tr>
<tr>
<td>Length of symphysis</td>
</tr>
<tr>
<td>Breadth of hinder end of rami of lower jaw</td>
</tr>
<tr>
<td>From tip of lower jaw to mental foramen</td>
</tr>
<tr>
<td>Thickness of rami below coronoid process</td>
</tr>
</tbody>
</table>

From the foregoing measurements it will be seen that the end of the supraoccipital process and the extremity of the squamosal extend a considerably less distance behind the occipital condyle than they do in *Caretta caretta*. The slope of the skull (Plate X, fig. 1) from rear to front is about as in the Atlantic loggerhead, but it is less convex. The pterygoids are narrower behind the ectopterygoid processes. The choanae are placed farther forward and they are much wider behind. The rami of the lower jaw are shorter and likewise their symphysis. The hinder end of the rami, measured across the articulation for the

* Amer. Naturalist, XXIV, 1890, p. 487.
lower jaw is not nearly so wide. As compared with the lower jaw of *C. caretta*, the rami (Plate X, fig. 1; Plate XI, fig. 5), seen from below are not so straight and are thicker. The tip is more upturned and more pointed. The alveolar surface is more concave; it is divided by a low ridge along the symphysis, and a larger part of it lies behind the symphysis, and the symphysis is shorter. The hinder portion of the prearticulate bone extends much farther backward than it does in the Atlantic loggerhead. The horny sheaths of the jaws of this species are unknown.

The horny scutes of the upper surface of the skull (Plate X, fig. 2) appear to differ somewhat from those of *C. caretta*. The frontal scute, lying between the orbits, is bounded on each side by two scutes. Of these the anterior pair are widely separated from each other in advance of the frontal scute. In *C. caretta* the anterior pair meet before the frontal. As in *C. caretta*, there is a large parietal shield and behind it two occipitals. In *C. caretta* the occipitals are much shorter than the parietal; in *C. remiraga* they are fully as long as the parietal.

No. 29354 of the U. S. National Museum is a skull of unknown origin. It is undoubtedly cospecific with the type of *C. remiraga*. It differs in having the frontal bone of the left side excluded from the rim of the orbit.

The type of this species was mentioned by Dr. George Baur in the American Naturalist, a where he speaks of having examined a skull of *Lepidochelys olivacea* from West Africa and says that the skull from Ventosa Bay belongs to the same genus; but he does not give any specific name. That it does not belong to *L. olivacea* seems evident. We have at present for comparison of the latter with our new species only Eschscholtz's figure and his description,b A reproduction of this figure is to be found in Stejneger's Herpetology of Japan, 1907, Plate XXXIV.

The head, and especially the snout, of the type of *L. olivacea* are more elongated than those of *C. remiraga*. Eschscholtz says that the head of his figured specimen was 2 4 inches long and 1 2 inches wide. The width, then, was just two-thirds the length. In our species the width is close to 80 per cent of the length. In *L. olivacea* the snout, back to the orbit, is one-third the length of the head and one-half its width. In *C. remiraga* the length of the snout enters into the length of the head 4.5 times; into the width, 4 times. In *L. olivacea* the interorbital space is included in the length of the head 2 1/2 times; in *C. remiraga*, 3 1/2 times. The frontal scute of *L. olivacea* extends much behind the orbits; in *C. remiraga* hardly at all behind them.

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a Volume XXIV, 1890, p. 487.
b Zool. Atlas, 1829, p. 3, pl. iii.
Besides his type, Eschscholtz had a larger specimen, which differed in many respects from the type. Its head was 6 inches long and 5\(\frac{3}{4}\) inches wide, the greatest width being just behind the eyes. The width, then, was 96 per cent of the length. In these measurements the length of the head is taken to, or nearly to, the end of the supraoccipital process. The skull of C. remicaya, being larger than the one just described, ought, if it belonged to the same species, to have a width of at least 150 mm., instead of about 125 mm.

A consideration of Eschscholtz’s descriptions leads to the conclusion that either his specimens belonged to two distinct species or that during growth there occurs a remarkable increase in the width. The skull of a specimen of C. caretta, No. 29204, has a length, from the snout to the supraoccipital process, of 155 mm.; the greatest width is 117 mm., 75 per cent of the length. An aged specimen, No. 29234, from Swan Island, Caribbean Sea, has the length of the skull, as measured above, 317 mm.; the width, 260. The percentage is therefore 82. The increase in the width during growth is then far less than in the supposed specimen of L. olivacea.

DESCRIPTION OF PLATES.

PLATE VI.

*Colpochelys kempi*, No. 29323, \(\times\).

Fig. 1. Carapace.

2. Plastron.

PLATE VII.

*Caretta caretta*, No. 29013, \(\times\frac{1}{2}\).

Fig. 1. Skull seen from above.

*Colpochelys kempi*, No. 29323, \(\times\frac{1}{4}\).

2. Skull seen from above.

3. Horn sheath of lower jaw.

4. Horn sheath of upper jaw.

PLATE VIII.

*Caretta caretta*, No. 29013, \(\times\frac{1}{2}\).

Fig. 1. Skull seen from below.

*Colpochelys kempi*, No. 29323, \(\times\frac{1}{4}\).

2. Skull seen from below.

*Caretta caretta*, No. 29013, \(\times\frac{1}{3}\).

3. Horn sheath of lower jaw.

4. Horn sheath of upper jaw.
Plate IX.

*Colpochelys kempi*, No. 29623, $\times \frac{2}{3}$.

Fig. 1. Skull seen from right side.

*Caretta caretta*, No. 28913, $\times \frac{3}{4}$.

2. Skull seen from right side.

Plate X.

*Caretta remigata*, No. 28973, $\times \frac{4}{3}$.

Fig. 1. Skull seen from right side.

2. Skull seen from above.

3. Skull seen from below.

Plate XI.

*Caretta caretta*, No. 28913, $\times \frac{3}{4}$.

Fig. 1. Section of right sixth peripheral.

*Colpochelys kempi*, No. 29623, $\times \frac{2}{3}$.

2. Section of right sixth peripheral.

*Caretta caretta*, No. 28913, $\times \frac{3}{4}$.

3. Lower jaw seen from above.

*Colpochelys kempi*, No. 29623, $\times \frac{2}{3}$.

4. Lower jaw seen from above.

*Caretta remigata*, No. 28973, $\times \frac{4}{3}$.

5. Lower jaw seen from above.
COLPOCHELYS KEMPI.

For explanation of plate see page 197.
Fig. 1, Caretta caretta; Figs. 2-4, Colpochelys kempi.
For explanation of plate see page 197.
Figs. 1, 3, 4, Caretta caretta; Fig. 2, Colpochelys kempi.
For explanation of plate see page 197.
Fig. 1, Colpochelys kempi; Fig. 2, Caretta caretta.

For explanation of plate see page 198.
CARETTA REMIVAGA.

For explanation of plate see page 198.
Figs. 1, 3, CARETTA CARETTA; Figs. 2, 4, COLPOCHELYS KEMPI; Fig. 5, CARETTA REMIVAGA.

For explanation of plate see page 198.
THREE NEW SPECIES OF LIZARDS FROM THE PHILIPPINE ISLANDS.

By Leonhard Stejneger.
Curator, Division of Reptiles and Batrachians, U. S. National Museum.

The smaller species of the genus *Sphenomorphus* offer some of the most unsatisfactory objects for identification among the skinks, not on account of any great amount of individual variability, but chiefly because of the small size of the specimens, their shiny surface making the distinction of scutes and the counting of scales very difficult and tedious, the slight, but apparently important differences in proportions and size of body, legs, and ear-openings, and the great superficial resemblance of many of the species both as regards shape, coloration, and arrangement of head-shields. Add to this that even standard descriptions of the most recent authors fail to indicate such important structural characters as the temporal shields or scales, and it will be understood that the study of these forms is not a very easy one.

On the other hand, the large *Tropidophorus* offers no such difficulties, and the new species described below forms a conspicuous and easily identified addition to the Philippine reptile fauna.

*Sphenomorphus atrigularis*, new species.

*Diagnosis*.—No supranasals; fronto-nasal broadly in contact with rostral; fronto-parietals distinct; four large supraoculars; no auricular lobules; distance between tip of snout and fore leg about once and a half in distance between axil and groin; fourth toe scarcely longer than third; head and body nearly equalling length of tail; temporal region covered by scales scarcely larger than dorsals.

*Habitat*.—Mindanao, Philippine Islands.

*Type*.—Cat. No. 37386, U.S.N.M.; Catagan, Datu Anib’s place, base of Malindang Mountains, 1,100 feet altitude, Misamis Province. N. W. Mindanao; May 24, 1906; Dr. E. A. Mearns, U. S. A., collector.

Description of type-specimens (figs. 1, 2).—Snout short, obtuse; no supranasals; fronto-nasal broader than long, broadly in contact with rostral, separated from frontal by prefrontals, which are broadly in contact; frontal almost triangular, pointed behind, not longer than fronto-parietals, much shorter than fronto-parietals and interparietal together; fronto-parietals separated by a suture; interparietal large, as wide as frontal, losenge-shaped, almost equilateral; parietals in contact behind interparietal; four supraoculars, subequal, the two anterior in contact with frontal; eight superciliaries; nostril pierced in nasal; a single frenal behind nasal; lower eyelid scaly; supralabials separated from eye by a row of small scales; fourth supralabial beneath center of eye; temporals not differentiated as shields, consisting only of ordinary cycloid scales but slightly larger than those on the back; no enlarged nuchals; ear-opening roundish, large, fully two-thirds the eye-opening; 30 smooth scales around the middle of the body; a pair of enlarged preanals; legs weak and digits short; the distance between tip of snout and fore leg contained about once and one-half in distance between axilla and groin; hind leg slightly longer than distance from center of eye to fore leg; adpressed fore and hind legs fail to meet on the side of the body by more than the length of the foot; third toe almost as long as fourth; 10 smooth lamelae under fourth toe; tail cylindric, slightly longer than head and body together, without enlarged scales underneath. Color (in alcohol) above chestnut brown, very indistinctly spotted with paler and darker brown; a well-defined blackish lateral band from eye to groin and continued behind thigh along the side of the tail, with small whitish spots and bordered above on neck and anterior half of back by a narrow pale brown band; lips, chin, throat, neck underneath and on the sides bluish black, the sutures more or less regularly edged with whitish; rest of underside and flank whitish, densely sprinkled with minute dark brown dots on sides, lower abdomen, underside of legs and tail; legs above dark brown, with small, pale spots.

Dimensions.

<table>
<thead>
<tr>
<th>Description</th>
<th>mm.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total length</td>
<td>64</td>
</tr>
<tr>
<td>Tip of snout to vent</td>
<td>31</td>
</tr>
<tr>
<td>Tip of snout to fore leg</td>
<td>11</td>
</tr>
<tr>
<td>Width of head</td>
<td>5</td>
</tr>
<tr>
<td>Axilla to groin</td>
<td>16</td>
</tr>
<tr>
<td>Vent to tip of tail</td>
<td>33</td>
</tr>
<tr>
<td>Fore leg</td>
<td>6</td>
</tr>
<tr>
<td>Hind leg</td>
<td>9</td>
</tr>
</tbody>
</table>
Remarks.—This species, represented by a single well-preserved specimen, needs no comparison with the other Philippine species. In many respects it seems to resemble Sphenomorphus temminckii (Duméril and Bibron) from Java, to which it may be related, a point which can not be decided here, as the descriptions published of this rare species fail to mention the character of the temporals. From this species it differs among other things by its smaller size and the relatively much shorter tail.

**Sphenomorphus steerei**, new species.

**Diagnosis.**—No supranasals; fronto-nasal broadly in contact with rostral; fronto-parietals fused; four large supraroenulars; no auricular lobules; fourth toe much longer than third; head and body equalling length of tail; well-differentiated temporal scutes; 30 scale rows around the middle of the body; ear-opening large, about two-thirds the eye-opening, nearer to the fore leg than to the tip of snout.

**Habitat.**—Guimaras Island, Philippines.

**Type.**—Cat. No. 32658, U.S.N.M.; Guimaras Island; Prof. J. B. Steere, collector.

**Description of type-specimen** (figs. 3, 4).—Snout somewhat elongate and pointed; no supranasals; fronto-nasal broader than long, in contact with rostral, separated from frontal by prefrontals, which are broadly in contact; frontal shorter than fronto-parietal, in contact with first and second supraoculars; fronto-parietals elongate, fused into a single shield; interparietal long and narrow, shaped like and but slightly shorter than frontal; parietals large, barely in contact behind interparietal; four supraoculars, first largest; seven superciliaries; nostril pierced in nasal; two vertical frenals behind nasal; lower eyelid scaly; supralabials separated from eye by a row of small scales; fifth supralabial under center of eye; two anterior temporals well differentiated, the upper being a large wedge-shaped shield; no enlarged nuchals; ear-opening circular, large, two-thirds the eye-opening, its center considerably nearer the insertion of the fore leg than the tip of the snout; 30 smooth scales around the middle of the body; a pair of enlarged preanal; legs moderately developed, digits slender; hind leg equals distance from center of eye to fore leg; fourth toe much longer than third, with 12 lamellae on underside; tail as long as head and body, tapering from the base, without enlarged scales underneath. Color (in alcohol) above mummy brown, with a series of indistinct, elongate dusky spots on the median line of the back; a narrow, dark brown dorso-lateral
band from the temporal region above the insertions of the legs to the side of the tail, edged above by an indistinct pale line; hips and underside unspotted, pale; legs above reticulated with brown.

**Dimensions.**

<table>
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<tr>
<td>Tip of snout to vent</td>
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</tr>
<tr>
<td>Tip of snout to fore leg</td>
<td>12</td>
</tr>
<tr>
<td>Width of head</td>
<td>4.5</td>
</tr>
<tr>
<td>Vent to tip of tail</td>
<td>23</td>
</tr>
<tr>
<td>Fore leg</td>
<td>6</td>
</tr>
<tr>
<td>Hind leg</td>
<td>10</td>
</tr>
</tbody>
</table>

**Remarks.**—In proportions, coloration, size of ear-opening, and general conformation of the upper head-shields, this new species, which I dedicate to its discoverer, Prof. J. B. Steere, in recognition of his contributions to Philippine zoology, agrees very well with *Sphenomorphus decipiens* (Boulenger), but the latter has 36 scale rows around the middle of the body. In many respects it also resembles *S. moellendorffi* (Boettger), but the more backward position of the ear-opening which seems to be such a characteristic feature of *S. steerei* is alone sufficient to vindicate specific distinction for it.

**Tropidophorus misaminius,** new species.

**Diagnosis.**—Dorsals strongly keeled; fronto-parietals distinct; a single large preanal; sixth and seventh supralabials largest and entering the orbit; parietals not in contact behind interparietal; ventrals smaller than dorsals.

**Habitat.**—Mindanao, Philippine Islands.

**Type.**—Cat. No. 37383, U.S.N.M.; Catagan, Datu Anib’s place, base of Malindang Mountains, 1.100 feet altitude, Misamis Province, N. W. Mindanao: May 25, 1906; Dr. E. A. Mearns, U. S. Army, collector.

**Description of type-specimen.**—Adult male (figs. 5, 6): upper head-shields smooth; fronto-nasal slightly longer than broad; prefrontals broadly in contact; frontal as long as fronto-parietals and interparietal together, in contact with three anterior supraoculars; five supraoculars, first longest, fifth smallest; two or three anterior superciliaries large, followed by six very small ones, none behind the suture between third and fourth supraocular; fronto-parietals separate, shorter than interparietal; parietals not in contact behind interparietal; nostril in a single nasal, which is followed by two loreals, one behind the other; anterior row of temporals differentiated from the scales behind, the upper three being shorter and broader, the lower two long and narrow; eight supralabials, the anterior five
low and subequal, the sixth suddenly much higher and twice as wide, seventh equalling sixth and with the latter entering the orbit, from which they are separated, however, by a single row of small scales as large as the smaller superciliaries; a large unpaired post-mental followed by three pairs of large submandibulars, the two anterior pairs of which are in contact on the middle line; ear-opening oval, erect, smaller than eye-opening; 32 scales around the middle of the body; dorsals, ten in the shielded part of the head, and laterals strongly keeled, not mucronate. The keels forming eight straight lines on the back; ventrals smooth, perceptibly smaller than the dorsals, twelve in a head length; a single, very large preanal plate; third finger almost as long as fourth; subdigital lamellae smooth, 25 under the fourth toe; extended hind leg barely reaches the elbow; tail strongly compressed, with four strong keels above at base, diminishing to two towards the middle, and with a medium series of wide smooth plates underneath; length of tail much less than twice the length of body. Color (in alcohol) above and on sides vandyke-brown, shiny on the head, dull on body and extremities; obscure traces of blackish cross-bars on the back and of vertical bars of pale spots on sides of body and tail; a blackish postocular streak below which on the temples a cluster of small whitish spots and a few scattered ones on the sides of neck; underside shiny, chin, throat, lower neck, palms, soles, and posterior two-thirds of tail blackish brown, each scale with a narrow pale edge; rest of underside whitish.

**Dimensions.**

<table>
<thead>
<tr>
<th>Dimension</th>
<th>mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total length</td>
<td>210</td>
</tr>
<tr>
<td>Tip of snout to vent</td>
<td>89</td>
</tr>
<tr>
<td>Tip of snout to ear-opening</td>
<td>18</td>
</tr>
<tr>
<td>Width of head</td>
<td>12.5</td>
</tr>
<tr>
<td>Vent to tip of tail</td>
<td>130</td>
</tr>
<tr>
<td>Fore leg</td>
<td>26</td>
</tr>
<tr>
<td>Hind leg</td>
<td>41</td>
</tr>
</tbody>
</table>

**Variation.**—Two other specimens, from the same locality, one halfgrown (No. 37384) and one young (No. 37385) agree closely in all the structural characters as given in the above description of the type, except that in the young the head-shields are not smooth but feebly rugose. The halfgrown specimen also agrees very closely in
coloration, but the young is lighter brown, with better defined cross-bars; it has a whitish streak between eye and ear instead of the temporal spots, and the chin and middle of throat are whitish.

Remarks.—This species is apparently closely allied to *Tropidophorus brookei*, from which it differs in several essential points, especially in the number and size of the supralabials, the relative length of interparietal and parietals, the relative size of ventrals and dorsals, and apparently in the length of the tail.

*Boulenger* (Cat. Liz. Brit. Mus., 111, 1887, p. 361) says of *T. brookei* that the tail is "nearly twice as long as the body," but in the dimensions given that of the body is said to be 68 mm., while that of tail is 155 mm., consequently much more than twice the body.
NEW STALKED CRINOIDS FROM THE EASTERN COAST OF NORTH AMERICA.

By Austin Hobart Clark.
Of the United States Bureau of Fisheries.

In 1885 Prof. A. E. Verrill mentioned that “a fine species of stalked crinoid, belonging to the genus *Benthoecrinus*, was dredged in 1884 in 2,021 \(^{a}\) fathoms, off Chesapeake Bay.” Later, he referred to the specimen as a species of *Bathycriinus* “near *B. gracilis* Wyville Thomson.” No further mention is made of it, and the record and specimen appear to have been forgotten. Recently, however, the example has been sent to Washington, together with a large number of other crinoids, from New Haven, where I have had an opportunity of examining it. It proves to be a remarkably fine specimen of a new species of *Bathycriinus*, allied to *B. aldrichianus*, from the tropical mid-Atlantic, but quite different from anything heretofore known.

The genus *Bathycriinus* was first discovered off the coast of Europe by the *Porcupine*, and has since been found abundantly in the northeast Atlantic, and recorded from the middle Atlantic, Antarctic Ocean, East Indies, mid-Pacific, off southern Japan, and off Kamchatka, in the last four localities only within the past year. The first definite record for the genus on the American side of the Atlantic was published in January, 1908, when a small species, *B. caribbeus*, was described from the West Indies. It is therefore with considerable satisfaction that I am able to add another species of this especially interesting genus to the marine fauna of the American coast.

**BATHYCRINUS SERRATUS**, new species.


\(^{a}\) Typographical error for 2045.

Stem and basal ring lacking.

Radial funnel with somewhat convex sides, and the anterior angles produced anteriorly between the first costals, about twice as broad at its anterior end as high; the radials are strongly convex dorsally; first costals trapezoidal, about as wide at the anterior end as long, with a strong median elevation occupying the whole of the posterior border, but becoming narrow anteriorly; costal axillaries about twice as broad as long, trapezoidal, the anterior angle very low, the anterior edges very slightly curved, furnished with a prominent rounded median ridge, narrow posteriorly, but rapidly widening anteriorly; first three brachials oblong, not quite so long as broad; fourth brachial trapezoidal, rather broader than long; fifth brachial similar; following brachials squarish; the distal edge of the second brachial projects somewhat, those of the third and following being strongly overlapping, giving the arms a very serrate appearance; the first six brachials are provided with a strong rounded median ridge and thin lateral borders; the remaining brachials are strongly convex dorsally; the first pinnule is on the tenth brachial. Length from lower edge of radial funnel to tip of arms 40 mm. (fig. 1).

Type.—Cat. No. 22667, U.S.N.M., from U. S. Bureau of Fisheries steamer Albacross, station No. 2226; 37° 00' 00'' north latitude, 71° 54' 00'' west longitude (off the coast of Virginia); 2,045 fathoms.
A small fragment of the lower part of a stem from Albatross Station No. 2713, 38° 20' 00" north latitude, 70° 08' 30" west longitude (off the coast of Maryland), 1,859 fathoms, also appears to belong to this form.

This species is very distinct from any heretofore known from the Atlantic; the strongly serrate arms at once differentiate it from Bathycrinus carpenterii and B. australis, the somewhat convex and not at all constricted radial funnel separates it from B. aldrichianus, and the broadly rounded instead of sharp median ridge on the costals from B. gracilis.

Doctor Döderlein has recently expressed serious doubts regarding the possibility of considering Bathycrinus as a genus distinct from Rhizocrinus, a conclusion at which I had also arrived independently, through a study of material from other localities than the source of his. I am here following him, however, in arbitrarily assigning certain species to one genus and others to the other, chiefly for the reason that the species in the western Atlantic fall sharply into one or other of these genera, and, until considerably more is known about the intermediate tropical Pacific forms, it would be rather hasty to reduce Bathycrinus to a synonym of Rhizocrinus. The West Indian species of Bathycrinus, described as B. caribbeus (fig. 2), evidently is much nearer Bathycrinus gracilis than to Rhizocrinus lofotensis, in spite of the elongate basal ring; but B. equatorialis (fig. 3), from the central Pacific between the Marquesas Islands and Central America, is, so far as can be judged from the stem and basals alone, practically intermediate.

**Rhizocrinus verrilli**, new species.


In 1885 Professor Verrill recorded, under the name of *Rhizocrinus lofotensis*, a small *Rhizocrinus* which had been obtained in 640 fathoms off Marthas Vineyard, Massachusetts. I have recently been enabled to reexamine the specimen, and find that it represents a species quite distinct from *R. lofotensis*, which I propose to call *R. verrilli*, in recognition of the great services rendered to science, particularly in regard to submarine life, by Professor Verrill.

The species may be described as follows: Basals and radials ancylosed, with no trace of sutures, forming a cup, about half as long again as its anterior diameter, with moderately and uniformly convex
sides; the portion of the stem remaining is composed of seventeen joints, with the anterior half of the eighteenth; the first stem joint is very short, the second about double its length, the third about double the length of the second, and so on to the fifth, which is squarish; the following joints increase more gradually in length, after the ninth being about twice as long as their terminal diameter; the ninth and following joints also are rather strongly constricted centrally, with bulbous ends; first brachials very short, over twice as broad as long; second brachials about as long as broad at the proximal end, trapezoidal, the distal end being about three-fourths the length of the proximal; remainder of arms lacking.

The total length of the specimen is 15 mm., of which the calyx represents a length of 1.5 mm.

*Type.*—Cat. No. 22698, U.S.N.M.

Professor Verrill regarded this specimen as a young example of *R. lofotensis*; but Sars says that in the young of that species the stem joints are more slender than in the adult, whereas in *R. verrilli* they are very stout, resembling those of *R. rawsonii* more nearly than those of *R. lofotensis*. The greatest difference is found in the first brachials of the two species, those of *R. lofotensis* being longer than broad, those of *R. verrilli* being twice as broad as long; in the latter, moreover, two of the first brachials are much larger than the other three, a point which I shall discuss more fully later.
DESCRIPTIONS OF NEW SPECIES OF CRINIDS, CHIEFLY FROM THE COLLECTIONS MADE BY THE U. S. FISHERIES STEAMER "ALBATROSS" AT THE HAWAIIAN ISLANDS IN 1902; WITH REMARKS ON THE CLASSIFICATION OF THE COMATULIDA.

By Austin Hobart Clark,
Of the United States Bureau of Fisheries.

The present paper relates chiefly to the collections made in 1902 at the Hawaiian Islands by the steamer Albatross, of the Bureau of Fisheries, but contains also descriptions of new species obtained elsewhere by the same steamer, and a discussion of the classification of the free crinoids.

Mr. Walter K. Fisher, of Palo Alto, California, who accompanied the Albatross on the Hawaiian cruise, made color notes from life of some of the species on the labels. I have made use of these notes, giving due credit to Mr. Fisher.

Although the Albatross made 344 dredge hauls, the collection is a small one, containing only 64 specimens, representing 11 species, 7 of which are known only from a single example, and 2 more from only 2. In other words, the entire collection is rather less in individuals and in species than a single haul made by the Albatross in 1906 in the Eastern Sea, off Kagoshima Gulf. However, in spite of its small size, it is a collection of very exceptional interest, quite as much through the forms which are lacking as through those included.

No stalked crinoids were found among the Hawaiian Islands, all the forms belonging to the order Comatulida, the Comatulids, or Feather Stars.

The order Comatulida, as at present understood, consists of 11 families, including about 30 recent genera. Two of the families, Thiolliericrinidae and Uintacrinidae, each containing only a single genus representing, respectively, the least and most specialized types of the order, are only known in the fossil state.

KEY TO THE FAMILIES OF COMATULIDA HAVING RECENT REPRESENTATIVES.

a. Large orals present

b. Basals present; cirrus sockets bordered anteriorly and laterally by an elevated ridge

c. Arms undivided

d. Mouth central, arms lateral; oral pinnules with the tips not furnished with a comb.

e. Costals articulated.

f. Middle and distal pinnules sharply triangular and styliform; central cavity of centro-dorsal very small.

g. Muscular fossae on distal face of radials very high, much longer than broad; terminal pinnules very short, not extending beyond tip of arm

h. Muscular fossae narrow and transversely linear; terminal pinnules extending far beyond tip of arm

j. Middle and distal pinnules round, the articulations swollen; central cavity of centro-dorsal very large.

k. Lower pinnules slender, like the following: opposing spine when present terminally situated; some or all of the cirrus joints "dice-box shaped"; muscular fossae on faces of radials meeting in the median line, and separated from the ligament fossae by a strong diagonal ridge

l. One or more of the lower pinnules enlarged, and much stouter than the succeeding; opposing spine, when present, centrally situated; cirrus joints with more or less convex borders; muscular fossae entirely and widely separated from each other, but not separated by a diagonal ridge from the ligament fossae

c. Costals united by syzygy

d. Mouth marginal, arms central; oral pinnules furnished with a terminal comb

This key is, so far as possible, based upon obvious external characters which can be appreciated at a glance; a detailed discussion of the families and their fundamental characters is reserved for a future paper.

The geographical and bathymetrical range of the families is as follows:

THAUMATOCRINIDÆ (based upon a genus and species founded upon a single small, probably immature, individual): southwest of Melbourne, Australia: 1,800 fathoms.

ATELECRINIDÆ (Atelerixinus): West Indies; coast of Brazil; Fiji; Hawaiian Islands: 291 to 610 (809) fathoms.

EUDIOCRINIDÆ (Eudioximus; Decametrocrinus): West Indies; coasts of southern Europe; coasts of Somaliland, and the Crozet Islands, eastward to the Meangis and Hawaiian Islands, northward to Japan: 103 to 1,800 fathoms.
NEW SPECIES OF CRINOIDS—CLARK.

**Thalassometridae** (Thalassometra; Stylometra; Charitometra; Paeclometra): West Indies and coast of Portugal southward to Cape Colony and the Crozet Islands, eastward to Australia, the Macangis Islands, the Galapagos Islands, Panama, and the Hawaiian Islands, and northward to Japan and the western Aleutian Islands; 52 to 1,600 fathoms.

**Tropiometridae** (Tropiometra; Ptilometra; Asterometra; Calometra): West Indies and coast of Brazil; Madeira south to Cape Colony; Red Sea and east Africa eastward to the South Sea Islands, northward to Japan, and southward to the southern coast of Australia; mainly littoral and sublittoral, but in the Caribbean Sea, extending down to 278 fathoms.

**Antedonidae**, as restricted (Antedon; Thysanometra; Coccometra; Heliometra; Promachocerinus; Trichometra; Adelometra; Psathyrometra; Zenometra; Hypalometra; Isometra; Bathymetra; Thaumatometra; Hathrometra; Leptometra; Compsometra; Iridometra; Nanometra; Erythrometra; Perometra): practically cosmopolitan; littoral down to 2,900 fathoms.

**Himerometridae** (Oligometra; Cyclometra; Himerometra; Pontiometra): Caribbean Sea at Panama; East Africa and Madagascar eastward to the Marshall and Society Islands, southward to New South Wales and northward to Japan; mainly littoral and sublittoral, but possibly extending down to 255 fathoms.

**Zygometridae** (Zygometra): northern Australia northward to Japan; sublittoral, and down to 152 fathoms.

**Comasteridae** (Comaster; Comatula): South Carolina and the Bay of Biscay, south to southern Brazil and Cape Colony; east Africa and Madagascar, eastward to the Society Islands and Peru, northward to Japan and southward to southern Australia; mainly littoral and sublittoral, but extending down to 830 fathoms in the Caribbean Sea.

It must be emphasized that the collection undoubtedly represents but a very small fraction of the entire number of species inhabiting the area under consideration, but, on the other hand, it is probable that further investigation will not radically alter the general conclusions.

Crinoids were found only between 136 and 1,000 fathoms, although the investigations were carried on from the exposed reefs down to 2,629 fathoms. The following families were not represented: Thaumatocrinidae, Himerometridae, Tropiometridae, Zygometridae, and Comasteridae, while representatives of the families Atelecrinidae, Thalassometridae, Eudicrinidae, and Antedonidae were secured. This is very significant, for the four families which, by their great abundance in the region from east Africa eastward to Oceania and northward to Japan (to which one of the families and seven of
the ten genera forming the others are exclusively confined), may be considered as peculiarly characteristic of it, are entirely absent; while the four families occurring in the Hawaiian Islands are all of very wide distribution, in the Atlantic as well as the Pacific; moreover, the former are mainly littoral or inhabitants of shallow water, while of the latter three are confined to deep water and the other is cosmopolitan. The Hawaiian crinoids, so far as known, all belong to very wide-ranging types inhabiting fairly deep water. Comparison with other localities is interesting; in the following table are given the genera occurring in the West Indies, Japan, off the Crozet Islands, among the western Aleutian Islands, and in the Galapagos Islands, compared with those of the Hawaiian Islands:

<table>
<thead>
<tr>
<th>Name</th>
<th>West Indies</th>
<th>Japan</th>
<th>Crozet Islands</th>
<th>Aleutian Islands</th>
<th>Galapagos Islands</th>
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<td>Comatula</td>
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It will be observed, then, that of the 8 genera represented in the Hawaiian Islands, 2 occur in the Aleutian and Galapagos Islands; 2 occur in the Crozet Islands; 5 occur in Japan; 4 occur in the West Indies, only one of which occurs in Japan, two of them being known from only the West Indies and the Hawaiian Islands.

The Hawaiian fauna, as at present known, comprises two West Indian genera (Zenometra; Trichometra), one East Indian-Japanese genus (Iridometra), one South Seas-Indo-Pacific genus (Decame-
trachinum), one North Pacific genus (*Psathyrometra*), and three genera (*Altecreurus; Thalassometra; Charitometra*) of exceedingly wide distribution; of the six species belonging to the three last, four are of a generalized type, while two, *Thalassometra fisheri* and *Charitometra lateralis* show Indo-Japanese affinities. In other words, it is *tropical oceanic*; that is, composed of genera which are certain to be found in all tropical or subtropical isolated islands, with a slight West Indian and somewhat stronger Indo-Japanese tinge. As might be expected from the isolated condition of the islands, and the great distance separating them from any locality of which we have a clear idea of the crinoid fauna, all the species are new; but, rather oddly, there are no new genera.

It is perhaps well to call attention to the fact that species have been recorded from the Hawaiian Islands, and specimens exist in collections so labeled, belonging to the Comasteridae and Himerometridae; these have probably been brought as curios to Honolulu from Japan or Samoa and then sold as having been obtained in the Hawaiian Islands; did these families really occur, I am sure they would not have escaped such energetic collectors as the scientific staff of the *Albatross*.

KEY TO THE CRINOIDS OF THE HAWAIIAN ISLANDS.\(^a\)

a. Basals present, forming a narrow band between the radials and the long conical centro-dorsal; no pinnules on the lowest 12 brachials.

*Altecreurus conifer.*

a'. Radials resting directly upon the centro-dorsal; the second brachial, and all following, bear pinnules.

b. Nine radials, giving rise to nine undivided arms. *Decametrocrinus rugosus.*

b'. Five radials, giving rise to arms which divide at least once.

c. Ambulacra of arms and pinnules naked.

d. Centro-dorsal low, the cirri without definite arrangement; yellow or brownish; small.

c. 25-45 cirrus joints; first pinnule greatly elongated and extremely slender. *Trichometra verator.*

c'. 10 or 12 cirrus joints; first pinnule only slightly longer than the second. *Iridometra crispata.*

d'. Centro-dorsal long and conical, the cirri in definite columns; red or purple.

c. Cirri in 15 columns; calyx spiny; proximal cirrus joints elongated, distal short and spiny. *Zonometra triserialis.*

c'. Cirri in 20 columns; calyx smooth; all the cirrus joints greatly elongated, the distal without spines. *Psathyrometra congesta.*

c'. Ambulacra of arms and pinnules protected by large covering-plates.

d. First pinnule larger and stouter than its successors; genital pinnules not expanded; distal cirrus joints very short and spiny.

\(^a\) This key is not adapted to any but Hawaiian species.
c. Calyx and arm bases very spiny; distichals 1 (3+4).

f. First pinnule enormously enlarged with 12 joints; 10 to 12 arms up to 110 mm. in length; palmaris not present; spines on cirri sharp. — Thalassometra hawaiiensis.

f'. First pinnule not especially enlarged, with 22 joints; 17 arms 180 mm. in length; palmaris present; blunt spines on cirri.

Thalassometra gigantea.

c'. Calyx and arm bases smooth; distichals 2.

f. Less than 30 cirrus joints. — Thalassometra fisheri.

f'. More than 30 cirrus joints.

g. Palmaris absent; cirri stout with 55–60 joints.

Thalassometra crassicirra.

g'. Palmaris present on outer side of rays; cirri slender with 40 joints. — Thalassometra delicata.

d'. First two pinnules more slender than their successors with more numerous and smaller joints; genital pinnules expanded; all the cirrus joints elongated, without dorsal spines. — Charitonometra lateralis.

Order COMATULIDA.

Family ATELECRINIDÆ.

Genus ATELECRINUS.

ATELECRINUS CONIFER, new species.

Centro-dorsal conical, the sides but slightly convex, 5 mm. broad at the base and 6 mm. long, bearing 15 columns (3 triple columns) of cirrus sockets, about 5 to a column, the cirrus sockets being similar in character to those of the other species of the genus.

Cirri broken; the longest stump, which measures 35 mm., consists of 19 joints, of which the first 2 are short, the third about half again as long as wide, and the remainder about three times as long as wide; the joints do not overlap.

Basals very narrow, forming a uniform narrow band between the radials and the centro-dorsal, not prominent interradially; the proximal edge of the centro-dorsal is somewhat prominent in the angles of the calyx; radials somewhat over twice as broad as long, closely united laterally, the dorsal surface almost flat, the anterior edge straight, the posterior convex; first costal not quite so long as broad, oblong, slightly incised anteriorly, the dorsal surface moderately curved; costal axillaries about as long as broad, nearly square, the sides slightly concave; the brachials are similar to those in Atelecrinus balanoides, but are proportionately stouter; the junctions between the costals and the first two brachials are more tubercular than in the other species.

The longest arm is broken off at the twelfth brachial. The specimen has no pinnules.

The entire length of the specimen, from the tip of the centro-dorsal to the twelfth brachial, is 25 mm.
Color (in spirits).—Dull yellowish white; probably yellow in life.

Locality.—Albatross Station No. 3887; Mokuhooniki Islet bearing S. 15° W. 8.8 miles distant (north coast of Molokai); 552-809 fathoms; globigerina mud.

One specimen, much mutilated.

Type.—Cat. No. 22685, U.S.N.M.

Remarks.—Atelecrinus conifer is at once distinguishable from the three other species of the genus by having three instead of two columns of cirrus sockets in each radial area on the centro-dorsal. It lacks the peculiar groove between the basals and the centro-dorsal which is found in the other Pacific species, and is much the largest species yet discovered.

Atelecrinus was first discovered off Cojima, near Habana, Cuba, and later at many points in the Caribbean Sea, and off the Brazilian coast, southeast of Perambuco; later the Challenger discovered it in the south Pacific near Fiji. The discovery of a species in the Hawaiian Islands, therefore, greatly increases its known geographic range.

Family EUDIOCRINIDÆ.

Genus DECAMETROCRINUS.

DECAMETROCRINUS RUGOSUS, new species.

Centro-dorsal very low, hemispherical, bearing about 90 closely crowded cirri; a rather large bare polar area, the surface thickly studded with shallow pits.

Cirri broken off at the base; the longest fragment is 15 mm. long with 7 joints, the first very short, the second about as long as broad, the third about three times as long as broad, and the remainder about four times as long as broad; the first two joints are practically round in cross-section, the third and following becoming laterally compressed; the joints are oblong with the distal ends nearly straight.

Nine rays, each with an undivided arm; radials even with the edge of the centro-dorsal; first brachials about twice as broad as long, closely united in their posterior half, but widely free anteriorly, leaving a large U-shaped gap extending down between the anterior halves of adjacent first brachials; second brachial trapezoidal, half again as broad anteriorly as posteriorly, the sides concave; second brachial nearly twice as broad as long, the anterior and posterior edges equal to the anterior edge of the first brachial in length, the lateral edges strongly concave; the long axis of its posterior face is at right angles to the median plane of the arm, but the long axis of its anterior face is turned nearly 45°; the fourth and fifth brachials constitute the first syzygial pair, which is about as long as its greatest diameter, and strongly concave laterally; the long axes of its anterior and
posterior faces are almost at right angles, the opposed syzygial faces being practically round; next four joints similar to the second brachial; the joints from the second to the ninth brachial are rather disproportionately large, and very strongly tubercular; the following joints are wedge-shaped, smooth, nearly twice as broad as long, soon becoming rather more obliquely wedge-shaped, or practically triangular, about as long as broad, and distally wedge-shaped again and much longer than broad, as much as four or five times as long as broad on the terminal joints. The arms appear to have been between 200 mm. and 250 mm. long. Syzygia occur between the fourth and fifth brachials, again between the ninth and tenth, and then at intervals of two to four (usually three or four) bifascial articulations.

The first pinnule is on the second brachial; the genital pinnules have short round genital glands.

Locality.—Albatross Station No. 4151: center of Bird Island bearing S. 77° 30' E.; 11.1 miles distance: 762-1,000 fathoms: white mud, foraminifera, and rocks.

One specimen, badly broken.

Type.—Cat. No. 22682, U.S.N.M.

Remarks.—Decametrocrinus rugosus is readily distinguishable from the other species of the genus by its large size and swollen and strongly tubercular lower brachials, as well as by its low centro-dorsal bearing a very large number of cirri, and having a large bare polar area.

The genus Decametrocrinus appears to be of very general occurrence in the Pacific and Southern oceans; first discovered by the Challenger near the Crozet Islands, it was again taken southwest of Melbourne, Victoria, and later in the Meangis Islands, northeast of New Zealand. The specimens from the two first localities were referred by Doctor Carpenter to the same species, abyssorum, while those from the last were considered to be distinct, and were called naresi. In 1906 the Albatross dredged a fine species off southwestern Japan which was described in the following year under the name of borealis. In depth, abyssorum ranges from 1,600 to 1,800 fathoms, naresi was found at 500 fathoms, and borealis at 361 fathoms, while rugosus was dredged somewhere between 762 and 1,000 fathoms, the bottom having receded during the haul.

It is of course impossible to tell whether the 9-rayed character of the type of this species is constant, although externally no difference whatever is visible between the various rays. Doctor Carpenter has shown in the case of Decametrocrinus abyssorum that the species is 10-rayed from the radials outward, the basal star being 5-rayed as usual, thus suggesting that in the present specimen one of the rays has been omitted: it is necessary to be cautious, however, and not accept that conclusion hastily, in view of the recent discovery of a
more or less normal multiradiate condition in Tropiometra cavatana. It may be that the 9-rayed condition arises from a departure from the usual pentamerous type which affects the entire animal, and not from a mere doubling of the rays.

It is well to here call attention to the fact that Promachocrinus and Decametrocrinus are not nearly related as supposed by Carpenter and Minckert; the former belongs to the Antedonidae and is near to Heliometra, while the latter belongs to the Eudiocrinidae and is related to Eudiocrinus.

Family ANTEDONIDÆ.

Genus TRICHOMETRA.

TRICHOMETRA VEXATOR, new species.

Centro-dorsal subconical, about twice as broad as high, bearing 40 to 60 cirri, closely crowded together and without definite arrangement; there is a moderately large bare polar area.

Cirri about 20 mm. long with 40 to 45 joints on the proximal part of the centro-dorsal, those near the apex being about half as long with 25 to 30 joints; first cirrus joint short, second squarish, third and fourth about half again as long as broad, fifth and following to about the fifteenth about twice as long as broad after which they decrease gradually in length, the last 15 or 20 being squarish; the distal end of the elongate proximal joints project slightly on the dorsal side, and the dorsal side of the shorter distal joints is rather strongly convex, but true dorsal spines are not developed; the opposing spine is prominent and sharp, terminally situated, triangular, in length about equal to the diameter of the penultimate joint.

Radials concealed: first costals short and broad, the lateral edges produced and in apposition, the anterior border strongly concave in the median line; costal axillaries about as broad as long, all the sides somewhat concave, with a rounded posterior border, incising the first costal. Ten arms 60 mm. to 65 mm. long; first brachials short, concave anteriorly, united interiorly in their posterior half; second brachials larger, triangular; third and fourth brachials (syzygial pair) about as long as wide, rather longer interiorly than exteriorly, the hypozygal being somewhat wedge-shaped; following six brachials oblong, broader than long, then becoming triangular about as long as broad, and elongate and somewhat swollen distally. Syzygia occur between the third and fourth brachials, again between the ninth and tenth, and distally at intervals of two bifascial articulations.

The lower pinnules are badly broken in all the specimens; the first pinnule and the pinnule on the fourth (i. e., "third") brachial are exceedingly slender, greatly elongated, with all but a few of the basal joints extremely elongated; the following pinnules are much shorter,
the third and following bearing genital glands; the second pinnule has much elongated joints, but those of the third and following pinnules are not especially long.

**Color (in spirits).**—White; yellow in life (Fisher).

**Localities.**—Albatross Station No. 3859.—Mokuhooniki Islet bearing N. 18° E. 5.6 miles distant (Pailolo channel, between Molokai and Maui); 138-140 fathoms; fine sand and mud.

Arm fragments.

Station No. 3865.—Mokuhooniki Islet bearing N. 79° E. 6.9 miles distant (same locality); 256-283 fathoms; fine volcanic sand and rock.

Twenty-one specimens.

Station No. 3885. Mokuhooniki Islet bearing S. 79° W. 7.8 miles distant (same locality); 277-284 fathoms; globigerina ooze.

Ten specimens.

Station No. 3910.—Diamond Head Light bearing N. 70° E. 12.5 miles distant (south coast of Oahu, near Honolulu); 311-337 fathoms; fine gray sand and mud.

Five specimens.

Station No. 3925.—Diamond Head Light bearing N. 29° 30' E. 10.2 miles distant; 323-299 fathoms; fine gray sand, mud, and rocks.

Two specimens.

Type.—Cat. No. 22691, U.S.N.M., from this station.

Station No. 4105.—Lae-o Ka Laau Light, Molokai Island, bearing S. 45° 30' E. 10.6 miles distant; 314-335 fathoms; fine coral sand and foraminifera.

Six specimens.

Remarks.—This species is very similar in general appearance to *T. aspera* of the coast of Florida, but it may be at once distinguished by the lack of the everted and spinous ends of the brachials from which *T. aspera* gets its name.

**Genus Iridometra.**

**Iridometra crispa, new species.**

Centro-dorsal hemispherical, bearing about 70 cirri without definite arrangement.

Cirri 4 mm. long with 10 to 12 joints, the first short, the remainder longer than broad, the third, fourth and fifth being the longest; the opposing spine is represented by a small tubercle.

Radials almost concealed: first costals short, narrowing rapidly anteriorly, and very deeply incised in the median line; they are rounded dorsally and widely separated; costal axillaries about as long as broad, all the sides concave, much produced posteriorly. Ten arms about 30 mm. long, resembling those of other species of the genus, as *I. parvicirra* or *I. minuta.*
NEW SPECIES OF CRINOIDS—CLARK.

First pinnule 6 mm. long with 12 or 13 joints, the first squarish, the second about twice as long as broad, the third about three times as long as broad, and the following becoming rather more elongated; second pinnule 4.5 mm. long, similar to the first and with the same number of slightly shorter joints; the third and following pinnules are shorter still and slightly stouter, with the distal edges of their component joints everted and serrate and bear genital glands; distally the pinnules become very slender and increase somewhat in length.

Color (in spirits).—Yellowish brown, the pinnules and cirri white, the interambulacral areas of the disk also white.

Locality.—Albatross Station No. 3938; Laysan Island Light bearing S. 88° 30' E. 7.8 miles distant; 148–163 fathoms; white sand and broken shell.

One specimen.

Type.—Cat. No. 22692, U.S.N.M.

Remarks.—Iridometra crispa agrees with I. serrata in having the lower pinnules elongate and the first longer than the second, but it differs strikingly in lacking altogether the enormous eversion and overlap of the pinnule joints of that species; the cirrus joints, also, which in I. serrata are strongly "dice-box shaped" are practically cylindrical or oblong in I. crispa.

Genus ZENOMETRA.

ZENOMETRA TRISERIALIS, new species.

Centro-dorsal elongate-conical, 6 mm. long by 3 mm. broad at the base, divided into 5 radial areas by interradial lines, which are not raised above the general area of the centro-dorsal; these lines are at first rather less in width than the diameter of the cirrus sockets, and become obsolete in the distal third of the centro-dorsal, which is thickly set with short spines; each radial area contains three crowded columns of cirrus sockets, usually five to a column.

Cirri about 75 in number, slender, 40 mm. to 45 mm. long, with 60 joints; first joint short; second rather longer; third about as long as broad; following joints becoming gradually longer to about the seventh, which is between two and one-half and three times as long as broad, then remaining uniform until about the eighteenth or twentieth, when they gradually decrease in length, becoming squarish about the thirty-third, and distally broader than long; the fourth or fifth to the eighth or ninth joints have their ends somewhat expanded, and the following have the distal dorsal edge rather prominent, giving the cirri a serrate dorsal and smooth ventral outline in profile; in the terminal portion the cirri become moderately compressed, and the dorsal surface of the joints becomes carinate and forms low
spines; the opposing spine is terminally situated, triangular, about equal in height to the diameter of the penultimate joint, and arising from the entire dorsal surface of that joint; the terminal claw is stout basally, slender distally, strongly curved, and longer than the penultimate joint; both the opposing spine and the terminal claw are rather disproportionately large.

A deep cleft is present between the proximal part of the centro-dorsal and the radials; ends of the basal rays visible, bridging over this cleft interradially. Radials short, the anterior edge fringed with spines; first costal short, about four times as broad as long, incised in the median line by a backward projection from the costal axillary, and with the posterior edge strongly everted and very spinous; costal axillaries rhombic, about twice as broad as long, the edges everted and very spinous. Ten deep, compressed arms, apparently about 150 mm. long; first brachial short, concave anteriorly, rather longer outwardly than inwardly where they are united in their proximal half above the angle of the costal axillary; the posterior border everted and spinous; second brachial larger, irregularly quadrate, the anterior and posterior borders everted and spinous; third and fourth brachials (syzygial pair) about as long as broad, slightly longer outwardly than outwardly, the anterior and posterior edge and the syzygial line spinous; following five joints oblong, about half again as broad as long, with both edges everted and standing up vertically as a row of fine thickly set spines; the following joints are quadrate, about as long as broad, gradually becoming more elongate distally, at the extreme arm tips being oblong, and twice as long as broad; all the joints have overlapping spinous ends. Syzygia occur between the third and fourth, ninth and tenth, and fourteenth and fifteenth brachials, and distally at intervals of two to five (usually three or four) bifascial articulations.

First pinnule 7 mm. long, very slender, the first four or five joints about as long as broad, broader than the others, the remainder filiform and elongated; second pinnule 10 mm. long, somewhat stouter than the first pinnule, the first two joints comparatively broad, and about as long as broad, the remainder elongate and slender; the following pinnules are very slightly stouter and of decreasing length, then becoming longer again and slightly more slender distally; all the pinnule joints have slightly overlapping, finely spinous edges; the distal pinnules have their two proximal joints considerably expanded, the first joint short and crescentic, the second about as long as its proximal diameter and trapezoidal, the remainder about three times as long as broad.

Color (in life).—A deep purplish vinaceous, the calyx and arm bases brownish (Fisher).
NEW SPECIES OF CRINOIDS—CLARK.

Locality.—Albatross Station No. 4122; Barber's Point Light (near Honolulu) bearing N. 82° E., 2.2 miles distant; 192-352 fathoms; coarse coral sand and shell.

One specimen.

Type.—Cat. No. 22682, U.S.N.M.

Remarks.—It was a great surprise to find the genus Zenometra represented in the Hawaiian Islands, as the two species with which I was previously acquainted are only known from the West Indies and the Atlantic coast off Florida and southern Georgia; moreover, the Hawaiian species differs markedly from the other two in having the cirri in three instead of two columns in each radial area of the centro-dorsal, thus necessitating a change in the generic diagnosis, while the “wall-sided” character of the costals and lower brachials is much less marked, and the characteristic interradial ridges on the centro-dorsal are obsolete. These differences appear at first sight to suggest that Zenometra is really much nearer Psathyrometra than was previously supposed; but the very characteristic cirri with much elongate joints in the proximal part, and very short and spiny joints in the distal, the spiny character of the calyx and arm bases, and the elongate conical-columnar centro-dorsal are even more marked in Z. triserialis than in Z. columnaris and Z. pyramidalis, and show that the two genera are perfectly distinct, though their differential characters are somewhat different from those originally outlined.

Genus PSATHYROMETRA.

PSATHYROMETRA CONGESTA, new species.

Centro-dorsal conical, the tip rounded, 5 mm. broad and 5 mm. long, with 20 crowded columns of cirrus sockets, 5 to a column, 4 columns to each radial area; the columns in each radial area are not separated in any way from those in adjacent areas. Cirri lacking.

Ends of basal rays prominent, forming an elongate interradial tubercle, which at its distal end separates the two topmost cirrus sockets of the adjoining radial areas; a deep cleft is present between the proximal end of the centro-dorsal and the dorsal surface of the radials, bridged over interradially by the ends of the basal rays; radials visible as a small triangle over the anterior end of the tubercle representing the extremity of the basal ray; first costal short, narrowing anteriorly, deeply incised in the median line by a strong median backward prolongation of the costal axillary; the first costals are rounded and very widely separated; costal axillaries rhombic, longer than broad, the anterior angle approximately a right angle, the posterior angle acute, the two posterior sides somewhat strongly concave; a fairly sharp high median keel occupies the posterior two-thirds of the joint. Ten arms; first brachial short, longer outwardly
than inwardly, very sharply incised by an angular posterior prolongation from the second brachial, and inwardly united for their anterior half, their free inward sides forming a straight line which is at right angles to their apposed edges; second brachial triangular, somewhat longer than broad; following brachials at first slightly wedge-shaped, broader than long, soon becoming triangular, as long as broad, and quadrate again and finally elongate distally; the distal edges of the joints project very slightly, making the arms somewhat rough. Syzygia occur between the third and fourth, ninth and tenth, and fourteenth and fifteenth brachials, and distally at intervals of three bifacial articulations.

Color (in spirits).—Light purplish brown.

Locality.—Albatross Station No. 3992; Mokuacae Islet bearing S. 54° E., 3.5 miles distant; 400-500 fathoms; fine gray sand and mud.

One specimen, much mutilated.

Type.—Cat. No. 22684, U.S.N.M.

Remarks.—The four closely crowded columns of cirrus sockets in each radial area on the centro-dorsal distinguish this species at once from all the others of the genus; it is possibly nearest to P. bigradata, which also has four columns of cirrus sockets in each radial area, but in P. bigradata they are very small and widely separated, and the radial areas are strongly marked off, while in P. congesta they are very large, and the division lines separating the radial areas are obsolete.

Family THALASSOMETRIDÆ

Genus THALASSOMETRA.


This species was not obtained by the Albatross in 1902, but has previously been taken among the Hawaiian Islands at the following localities:

Albatross Station No. 3475.—Kaiwi Channel, southeast of Honolulu; 354 fathoms; fine white sand; December 6, 1891.

Type.—Cat. No. 22653, U.S.N.M.; from this station.

Albatross Station No. 3476.—Same locality; 298 fathoms; fine white sand; December 6, 1891.

THALASSOMETRA GIGANTEA, new species.

Centro-dorsal large, conical, the apex blunt, divided by 5 inter-radial ridges into 5 radial areas, each with 2 columns of cirrus sockets, which are more widely separated from each other than from those of adjoining radial areas.

About 30 cirri 60 mm. to 80 mm. long, stout, with 55 to 60 joints, the first 4 short; the fifth squarish, the sixth and seventh about half
again as long as wide, the eighth twice as long as wide, the ninth and tenth about half again as long as wide, the following squarish, gradually becoming shorter distally; the joints up to, and including most of, the eighth, are dull and rather rounded in cross-section; the distal portion of the eighth and the remaining joints are polished and more compressed; from the twelfth or thirteenth onward dorsal spines are developed.

Ends of basal rays visible as a bunch of branching spines in the angles of the calyx; radials even with the edge of the centro-dorsal; first costals very short; costal axillaries rhombic, over twice as broad as long; distichals 4 (3-4), rarely 2 (in the type five times the former, once the latter); palmars (when present) 2, developed on the inside of the arms (1, 2, 2, 1). Seventeen arms (in the type) 180 mm. long; first 10 brachials oblong, about twice as broad as long, then becoming triangular, about as long as broad, distally becoming quadrate and more elongate. The costals and oblong lower brachials have everted edges armed with numerous spines; the following brachials have the edges everted, but more bluntly spinous; the distal brachials have overlapping and spinous distal edges; the axillaries and second distichals (whether axillaries or not) and the second brachials bear a sharp median keel, which is absent from all the other joints.

The first pinnule (and distichal pinnule when present) is 18 mm. long, stout (but not so stout as in \textit{T. hawaiiensis}), with 22 joints, all of which are much broader than long and strongly carinate; the second pinnule is 10 mm. long and much more slender, the third and following 8 mm. long; the distal pinnules reach a length of 27 mm.

\textit{Color} (in life).—Cirri light chrome yellow; arms light chocolate (Fisher).

\textit{Locality}.—Albatross Station No. 3985; Hanamauhau warehouse (Kanai) bearing S. 53° 30' W., 6 miles distant; 477-430 fathoms; gray sand, foraminifera, and shore deposit.

One specimen.

\textit{Type}.—Cat. No. 22687, U.S.N.M.

\textit{Remarks}.—The very large size, comparatively slender first pinnule with relatively numerous joints, and the presence of palmars, as well as the remarkable proportionate stoutness of the cirri, distinguish this species from the small 10 to 12 armed \textit{T. hawaiiensis}, in which the first pinnule is exceedingly stout, with only 12 joints.

\textbf{THALASSOMETRA FISHERI}, new species.

Centro-dorsal hemispherical, rather small, the cirrus sockets in 10 columns, 2 in each radial area, and 2 to a column.

Cirri 20 mm. long with 20 to 27 joints (most commonly 25 to 27); the first very short, the next two progressively longer, the fourth
squirash, the fifth half as long again to twice as long as broad, smaller distally than proximally, the terminal quarter with a polished surface like the succeeding, the proximal three-quarters with a dull surface like the preceding joints; this joint has a blunt spine on its dorsal distal edge; sixth joint about half again as long as wide, eighth squarish, the following remaining practically uniform; the sixth and following joints bear sharp dorsal spines.

Radials concealed: first costals short, about three times as broad as long, with a rounded median tubercle; costal axillaries almost low-triangular, about twice as broad as long, the center strongly convex; distichals 2 similar to the costals. Thirteen arms (in the type) 120 mm. long; first and second brachials oblong, about twice as wide as long, the former united interiorly for about two-thirds of their length; third and fourth brachials (syzygial pair) about as long as wide, the hypozygal much larger than the epizygals; following eight brachials slightly wedge-shaped, broader than long, then becoming more obliquely wedge-shaped or almost triangular, about as long as wide, and distally quadrate again and finally elongate. Syzygia occur between the third and fourth brachials, again between the thirteenth and fourteenth to fifteenth and sixteenth (more commonly the former) and distally at intervals of three to seven (most commonly four) bifascial articulations. The costals, distichals, and lower brachials are in close apposition and flattened laterally.

First pinnule 7 mm. long with 15 or 16 joints, the first 3 to 5 large and strongly carinate, about as long as wide or somewhat wider than long, the remainder more slender and slightly longer than wide; second pinnule shorter, somewhat less stout at the base, and tapering evenly to the tip, the lower joints not being disproportionately large, though they are somewhat carinate; third and fourth pinnule like second, but progressively shorter; the fourth and following pinnules are 5 mm. long with about 12 joints, slightly longer than broad, flattened and markedly carinate, the distal angles of each joint overlapping the base of the next succeeding, producing a strongly serrate lateral outline; the joints are all subequal in size, so that the pinnules appear generally stouter, though smaller, than those preceding; these gradually become longer, reaching 9 mm. distally, but preserve their thin, flattened character, and the serrate appearance of the lateral edges.

Color (in life).—Arms cadmium orange, darkest on pinnules; cirri bright lemon yellow (Fisher).

Locality.—Albatross Station No. 4122; Barber's Point Light (near Honolulu) bearing N. 82° E., 2.2 miles distant; 192-352 fathoms; coarse coral sand and shell.

One specimen.

Type.—Cat. No. 22686, U.S.N.M.
Remarks.—This species is related to Thalassometra compressa of the Philippines and T. orion of southern Japan, but is at once distinguished by the prominent dorsal spines on the cirri, the greater number of cirrus-joints, and the greater proportionate length of the cirri, and the flatness and strong carination of the middle and distal pinnules.

In the lists of species belonging to the two genera published when I established Thalassometra and Charitometra, orion and compressa were erroneously assigned to the latter. Porrecta and flava, of whose position I was at the time uncertain, also belong to Thalassometra.

I take great pleasure in associating with this interesting species the name of my friend Mr. Walter K. Fisher, of Stanford University, California.

**THALASSOMETRA CRASSICIRRA, new species.**

This species in its general appearance and proportions resembles T. gigantea; but it differs in having exactly 20 arms, all the distichals being 2, and in having the costals, distichals, and first 7 brachials perfectly smooth, without spines, in close apposition and sharply "wall-sided." The cirri are stout, and resemble those of T. gigantea, having approximately the same number of joints. The arms are about 120 mm. long.

Color (in spirits).—Light orange brown, the costals, distichals, and first four brachials dark brown.

Localities.—Albatross Station No. 3882; Mokuhooniki Islet bearing N. 30° W., 3.1 miles distant (Pailolo channel, between Maui and Molokai): 136 fathoms; sand, coral, and rock.

One specimen.

Type.—Cat. No. 22689, U.S.N.M., from this station.

Station No. 4107.—Lae-o Ka Laau Light, Molokai Island, bearing S. 34° 30' E., 12.3 miles distant: 350-355 fathoms; coral, sand, and foraminifera.

One small ten-armed specimen.

Remarks.—The absence of palmars and the stout cirri with a comparatively large number of joints distinguish this form from the only other "bidistichate" species of the genus occurring in the Hawaiian Islands.

**THALASSOMETRA DELICATA, new species.**

Centro-dorsal small, conical, bearing 10 columns of cirrus sockets, 2 to a column, the 2 columns in each radial area separated by a more or less pronounced radial ridge.

Cirri 25 mm. to 30 mm. long of about 40 joints, the first 3 short, the fourth squarish, the following to the sixteenth about half again as long as wide, perfectly smooth, the surface dull; remaining joints

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highly polished, at first squarish, then gradually becoming short; all the short and polished joints are furnished with sharp dorsal spines.

Ends of basal rays visible as small tubercles in the angles of the calyx; radials concealed; first costals very short, with the edges somewhat raised, and a pronounced median tubercle; costal axillaries rhombic, over twice as broad as long, the edges somewhat raised, and with a rounded median keel; distichals and palmar 2, similar to the costals, but with the edges not so prominent; the latter occurring 2, 1, 1, 2. Twenty-eight arms (in the type) 100 mm. long; lower brachials discoidal, gradually becoming wedge-shaped (broader than long), then triangular; the rays and division series and the lower brachials up to about the fifteenth are sharply flattened laterally, the arms then becoming strongly compressed laterally, and developing strongly overlapping distal edges to the brachials, which in a lateral view appear as overlapping spines. Syzygias occur between the third and fourth brachials, again about the sixteenth and seventeenth, and distally at intervals of 2 to 8 (usually 4) bifascial articulation.

The first pinnule is considerably longer and stouter than the following, which decrease in length to about the fifth, after which they gradually increase distally, but never become very long. The first pinnule is not excessively stout, as in T. hawaiicaimensis, but is more of the proportions of those of T. orion and T. fisheri.

Color (in spirits).—Brownish yellow, the distal half of the cirri lighter.

Locality.—Albatross Station No. 3963; Laysan Island Light bearing N. 56° 30' E., 6.6 miles distant; 319 fathoms; white sand and broken shell.

Two specimens.

Type.—Cat. No. 22690, U.S.N.M.

Remarks.—The presence of palmars and the slender cirri with only 40 joints distinguish this species at once from the preceding.

**CHARITOMETRA LATERALIS.** new species.

Centro-dorsal very thick, discoidal or almost columnar, more rarely truncated conical, bearing about 30 closely crowded cirri.

Cirri 30 mm. to 40 mm. long, stout, with 16 to 19 (rarely as few as 15 or as many as 21) joints, the first about half as long as broad, the second almost as long as broad, the third rather longer than broad, the remainder about half again as long as broad; the last 4 or 5 joints have the median part of the distal dorsal edge rather prominent, and the penultimate bears a small opposing spine.

Rays and usually all of the first costals concealed by the centro-dorsal; costal axillary low and broad, nearly three times as broad as long. Ten arms 160 mm. to 180 mm. long; first two brachials very short, about four times as wide as long, oblong; the costal axillaries
and first three brachials have produced, thin, and everted lateral edges, those of adjacent joints in close apposition and flattened against each other, very crenulate anterior and posterior edges, often dovetailing more or less, and rounded median ridges; the following 5 or 6 brachials are alternatingly tubercular, this feature being more or less pronounced, and sometimes almost obsolete in the smaller specimens; the fourth to about the twelfth brachials are wedge-shaped, broader than long, then becoming triangular and as long as wide, this continuing almost to the tip of the arm; the terminal brachials are quadrate, and finally elongate. Syzygia occur between the third and fourth brachials, again at about between the fifteenth and sixteenth, and distally at intervals of from 5 to 11 (usually 5 to 7) bifascial articulations. The brachials are, all but those at the base of the arms, rather strongly overlapping with finely serrate edges; the costals and lower 6 or 7 brachials are very sharply "wall-sided" and flattened against each other; the lower 10 to 15 brachials have more or less developed thin lateral flange-like processes, most developed in the posterior part; the lower brachials also have single small rounded tubercles developed on alternate sides of the median line, which may persist almost throughout the length of the arm.

The first two pinnules are somewhat longer, and more slender than their successors, and are composed of a greater number of smaller joints; the following pinnules are very stout in the basal half, then taper to a slender tip, the expansion of the basal joints gradually becoming less and less marked distally.

Color (in life).—Arms ochre yellow; cirri clear lemon yellow (Fisher). The containing alcohol is stained either a deep orange-red or emerald green.

Localities.—Albatross Station No. 4177: Kwahioa Point bearing S. 54° W., 17.5 miles distant (off Niilhau): 451-319 fathoms: gray sand and globigerinae.

One specimen.

Station No. 4179.—Kawahioa Point bearing S. 60° 45' W., 19.2 miles distant (same locality): 378-426 fathoms: coarse sand, rocks, and pebbles.

Six specimens.

Type.—Cat. No. 22688, U.S.N.M., from this station.

Station No. 4180.—Kawahioa Point bearing S. 58° W., 19.5 miles distant (same locality): 426-417 fathoms: pebbles, globigerinae, and rocks.

Two young specimens, arms 25 mm. and 80 mm. long.

Remarks.—In the specimen with arms 80 mm. long both costals are visible, and the ends of the basal rays are prominent as vertically elongate tubercles in the angles of the calyx: the very broad character of the costals and lower brachials is very marked, as in the eversion
of their edges, especially the lateral edges; but the proximal and distal edges as yet have not taken on the characteristic crenulate character of those of the adults. The basal broadening of the arms of this species reminds one of the same character seen in the arms of Rhizocrinus. This specimen is peculiar in having on one ray a regenerating pair of arms in the place of a single arm lost, the distichals being 2, thus making 11 arms in all; no specimen with more than 10 arms has heretofore been observed in this group of the genus.

The smallest specimen has the entire radials visible; these have a pronounced rounded median ridge; the ends of the basal rays are prominent, and project rather more than in the preceding specimen. The broadness of the costals and lower brachials is marked, even at this early stage, though the succeeding brachials are much elongated; the eversion of the lateral edges of the costals and lower brachials is already apparent.

Charitometra lateralis belongs to the same division of the genus as C. tuberosa from the Philippines and C. lata from Japan; it differs from both in its larger size, much longer cirrus joints, which are about half again as long as wide instead of squarish, and the prominent eversion of the lateral edges of the costals and lower brachials, and the absence of the dorsal carination of the lower part of the arms, which is so characteristic a feature of C. tuberosa.

DISTRIBUTION OF THE SPECIES BY STATIONS.

Station No. 3475.—Kaiwi channel; 351 fathoms.  
Thalassometra hawaiiensis.

Station No. 3476.—Kaiwi channel; 298 fathoms.  
Thalassometra hawaiiensis.

Station No. 3859.—Between Molokai and Maui; 138-140 fathoms.  
Trichometra vexator.

Station No. 3865.—(Same locality); 256-283 fathoms.  
Trichometra vexator.

Station No. 3882.—(Same locality); 136 fathoms.  
Thalassometra crassicirra.

Station No. 3883.—(Same locality); 277-284 fathoms.  
Trichometra vexator.

Station No. 3887.—North coast of Molokai; 552-809 fathoms.  
Atelecrinus conifer.

Station No. 3910.—South coast of Oahu; 311-337 fathoms.  
Trichometra vexator.

Station No. 3925.—(Same locality); 323-299 fathoms.  
Trichometra vexator.

Station No. 3938.—Off Laysan Island; 148-163 fathoms.  
Iridometra crispa.
Station No. 3963.—(Same locality); 319 fathoms. 
*Thalassometra delicata.*

Station No. 3985.—Off Kauai; 477-430 fathoms. 
*Thalassometra gigantea.*

Station No. 3992.—(Same locality); 400-500 fathoms. 
*Psathyrometra congesta.*

Station No. 4105.—Kaiwi channel; 314-355 fathoms. 
*Trichometra excavata.*

Station No. 4107.—Kaiwi channel; 350-355 fathoms. 
*Thalassometra crassieira.*

Station No. 4122.—Southwest coast of Oahu; 192-352 fathoms. 
*Thalassometra fischeri.*

*Zenometra triserialis.*

Station No. 4157.—Vicinity of Moloa Manu; 762-1,000 fathoms. 
*Decametrocrinus rugosus.*

Station No. 4177.—Off Niihau; 451-319 fathoms. 
*Charitometra lateralis.*

Station No. 4179.—Off Niihau; 378-426 fathoms. 
*Charitometra lateralis.*

Station No. 4180.—Off Niihau; 426-417 fathoms. 
*Charitometra lateralis.*

**Descriptions of New Species Referred To, and Some Additional Species from the Pacific Ocean.**

**Trichometra Aspera.** *new species.*

Centro-dorsal hemispherical or rounded-conical, nearly covered with cirrus sockets.

Forty to 60 cirri 15 mm. long, with 25 to 30 joints: first joint short; second joint about as long as broad; third to eighth joints about twice as long as the proximal diameter; these joints are rather strongly "dice-box shaped," with flaring and overlapping distal ends, which are especially prominent in the median dorsal part, though they can scarcely be called spinous: following joints increasing in diameter from the proximal to the distal end, where they overlap somewhat, and gradually decreasing in length, from the twelfth onward being about as long as broad; while the distal dorsal border is somewhat prominent, it can never be considered a true spine; opposing spine arising from the entire dorsal surface of the penultimate joint, situated at its distal end, its length rather less than the diameter of the joint; terminal claw usually rather longer than the penultimate joint, moderately stout, and comparatively slightly curved. There are usually a few small cirri situated near the pole which may be less than half as long as the "long mature" cirri, and have 10 or 12 very slender and much elongated joints, with greatly expanded articulations.
Distal edges of radials even with the edge of the centro-dorsal, and very slightly curved, not extending up into the angles of the calyx interradially; first costals very short (six or eight times as broad as long) and bandlike, with a rounded notch in the distal median line; costal axillaries rhombic, about half again as broad as long, with a rounded posterior projection incising the first costals; the anterior sides are moderately concave, but the anterior angle is not especially long; costals and two lowest brachials in close apposition and laterally flattened. Ten arms 45 mm. to 60 mm. long (usually about 50 mm. to 55 mm.); first brachial very short, much longer outwardly than inwardly, and almost bisected by a backward prolongation from the second brachial, which is irregular in shape and considerably larger; third and fourth brachials (syzygial pair) about half again as broad as long, rather longer on the inner than the outer side; following brachials to the eleventh wedge-shaped, much broader than long, with the anterior and posterior ends strongly concave; following brachials becoming more obliquely wedge-shaped, after the sixteenth or seventeenth triangular, as long as, or rather longer than, wide, after the proximal third of the arm becoming wedge-shaped again and more elongate, somewhat “dice-box shaped,” and distally still more elongate, less and less obliquely quadrate, and more and more “dice-box shaped.” Syzygia occur between the third and fourth, ninth and tenth, and fourteenth and fifteenth brachials, and distally at intervals of two (more rarely three) bifascial articulations. The lower brachials have the distal edges strongly and prominently everted and spinous, standing out vertically from the axis of the arm, giving it a characteristic scalloped dorsal outline; this condition, however, dies away after about the sixteenth brachial, the distal edges of the joints becoming almost smooth, although they may be seen, under a strong glass, to bear a fringe of short, fine spines.

First pinnule 6 mm. long with 20 to 25 joints, very slender, the first 3 or 4 joints about as long as broad, the remainder becoming progressively elongated and exceedingly long and slender distally; after the fourth or fifth joint the distal ends become greatly expanded and widely flaring, overlapping the bases of the succeeding joints; this flaring of the distal ends is confined to the distal ends of the joints, arising rather suddenly; the distal end of a joint is usually about twice the diameter of the remainder; the pinnule of the first syzygial pair (first inner pinnule) may be similar or it may be twice as long as the first pinnule; the second pinnule is 4 mm. long, considerably stouter than the first, tapering evenly from the base to the tip, with 10 joints, the first 3 squarish, the remainder becoming progressively elongated; the distal ends of the joints are not especially prominent; third pinnule about the same length, but rather stouter (especially
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distally) and much stiffer, with 10 joints, the first not so long as wide, the second and third squarish, the following becoming progressively elongated; the fourth, fifth, sixth, and proximal half of the seventh bear a large genital gland: following pinnules to the seventh or eighth similar, but gradually becoming longer and stouter; after the ninth the pinnules develop somewhat "dice-box shaped" joints with prominent distal ends, contrasting more or less with the smoother genital pinnules: the distal pinnules are 6 mm. long, the first joint short and wedge-shaped, the second about as long as wide, slightly trapezoidal, the remainder much elongated with prominent articulations and protruding distal ends.

Type.—Cat. No. 22678, U.S.N.M.; from Albatross Station No. 2666; off southern Georgia; 270 fathoms.

THAUMATOMETRA PARVA, new species.

Centro-dorsal rather small, hemispherical or low-conical, the cirrus sockets closely set in two or three crowded rows, leaving only a small portion of the dorsal pole bare.

Cirri about 30 in number, 9 mm. long, with 10 to 12 joints; first joint squarish, second about half again as long as broad, third and fourth between three and four times as long as broad, following joints gradually decreasing in length, and gradually becoming broader dorso-ventrally and laterally compressed; the antepenultimate joint is oblong, about twice as long as broad, and the penultimate is about half again as long as broad and bears on its anterior dorsal edge a small opposing spine less than one-third of its transverse diameter in length, which is directed obliquely forward; the terminal claw is about the length of the penultimate joint, rather stout, and moderately curved; the second to the fifth joints have expanded ends, but these die away as the joints become compressed.

Radials even with the edge of the centro-dorsal; first costals short, oblong, about four times as broad as long, somewhat narrower anteriorly than posteriorly, rounded, and well-separated laterally; costal axillaries rhombic, somewhat broader than long, the anterior sides somewhat curved and the anterior angle rather sharp, with a rounded backward projection rising to a slight tubercle. Ten arms, apparently about 30 mm. long; first brachial wedge-shaped, the outer sides longer than the inner, entirely free interiorly; second brachial much larger, irregularly quadrate; third and fourth (syzygial pair) somewhat longer than broad, and slightly longer interiorly than exteriorly; fifth to eighth brachials oblong, about half again as broad as long, the joints then becoming wedge-shaped and about as long as broad; only the basal third of the arms is present. Syzygia occur between the third and fourth, ninth and tenth, and fourteenth and fifteenth brachials.
First pinnule 6 mm. long, very slender, with 15 joints, the first very short, the second and third about as long as broad, with their corners cut away, the fourth and fifth about half again as long as broad and more slender than the preceding, and the remainder becoming rapidly elongated with swollen articulations, and very slender and filiform; second pinnule very slightly shorter, the first joint short, the second squarish, the third about half as long again as wide, and the remainder becoming progressively elongated; this pinnule is about as stout basally as the first, but does not taper so rapidly, so that the general appearance is considerably stouter; a large genital gland is present, occupying from the fourth to the eleventh joints; following pinnules, so far as they remain, similar to the second.

Color (in spirits).—White, the perisome darker.

Type.—Cat. No. 22694, U.S.N.M.; from Albatross Station No. 3697; Sagami Bay, Japan; 120 to 265 fathoms.

THAUMATOMETRA COMASTER, new species.

Centro-dorsal low-hemispherical, nearly covered with cirrus-sockets which are closely crowded together and more or less irregularly placed.

Forty to 45 cirri, 8 mm. long (the "small mature" cirri being rather shorter), with 13 to 17 (usually about 15) joints; first joint short, second about as long as broad, third over twice as long as its proximal diameter, and the fourth, which is the longest, about three times as long as its proximal diameter; the following joints gradually decrease in length, the 4 or 5 terminal joints being about half again as long as broad; opposing spine very small, terminally situated, and directed obliquely forward; terminal claw about as long as the penultimate joint, rather stout and well curved; the lower joints have flaring and expanded ends, this character dying away on the terminal 5 or 6, which are somewhat compressed laterally.

Radials even with the edge of the centro-dorsal; first costals very short, with straight lateral edges, concave anteriorly; costal axillaries rhombic, about as long as broad, the anterior angle somewhat produced, the posterior projection incising the first costal rather sharp. Ten arms about 45 mm. long; first brachial short, about twice as long exteriorly as interiorly, concave anteriorly, the inner edges entirely free; second brachial larger, irregular, with an angular posterior projection incising the first brachial; third and fourth brachials (syzygial pair) about as long as broad, slightly longer interiorly than exteriorly; following 4 or 5 joints oblong or slightly wedge-shaped, broader than long, then becoming more obliquely wedge-shaped and rather longer than broad, gradually increasing in length distally. Syzygia occur between the third and fourth, ninth and
tenth, and fourteenth and fifteenth brachials, and distally at intervals of three bifascial articulations.

The pinnules appear to be similar to those of *T. sisis*, but the genital gland on the second is much larger, and occupies the fourth to the eleventh joints.

**Color.**—Grayish brown, the skeleton dull white.

**Type.**—Cat. No. 22681, U.S.N.M.; from *Albatross* Station No. 5032; in Yezo Strait: 300 to 533 fathoms.

**Bathyometra minutissima**, new species.

Centro-dorsal rather small, hemispherical, the dorsal pole furnished with several rather long spines; the cirrus sockets arranged in 3 crowded columns of usually 3 each in each radial area.

Cirri about 45 in number, 4 mm. long, with 12 to 15 joints; first joint rather less than half as long as wide; second joint over twice as long as its proximal diameter, flaring rapidly from about the middle so that the diameter of the distal end is nearly twice that of the proximal; third and following joints very slender and greatly elongated, expanding in each direction, but especially distally, into large flaring ends; fourth joint similar; the following joints gradually decrease in length, the proximal ends becoming less and less enlarged, but the distal ends remain enlarged and funnel shaped; antepenultimate joint over three times as long as its proximal diameter, expanding from the base to the tip, but more rapidly in the outer two-thirds; penultimate about twice as long as broad, with a long triangular opposing spine arising from the whole of the dorsal surface, and nearly as long as the distal diameter of this joint; its distal edge is perpendicular to the long axis of the joint; terminal claw moderately slender, curved, about equal to the penultimate joint in length.

Radials rather short in the median line, but strongly produced interradially, the anterior border being very strongly concave; the anterior interradial projections do not separate the first costals, which are very short, the lateral edge, which is about twice as long as the length in the median line, being not much more than one-third of the width; the distal border is broadly fringed with fine spines, and the dorsal surface is finely granulose; costal axillaries rhombic, broader than long, the edges, especially the anterior, strongly concave; the dorsal surface is finely granulose, and fine spines are developed laterally; costals and first two brachials on the outside, and first three on the inside, in close apposition and flattened laterally, with very finely spinous lateral borders. Ten arms 13 mm. long; first brachial short, the outer edge rather longer than the inner, strongly concave anteriorly, the anterior border with a strong fringe
of very fine spines, the dorsal surface granulose; second brachial irregular in shape, with a strong rounded posterior projection; third and fourth brachials (syzygial pair) about half again as long as broad; following joints rather longer than broad, gradually becoming more elongate, in the outer part of the arm reaching a length of about three times their width; the brachials are all remarkable for their strongly concave surface, which makes them all strongly "dice-box shaped" with large and expanded ends, which, from the sixth brachial onward, bear a fringe of rather large spines. Syzygia occur between the third and fourth brachials, again between the ninth and tenth and fourteenth and fifteenth, and distally at intervals of two bifascial articulations (i.e., "in alternate joints").

First pinnule very slender and filiform; first 3 joints about as long as broad, strongly concave dorsally with prominent ends, then becoming rapidly elongated with broadly flaring distal ends; the tip of the pinnule is broken; the third and following pinnules bear on the fifth to the seventh joints (which are slender and much elongated) large genital glands; the distal pinnules are exceedingly slender, the first joint nearly as long as broad, the second about twice as long as broad, wider proximally than distally, the remainder very slender and greatly elongated, with expanded ends.

Bathymera miniatissima is scarcely half the size of the other three species of the genus, from all of which the presence of broad spinous borders on the costals and the prominent spinous overlaps of the brachials at once distinguish it.

Type.—Cat. No. 22671, U.S.N.M.; from Albatross Station No. 2761, east of the Abrolhos Islands, off the Brazilian coast; 818 fathoms.

BATHYMETRA BREVICIRRA, new species.

Centro-dorsal hemispherical, rather low, bearing about 45 cirrus sockets in 3 crowded columns of 3 each in each radial area.

Cirri 30 to 40, 6 mm. long, with 14 joints; first joint rather less than half as long as broad, second joint rather longer than broad, sometimes squarish, third joint rather more than twice as long as its proximal diameter, centrally constricted with expanded ends, fourth joint about three times as long as its proximal diameter, also strongly "dice-box shaped;" following joints decreasing gradually in length, the proximal ends becoming less, and the distal rather more expanded, the antepenultimate joint being about twice as long as the diameter of its proximal end, the penultimate rather shorter, with an opposing spine which is not so long as the diameter of the joint, arising from its distal half; terminal claw short, conical, slightly curved, from one-half to three-quarters the length of the penultimate joint.

Radials short, strongly concave anteriorly, and produced in the interradial angles of the calyx, but not separating the first costals;
first costals short, concave anteriorly, but with a straight posterior border, over twice as broad as its lateral and over three times as broad as its median length; costal axillaries practically square, the sides very little curved; costals and first two brachials flattened laterally and in close apposition. Ten arms about 25 mm. long; first brachial short, longer outwardly than inwardly, the anterior edge concave; second brachial about twice as large, irregularly quadrate; third and fourth brachials (syzygial pair) somewhat longer than broad, the epizygal oblong, the hypozygal wedge-shaped or almost triangular, the longer side in; following brachials squarish, after the ninth becoming wedge-shaped, longer than wide, and more elongate distally; all the brachials have a more or less concave surface, this becoming more marked after the ninth, when the distal edges begin to project somewhat. Syzygia occur between the third and fourth, ninth and tenth, and fourteenth and fifteenth brachials, and distally at intervals of three or four bifascial articulations.

First pinnule long, filiform, with 11 joints, the first 2 squarish, then becoming rapidly elongate, the distal being exceedingly long and slender; the distal pinnules have the first joint wedge-shaped or almost crescentic, broader than long, the second wedge-shaped, longer than broad, and the following becoming progressively elongated.

The comparatively short cirrus joints of this species, especially the second, which is hardly more than squarish, distinguish this species at once from the others in which the cirri are known; the large number of cirri and the comparative shortness of the interradial processes of the radials differentiate it at once from Bathymetra carpenteri.

Type.—Cat. No. 22672, U.S.N.M.; from Albatross Station No. 4766; western Bering Sea; 1766 fathoms.

BATHYMETRA CARPENTERI, new species.

1888. Antedon abyssicola P. H. Carpenter, Challenger Reports, XXVI, Zoology, pl. xxxiii, fig. 2 (not fig. 1), and p. 191 (part).

The name carpenteri is here conferred upon the form obtained by the Challenger west of Tasmania, and referred to abyssicola by Doctor Carpenter. The difference between the two forms is so very considerable that it does not seem desirable to include them both under the same specific name, at any rate until intergradation shall have been proven. In Bathymetra carpenteri the centro-dorsal is low, subconical, about half as high as broad, the cirrus sockets distributed about its margin, and the outline of the calyx and lower part of the arms is rounded, much as in Antedon or Helioiometra, whereas in B. abyssicola the centro-dorsal is about as long as wide, bearing cirri only about the dorsal pole, the basal half or more of the centro-dorsal being smooth, and the calyx is long and slender, with a small angle of divergence, as in Charitometra incisa or C. bacicurca.
It gives me pleasure to be able to associate with this species the name of the foremost worker on the unstalked crinoids, the late Dr. P. Herbert Carpenter.

ADELOMETRA TENUIPES. new species.

Ten arms: centro-dorsal conical, about once and one-half as long as broad, the sides rather slightly convex, bearing 10 columns of cirrus sockets, close together, the sockets of one column alternating with the sockets of those adjacent; the columns are definitely marked, each consisting of about 4 sockets.

Cirri about 30, 13 mm. to 18 mm. long, with 30 to 35 joints; first joint short; second about as long as wide, third joint twice as long as its distal diameter; fourth to tenth joints about three times as long as the distal diameter, then gradually diminishing in length, the sixteenth and seventeenth and remaining joints being about as long as wide; the elongate proximal joints have expanded and funnel-shaped distal ends, dorsally somewhat produced anteriorly, sometimes forming a small spine, this feature becoming less marked as the joints became shorter; the fourteenth joint bears distally a sharp dorsal spine, which on the following joints progressively occupies more and more of the dorsal surface, after 4 or 5 joints arising from the entire dorsal surface; as the dorsal spines increase in extent, the ventral overlap decreases, so that ventrally the terminal joints are perfectly smooth; the opposing spine is an equilateral triangle not quite so high as the width of the penultimate joint, the apex situated slightly beyond the center of the dorsal surface; terminal claw about the length of the penultimate joint, stout, and moderately curved.

Except in the characters of the centro-dorsal and cirri, as detailed above, this species closely resembles A. angustimadia, discovered by the Challenger in the Ki Islands, and described from a specimen in practically the same condition as the type of A. tenuiipes.

Type.—Cat. No. 22677, U.S.N.M.; from Albatross Station No. 2348; off Habana, Cuba; 211 fathoms.

PSATHYROMETRA BOREALIS. new species.

Centro-dorsal long-conical, 6 mm. long by 5 mm. broad, separated into five radial areas by interradial lines which are as wide as, or slightly wider than, the columns of cirrus sockets, and are continued to the tip of the centro-dorsal; cirrus sockets in 3 columns in each radial area, 7 to 9 to a column, separated from each other by narrow lines. In general form and build this is the most slender and delicate species of the genus.

Type.—Cat. No. 22670, U.S.N.M.; from Albatross Station No. 4780; east of Agattu Island, Aleutians; 1,046 fathoms.
PSATHYROMETRA PROFUNDORUM, new species.

Centro-dorsal conical, rather long, 7 mm. long by 4.5 mm. wide, divided into radial areas by interradial lines, proximally about half as broad as the cirrus sockets, gradually becoming narrower and obsolete distally; 3 columns of cirrus sockets in each radial area, closely crowded together, with prominent edges, especially proximally. 6 cirrus sockets to a column. The calyx and lower part of the arm are rather more tuberculous than in the other known species.

Type.—Cat. No. 22669, U.S.N.M.; from Albatross Station No. 3342, off Moresby Island, Queen Charlotte group: 1,588 fathoms.

ZENOMETRA PYRAMIDALIS, new species.

Centro-dorsal long-conical, about twice as long as its width at the proximal end, bearing 5 strong interradial ridges, high proximally, becoming gradually lower and finally obsolete distally; cirrus sockets in 2 columns of about 6 each, separated by a more or less distinct ridge, in each radial area. In other respects this species is similar to Z. columnaris, but the spines on the calyx are somewhat more numerous and much longer. The pointed centro-dorsal of this species makes confusion with Z. columnaris impossible.

Type.—Cat. No. 22668, U.S.N.M.; from Albatross Station No. 2415, off Savannah, Georgia: 440 fathoms.

HIMEROMETRA SUBCARINATA, new species.

Centro-dorsal thick discoidal, the large bare polar area strongly convex, bearing about 40 cirri in two irregular rows; cirri 22 mm. long with 33–35 segments, those in the basal half of the cirrus slightly longer than wide, those in the distal half gradually becoming short and bearing prominent dorsal spines; radials just visible in the angles of the calyx; first costals short and broad; axillaries short, broadly pentagonal or almost triangular; the rays, distichals, and first 2 brachials are in close apposition and are strongly flattened laterally; distichals 2, articulated; the costals, distichals, and first 2 brachials have a very narrow, delicate, raised median line, giving them a very characteristic appearance. Forty arms, 80 mm. long; first 2 brachials slightly wedge-shaped, following 6 discoidal about half as long as wide, then becoming quadrate, and almost triangular, soon becoming quadrate again, and almost oblong distally; the third and fourth brachials are united by syzygy; the next syzygial pair occurs at from the twentieth to the thirty-sixth (usually about the twenty-fifth); the distal intersyzygial interval is from 5 to 12 (usually about 7) brachials; first pinnule slender, stiffened, 7 mm. long, with 15 segments, the first 3 squarish and strongly carinate, the fourth
trapezoidal and somewhat carinate, the remainder elongate; second pinnule 11 mm. long, with 20 segments, the first 2 short and carinate, the others elongate, about two and a half times as long as broad; third and fourth pinnules similar and equal in length, 15 mm. long, with 18 to 20 segments, the first 2 as in the second, the others elongate, three or more times as long as broad; fifth pinnule 8 mm. long, most like the first; following pinnules 5 mm. long, small and weak, becoming slightly longer distally. The elongate lower pinnules are comparatively slender, but stiff and wiry.

Type.—Cat. No. 22666. U.S.X.M.; from Albatross Station No. 4880; Sea of Japan; 59 fathoms. August 2, 1906.

OLIGOMETRA CARIBBEA, new species.

Centro-dorsal thick-discoidal, with a rather large bare polar area, and bearing 2 irregular marginal rows of cirri.

Cirri about 20 in number, 5 mm. long, with 15 to 17 (usually 15 or 16) joints; first joint very short, second rather more than half as long as broad, the remainder squarish; the second and third joints bear on their distal edge a sharp dorsal spine, which after one or two joints moves to the middle of the dorsal edge; the opposing spine is rather less than the diameter of the penultimate joint in length, and stands out vertically from the middle of the dorsal side; terminal claw not quite so long as the penultimate joint, stout, and strongly curved.

Radials visible, but very short; first costals oblong, about twice as broad as long, slightly concave anteriorly, just in apposition laterally, but not laterally flattened; costal axillaries pentagonal, about as long as broad. Ten arms, probably about 25 mm. long; first brachial wedge-shaped, the longer side out and inwardly united for about the proximal two-thirds; second brachial larger, irregular in shape; following brachials squarish, gradually becoming wedge-shaped, more oblique after the twelfth, when they are about as long as wide. Syzygias occur between the third and fourth, ninth and tenth, and fourteenth and fifteenth brachials, and distally at intervals of three bifascial articulations.

First pinnule 5 mm. long, with 6 joints, the first short, but distally produced into a rounded projection, the second rather more than twice as long as wide, the remainder greatly elongated; second pinnule similar, equally stout basally, but not quite so long; third and following pinnules 3.5 mm. long, the first two joints short (the first somewhat broader than the second), the third, fourth, and fifth somewhat expanded laterally to protect the genital glands; the distal pinnules are lacking.

Type.—Cat. No. 22676. U.S.X.M.; from Albatross Station No. 2146; off Colon, Canal Zone; 34 fathoms.
This species represents *C. manca* in the waters about southern Japan; it differs strikingly from that species in having all the cirrus joints subequal in length, the distal with only slight paired tubercles on the dorsal side. In *C. manca* the proximal cirrus joints are much elongated, the distal short, with long bi- or tri-dentate dorsal spines. The number of arms in *C. albopurpurea* varies from 10 to 30, but is most commonly about 20. The 10 armed forms differ from *C. tigrina* in being more slender, with the second pinnule more slender, and composed of much elongated instead of short joints.

*Type.*—Cat. No. 22693, U.S.N.M.; from *Albatross* Station No. 5095; Urage Straits, entrance to Tokyo Gulf, Japan; 58 fathoms.
A NEW AMPHIPOD CRUSTACEAN, ORCHESTOIDEA BIOLEYI, FROM COSTA RICA.

By Thomas R. R. Stebbing.

Before proceeding to describe a new species of Talitridae I wish to refer to a former paper on Amphipoda from Costa Rica, in which I figured and described as new *Hyalella faxoni,* pointing out its near relationship to other forms earlier described under various names. Recently, in her very interesting paper cited below, Miss Weckel has made *H. faxoni* a synonym of the species which in her opinion ought to be called *H. knickerbockeri* (Bate). The independence of *H. faxoni* is not a matter of great moment; but the question remains an open one whether it may not be more inconvenient than necessary to fuse under one name the forms of *Hyalella* which have been distinguished as *dentata* and *inermis.* Supposing that a single name is required, there are three to choose from with claims prior to Bate’s *knickerbockeri.* These are the obscure *Amphitoec dentata* Say, 1818, *Amphitoec aztecus* Saussure, 1858, and *Amphitoec andina* Philippi, 1860. The reader inclined to accept a bias in a certain direction may consult the notes on these names in the bibliography to the “Challenger Amphipoda,” 1888, as well as the references supplied by Das Tierreich in 1906.

In the Amphipoda of Das Tierreich there is an inconsistency between pages 523 and 524, the former affirming that the palp of the first maxilla is one-jointed in the family Talitridae, the latter that it is two-jointed in the genus *Talitrus.* The alternative character of “minutely two-jointed” should have been added to the description of the palp in the diagnosis of the family.

Family TALITRIDE.


Genus ORCHESTOIDEA Nicolet.


This genus agrees with both sexes of Talitrus and with the female of Talorchestia in having the first gnathopod simple, differing from the male of Talorchestia and both sexes of Orchestia in which the first gnathopod is subchelate. All the four genera have the second gnathopod in the female feebly chelate, but in the male this is the case only with Talitrus, the second gnathopod of the male in the other three genera being powerfully developed. These distinctions do not enable us to separate a species of Talorchestia or Orchestoides from one of Talitrus, when only female, nor yet an Orchestia from a Talorchestia, when only male specimens are available. But as these animals are generally plentiful, where they occur at all, any difficulty arising from the absence of one or other sex will not as a rule be of long standing under the energy of modern research.

ORCHESTOIDEA BOLORLEYI, new species.

Plate XI.

Integument smooth and shining, but under a high power showing the three-spiked markings often seen in this family. Fifth side-plate of peraeon as deep as fourth. Postero-lateral corners of third pleon segment quadrate with minute projecting point.

Eyes large, dark, roughly rounded, in the largest specimens separated only by a short space at the top of the head.

First antenna very short, third joint of peduncle rather the longest, equal to the little five-jointed flagellum. Second antenna in the male longer than the body, last joint of peduncle considerably longer than the preceding joint, flagellum 39-jointed, more than thrice as long as the peduncle; in the female much shorter than the body, flagellum 23-jointed, not greatly longer than the peduncle.

The mouth-organs are in close agreement with those of Talitrus and Talorchestia. The minute palp of the first maxillae appears to be 2-jointed, with the second joint considerably shorter than the first.

The first gnathopods, in accord with the generic character, are simple in both sexes, but in the male the rather large fifth joint has at the distal end of the hind margin a transparent bulb or bubble-like expansion, which is wanting in the female.

The second gnathopods of the male have the fifth joint very small and feebly separated from the strong ovoid sixth joint, the hind margin of which is characterized by having near the distal end a small transparent bulb, the distal end itself being rounded and tipped with a spine. Within this apex the strong finger closes into a
pocket, being fitted over a broad spinose curve of the palm, between which and the hinge it inserts a squarish projection of its inner margin into a corresponding depression of the palm. The second gnathopod of the female is of the usual membranaceous character, the second joint expanded in the proximal half, the fifth joint wider and a little longer than the sixth, which is rather strongly and not narrowly produced beyond the diminutive longitudinal finger, which lies in a setulose gap of the sixth joint’s front margin. In the male specimen from which the detail figures have been drawn one of the gnathopods of the second pair is decidedly smaller than the other and is without the transparent process on the hind margin. In another specimen, probably abnormal, the apex of the sixth joint of the second gnathopod is laterally outdrawn, obscuring its ordinary character. Only one member of the pair is present, and the specimen is otherwise defective.

The first three pereopods are short, the second shorter than the first, with its finger more strongly notched. The third pereopod has its second joint almost circular, much less in diameter than the length of the side-plate. The fourth and fifth pereopods are very much longer, the fifth having its second joint much wider than that of the fourth pair, and its total length somewhat greater. The fingers in these two pairs are long and slender, in all the pairs there is an obliquely pointed spine in advance of the unguis. All the branchial
vesicles are narrowly twisted. The marsupial plates of the female examined do not seem to be fully developed.

The slender pleopods have along the peduncles two rows of short spines and two coupling-hooks. The rami are about nine-jointed, and are scarcely as long as the peduncles.

The first uropods have the peduncle longer than the subequal rami, one of which has conspicuous spines only at the apex. The second pair have one ramus much longer than the other, with the peduncle of intermediate length. The third pair have the rami about equal in length to the peduncle. The telson is about as broad as long, distally tapering, with a dividing line running up some part of the length from the apex.

Length of male about 10 mm., of female about 7.5 mm.

Habitat.—Several specimens were collected in February, 1907, at Punta Arenas, Costa Rica (Pacific coast), in sand, under trunks of trees, by the late Professor P. Biolley, out of respect to whom the specific name has been given to this species.

Type.—Cat. No. 38343, U.S.N.M.

EXPLANATION OF PLATE XIII.

n. s. ♂. n. s. ♀. Lines indicating natural size of male and female specimens, from which the details have been figured.

♂. ♂. i. Upper and lower antennae of male.

♂. 1. First maxilla of male, the inner plate seen by transparency through the outer. The scale of magnification higher than in the other figures.

♀. 1, ♂. 2, ♂. 1, ♂. ♂. 2, ♂. First and second gnathopods of the male and female, with portions of the same more highly magnified.

♂. 1, 2, 3, 4, 5. The five pereopods, with parts of the first, second, and fifth more highly magnified.

♀. 1, 2, 3, T. The three uropods and the telson, with the latter more highly magnified.

Two uniform scales have been used for the lower and higher enlargement of all the parts except the first maxilla.
A New Amphipod Crustacean.

For explanation of plate see page 244.
DESCRIPTIONS OF NEW SPECIES OF MOLLUSKS FROM THE PACIFIC COAST OF THE UNITED STATES, WITH NOTES ON OTHER MOLLUSKS FROM THE SAME REGION.

By William Healey Dall,

Curator Division of Mollusks, U. S. National Museum.

The generosity and interest of correspondents on the Pacific coast, especially in Southern California, through small but continuous contributions, have greatly enriched the series of mollusks from the Pacific States in the collection of the U. S. National Museum. Not only has the wider geographical range of known species thus been made evident, but new species or varieties are constantly coming in as the fruit of their researches. It is probable that this may continue for some time to come, as experience has shown that the rarities of one season become commonplace residents during another, as was shown in the summer of 1907, when Calliostoma supragranosum Carpenter, previously known by half a dozen specimens collected during the last forty-five years, swarmed on the new Government breakwater at San Pedro, to the surprise and delight of collectors.

While the hoped-for manual of west coast shells is in process of preparation it becomes necessary, for the convenience of collectors, to assign names to the treasures they discover, and in order that manuscript names may not pester the bibliographer, these names must from time to time be published. The present paper is one of several by the writer which owe their existence to these conditions and record our indebtedness to the energetic amateur students of the mollusca of the region mentioned.

No region out of the Tropics appears to be richer in interesting mollusks than the Californian coast. On the Atlantic we have to proceed to the Floridian peninsula for a parallel, and even then the discrepancy in favor of California remains great. Perhaps nowhere in the world may those seeking rest or recuperation find a more congenial and comfortable opportunity, at any season of the year, for occupying themselves with what the old French conchologists called


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"La belle Science," and, at the same time, of adding solid information to that already on record.

For the data accumulated in this paper I am indebted especially, among others, to Dr. R. H. Tremper, Messrs. Herbert N. Lowe and F. W. Kelsey, and the U. S. Bureau of Fisheries.

Genus CLISTAXIS Cossmann.

Some years ago Doctor Jeffreys proposed for a deep-water species the name Cryptaria, which proved to be preoccupied by Lowe in land shells and for which Cossmann substituted Clistaxis. The shell resembles Cylichna (=Bulimina Newton), but has the spire almost concealed. Jeffreys afterwards referred to this genus a shell, C. crebripunctatus, from the Triton dredgings, which has somewhat the form of Scaphander, but with the spire, except the apex of the nuclear shell, concealed. Whether this form is of the same genus as the original type, C. pareula Jeffreys, seems doubtful, but is too complicated a question to enter upon at this time. A species related to C. crebripunctatus, and which appears to be undescribed, was collected by Prof. F. W. Kelsey, in 50 fathoms off the entrance to San Diego Harbor. Two specimens were obtained, showing that the animal is contained within the shell, where it had been allowed to dry. In contracting, the test was badly shattered, but showed very strong spiral rows of punctations. A much smaller specimen was better preserved and affords the following notes:

CLISTAXIS? POLYSTRIGMA, new species.

Shell small, white, barrel-shaped, with the posterior part of the outer lip extending slightly beyond the apex of the shell; form much as in Haminia solitaria Say: apex sunk, imperfect, the spire concealed: outer lip partly membranous and contracting in drying, the shell normally covered with a thin periostracum, which in drying splits and contracts; sculpture of close, numerous, spiral rows of emphatic punctations, covering the shell: aperture ample; outer lip thin and submembranous, its posterior extremity rounded over evenly to the suture, the anterior part not expanded: pillar lip thin, arcuate, the margin reflected, forming a gutter just outside the margin; body with little callus, only one whorl visible. Length of young shell, 2.8; maximum diameter, 2.2 mm.

Type.—Cat. No. 110649, U.S.N.M. In 50 fathoms, off entrance to San Diego Harbor, F. W. Kelsey.

The adult is at least three times the length above given. The soft parts do not envelop the shell. The dried animal shows through its translucency the bases of three white gizzard plates which it is impossible to extract owing to the fragility of the shell. It is possible, however, to see that the plates are long, narrow, straight, parallel-
sided, and very large for the size of the animal. The plates in *Haminea* are quite different, so that, notwithstanding the general similarity of the shells, the present species can not be referred to the genus *Haminea*.

**Genus PEDIPES Scopoli.**

PEDIPES LIRATUS W. G. Binney.

This species was described from Cape St. Lucas, and many years later was collected near San Diego by C. R. Orcutt. Professor Kelsey now carries its northern limit to the village of La Jolla, on the seashore north of San Diego.

**Genus TURRIS Bolten.**

(*Pleurotoma* Lamarck.)

**Section ANTIPLANES Dall.**

TURRIS (ANTIPLANES) DIAULAX, new species.

Shell small, acute, conic, brownish, with about nine whorls; suture distinct, not appressed; surface smooth, except for incremental lines and two impressed shallow spiral channels near the periphery of the whorls; the surface just behind each channel is slightly raised, forming a flattish band about as wide and high as the channel is wide and deep: on the base and canal there are also some faint spiral threads; the sides of the spire are flattish, the periphery nearest the succeeding suture, which is laid on the anterior edge of the anterior channel, thus giving the whorls a sort of overhang in appearance; aperture short and rather narrow; outer lip sharp, simple, produced; anal sulcus narrow and rather deep, situated just behind the posterior channel; body without callus; canal short, wide, recurved; pillar lip arcuate, smooth. Height of shell, 19.0; of last whorl, 10.0; of aperture, 6.5; maximum diameter, 6.5 mm.

**Type.**—Cat. No. 110609, U.S.N.M. U.S.S. Albatross station 2931, off Los Coronados Islands, near San Diego, California, in 34 fathoms, sand.

This is quite a well-marked species, and differs from most of the others in its group in its stronger spiral sculpture.

There is a group of forms on the Pacific coast which have been referred by Carpenter to *Drillia*, in which usage he has naturally been followed by the collectors and students of the fauna. This group comprises "*Drillia* inermis* Hinds, D. incisa* and *D. cancellata* Carpenter, and the following species. Under *Pleurotoma*, *P. inermis* Hinds, 1844, is preoccupied by *P. inermis* Partsch, 1843; *P. cancellata* J. Sowerby, 1827, and about half a dozen others antedate *P. cancellata* Carpenter, 1863. For *inermis* Hinds, I would propose the specific name *ophioderma*, and for *cancellata* Carpenter, the
All belong to the subgenus *Surcula*, though not to its typical group. The following form is close to *P. ophioderma*, and for some time was regarded as a slender variety of it. The examination of a number of specimens and their constancy in character lead to the conclusion that it is a distinct species.

**Turris (Surcula) Halcyonis. new species.**

Shell small, slender, very acute, of a livid purple covered with an olivaceous periostracum, with about eleven whorls; nucleus more or less eroded, but apparently smooth, acute, and including about two and a half whorls; subsequent whorls rather flat, compressed and appressed at and in front of the suture, with a rounded base and inconspicuous anal fasciole; sculpture chiefly of flattish spiral threads, one at the suture, three smaller ones in front of it, followed by a flat broader one representing the fasciole, then (on the last whorl eight) more prominent threads, undulate or segmented by incremental lines and with wider interspaces (sometimes containing an intercalary smaller thread) to the base, followed by six or seven unsegmented threads to the siphonal fasciole, which bears six or seven smaller threads; the succession of undulations or slightly swollen segments gives a slightly cancellate effect to the part of the whorl which bears them, but there are no axial ribs, the effect being produced rather by depressions between the rather coarse incremental lines; aperture narrow, acute behind, the anal sulcus narrow and distinct but not very deep, the outer lip in front of it arcately produced, the canal contracted, short, and recurved; inner lip polished and superficially erased; the pillar twisted, with a thin layer of callos; operculum present as in *T. ophioderma*. Height of shell 23.0; of last whorl, 12.5; of aperture and canal, 8.0; maximum diameter, 7.0 mm.

*Type.—Cat. No. 110644, U.S.N.M. Off Coronado Beach, San Diego, in 10 fathoms. Professor Kelsey: San Pedro. various collectors.*

**Genus Acanthina Fischer.**

(Monoecos Lamarck.)

Acanthina Lapilloides Conrad. new variety *Aurantia* Dall.

The usual color of *A. lapilloides* is grayish, with a bluish or purplish tone and small brown maculations, but Dr. R. H. Tremper has collected an orange-yellow color variety on rocks at San Pedro which almost exactly mimics the yellow form of *Purpura (=Thais Bolten) decemcostata*. It is slightly smaller on the average than the ordinary *lapilloides*, with the interspaces of the spiral threads prettily lamellose axially and more or less articulated with blackish
brown small spots. Adults measure about 18 mm. in length and have the interior of the outer lip thickened and with six or seven well-marked denticulations.

_Type._—Cat. No. 199893, U.S.N.M.

**Genus Tritonofusus** Beck.

_Tritonofusus_ (Plicifusus) _Kelseyi_, new species.

Shell elongate, slender, acute, the spire much longer than the aperture; white, covered by an olivaceous periostracum; having ten whorls exclusive of the (eroded) nucleus of about two whorls; suture appressed and the whorls slightly constricted in front of it; axial sculpture of (on the seventh whorl about 12) concavely arcuate, slightly protractive, low narrow ribs, crossing the whorls, on the later whorls becoming obsolete and finally absent from the last whorl altogether; the interspaces are wider than the ribs; these are crossed by fine sharp spiral striae, somewhat irregularly spaced, of which there are about a dozen on the seventh whorl, a narrow space before the suture being less sharply or not at all striate; aperture narrow, outer lip arcuate, somewhat excavated near the suture and produced anteriorly, slightly thickened, simple, and internally smooth; inner lip smooth, with the sculpture erased, passing gradually into the long straight pillar, which is attenuated in front; canal long, narrow, straight; length of shell 34.0; of last whorl 18.5; of aperture 14.5; maximum diameter 8 mm.

Fossil in the Pleistocene of San Pedro, California, Eshmaur.

_Type._—Cat. No. 110631, U.S.N.M. Dredged by the U. S. Fisheries steamer _Albatross_ off San Diego in 124 to 359 fathoms, bottom temperature 49° F. (young specimens); dredged in 50 fathoms off San Diego, Prof. F. W. Kelsey (adult).

This species is closely related to _T. rectirostris_ Carpenter, which is less slender, with more numerous and persistent ribs, and spiral threading instead of striae. The latter is also a larger shell when full grown.

**Genus Boreotrophon** Fischer.

(Neptunea Bolten.)

_Boreotrophon Bentleyi_, new species.

Shell small, slender, acute, ashy white, with about seven whorls; nucleus with the surface eroded; suture distinct, the whorl in front of it somewhat tabulated by an obscure angle from which the spines arise; axial sculpture, besides incremental lines, only of about (on the last whorl) ten sharp depressed lamellar varices, prominent only behind the periphery and feeble on the base; at the shoulder these are produced into high, usually recurved, guttered spines,
which in some cases are nearly straight, in others curved toward the preceding whorl until they may even touch it; aperture ovate, canal long, slender, slightly recurved. Height, 19.5; of last whorl (without the spines), 14.5; of aperture and canal, 11.5; maximum diameter, 6.5 mm.

*Type.*—Cat. No. 110648, U.S.N.M. Dredged by Professor Kelsey off the entrance to San Diego Harbor in 20 fathoms mud, and at his request named in honor of Dr. Charles S. Bentley, resident naturalist of the San Diego Biological Station.

This is nearest to *B. avalonensis* Dall, but is more slender, with one or two more varices to the whorl, and is a more elegant shell. There are faint indications of spiral lineation, coarser toward the periphery and finer near the angle of the shoulder. From the variation in other species of *Boreotrophon* I conclude that the curvature of the spines is only an individual character, though the extremes are strongly contrasted.

**Genus COLUMBELLA** Lamarck.

**Subgenus ANACHIS** Adams.

**ANACHIS PETRAVIS**, new species.

Shell minute, blunt, solid, varicolored, chiefly purplish or flesh color, but distributed much like the colors on *Amphissa versicolor*, either solid or in pattern: whorls about six, the nucleus including two of these which are smooth, polished, swollen, and apically blunt; suture distinct, appressed, the whorl in front of it (the last whorl) slightly constricted; sculpture of (on the last whorl about 16) small, subequal, rounded, slightly flexuous ribs, distally protractive, and with narrower, microscopically faintly spirally striated interspaces: the last whorl terminates in a pale-colored thickening, or indistinct varix; aperture and canal very short and wide; outer lip internally with a few indistinct fine; pillar smooth, obliquely attenuated in front. Height, 4.5; last whorl, 2.0; aperture, 1.4; maximum diameter, 1.7 mm.

*Type.*—Cat. No. 110645, U.S.N.M. Under stones at Bird Rock, off San Diego, California. F. W. Kelsey.

This species, in miniature, is extremely similar to *C. (Anachis) minima* Arnold, from the Pleistocene of San Pedro, California. Arnold’s name being several times preoccupied, I would substitute for it *C. (A.) arnoldii*.

**Genus OPALIA** Adams.

**OPALIA (DENTISCALA) MAZATLANICA**, new species.

Shell small, slender, white, the porcellaneous layer subtranslucent, the surface layer very thin opaque white; nucleus smooth, of about a whorl and a half, blunt, and followed by five or six sculptured
whorls which become more and more rounded and constricted in front of the suture; suture distinct, with (on the last whorl 20) small milk-white points coronating it and separated by small pits corresponding to the interspaces between the ribs; whorls smooth, or with obsolete indications of arcuate ribs which show by their more opaque whiteness faintly against the translucent under layer; basal disk hardly perceptible, not angulating the whorl, but traceable by the row of faint indentations which bound the obsolete margin; surface originally covered with a microscopic reticulation of revolving and vertical lines impressed on a very thin chalky layer; base produced; aperture simple, surrounded by a thick white callous margin, the opening obovate. Height of shell, 12; of last whorl, 6; of peritreme, 3.5; maximum diameter, 4.0 mm.

Type.—Cat. No. 168669, U.S.N.M. Mazatlan, Mexico.

The type-specimen is somewhat worn and polished, but shows the minute sculpture in sheltered places.

**OPALIA (DENTICALCA) MEXICANA**, new species.

Shell small, slender, white, opaque, with two nuclear smooth whorls and seven subsequent whorls; nucleus very small, blunt; subsequent whorls moderately rounded; suture distinct, with nine coronating points separated by deep and conspicuous pits; the ribs corresponding to the points are wide and thick but obsolete on the periphery, appearing again near the margin of the basal disk, where they are separated by shallow but distinct depressions; surface microscopically sculptured by sharp revolving lines reticulated by somewhat fainter incremental lines; basal disk slightly flattened, its periphery slightly angulating the whorl; aperture nearly circular, surrounded by a thick, slightly reflected peritreme. Height of shell, 11; of last whorl, 5; of peritreme, 2.7; maximum diameter, 4.0 mm.

Type.—Cat. No. 59336, U.S.N.M. Acapulco, Mexico; W. H. Dall.

This is easily distinguished from the preceding by the smaller number and greater strength of the ribs. *O. mazatlanica* is more like *O. hotessieriana* Orbigny, of the West Indies than any other west American species known to me.

**Genus EPITONIUM** Bolten.

(*Scaluria* Lamarck.)

**EPITONIUM (CRISPOSCALA) ACROSTEPHANUS**, new species.

Shell slender, acute, turrited, with two nuclear and nine or more subsequent whorls which are in contact, though separated by a deep suture across which the varices are continuous; axial sculpture of (on the last whorl 14) nearly vertical, thin, sharp, slightly reflected varices, which are expanded near the suture into a small
lamella of which the posterior corner, when intact, bears a small sharp spine, behind which the varix is much attenuated and turns into the suture, which it crosses and becomes connected with one of the varices of the preceding whorl; the anterior face of the varices is concentrically sharply striate, and the portion which approaches the center of the base is slightly flattened, although there is no basal disk or perforation; the space between the varices is smooth and polished, but under a lens shows traces of faint spiral striation, more or less irregular; the aperture is rounded-ovate, the peritreme thin and like the preceding varices; the operculum is thin, of about three whorls, concave and centrifugally striated, of a pale horn color. Height of shell, 20; of last whorl, 8.5; of peritreme, 4.5; maximum diameter, 6.5 mm.

Type.—Cat. No. 110638, U.S.N.M. Range from Monterey, California, south to the Coronado Islands near San Diego. It has been dredged in depths from 16 to 34 fathoms. The type-specimen was collected by Mr. H. N. Lowe, who dredged it at Newport, California.

This is a not uncommon species in the dredgings, though usually smaller than the dimensions given above. It may be distinguished from *E. subcoronatum* Carpenter by its more crowded, higher and minutely lamelllose or striated varices which from the posterior expansion give the whorls a tabulate appearance.

**EPITONIUM (CRISPSCALA) CATALINÆ, new species.**

Shell slender, white, turrited, imperforate, with more than seven adherent whorls; nucleus (lost); suture distinct, closed; varices (on the last whorl 14) continuous, making nearly one revolution around the axis in ascending the spire; they are flatly reflected, axially striate, subspinose at the shoulder, giving a tabulate aspect to the rounded whorls. There is no basal disk on the whorl, but on the basal part of each reflection of the varices there is a smooth area over which the suture travels, and which, taken collectively, gives the effect of segments of a disk imposed on the varices but not on the whorl; below the shoulder the varices are widely reflected, extending for a space to the angle of reflection of the preceding varix, where it would seem these extensions are normally attached, covering a hollow space between them and the whorl, but in the type-specimen most of these extensions are broken away; aperture subcircular. Height of (decollate) six whorls, 12.0; of last whorl, 6.0; of aperture, 2.7; maximum diameter, 4.5 mm.

Type.—Cat. No. 198628, U.S.N.M. Off the south side of Catalina Island, California, in 16 fathoms, mud, near the entrance to the small harbor: W. H. Dall.

This is a very interesting species, which if perfect might have, from the fusion of the varices, much the aspect of a *Cirsotrema*. 
Genus *EULIMA* Risso.


Shell slender, acute, flat-sided or nearly so; chalky white, with an extremely thin yellowish external coating; nucleus eroded; subsequent whorls very slightly convex, with an obscure peripheral angle on the last whorl, upon which the suture of the advancing whorl is closely appressed; surface smooth and polished except for very obscure and minute spiral lines only visible in good light with a lens; base convexly rounded, imperforate; aperture ovate-quadrato, the outer lip simple, thin, gently arcuate; the body bare, the pillar almost straight, twisted and with a very obscure prominence like an obsolete plait: an examination of the interior of the upper whorls, however, shows no plication; anterior of aperture gently rounded; there are no indications of varices or resting stages on the spire. Height of shell, 20.0; of last whorl, 10.0; of aperture, 6.5; maximum diameter, 7.0 mm.

*Type.*—Cat. No. 110652, U.S.N.M. U. S. Bureau of Fisheries Station 4354, sixteen miles off Point Loma, San Diego, California, in about 650 fathoms mud; bottom temperature about 39° F.

This is a very peculiar shell, which so combines the aspect of a Pyramidellid and a *Eulima* that I feel uncertain as to its permanent place in the system. The nucleus is eroded, but seems to have been dextral. The surface recalls that of *Amaura* rather than *Eulima*, as does the texture of the shell, but this may be due to incipient decay. There is no plait on the pillar, but it has an obsolete twist unlike anything I have noted in typical *Eulima*. Nevertheless it has the external form and general characters of the latter genus, to which for the present it is provisionally referred. It may eventually prove to be a giant *Aelis*, though all the certainly identified *Aelides* from deep water I have examined have much more rounded whorls and constricted sutures. A shell called by Locard *Mesalia flammeifera*, from the *Talisman* expedition, has a similar outline, but has a pronounced basal keel and pattern of coloration.

Genus *ODOSTOMIA* Fleming.

*ODOSTOMIA (EVALEA) ATOSA*, new species.

Shell small, bulimiform, bluish white, polished, with four gently convex whorls beside a very minute (and somewhat eroded) nucleus of about one whorl; suture distinct, not appressed; surface with two or three faint spiral threads on the second, four or more on the third, becoming obsolete on the last whorl, subequally distributed between the sutures; beside these there are numerous extremely fine spiral striae only visible under a lens, and which also become obsolete toward
the aperture: aperture subovate, acute behind; outer lip simple, sharp; anterior margin gently rounding into the areolate pillar lip, which has a single strong plait close to the body; a thin wash of transparent enamel on the body; axis imperforate; operculum thin, paniculate, pale yellowish. Height of shell, 6.25; of last whorl, 5.0; of aperture, 3.25; maximum diameter, 3.7 mm.

Type.—Cat. No. 110637. U.S.N.M. San Pedro, California, on Haliotis, collected by Mr. H. N. Lowe.

This is one of a group of closely related species occurring in Southern California; it differs in detail from any of the others, but most obviously in its form, which, in miniature, recalls Bulinus ovatus Brug.

Genus TRICHOTROPIS Broderip.

TRICHOTROPIS KELSEYI, new species.

Shell small, whitish, with a velvety pale-olive periostracum and three and a half whorls; spire very short; suture very deep, not channeled, but with the whorl in front of it elevated so as to make a shallow V-shaped trough; nucleus large for the size of the shell, turgid, not distinctly marked off from the rest of the shell; sculpture of fine, even, rounded, closely adjacent, spiral threads, a little more distant on the base, absent from the trough of the suture, with about 22 between the suture and the rim of the umbilical funnel; axial sculpture only of incremental lines; last whorl much the largest, rounded, produced basally, with a deep narrow funicular umbilicus, bounded by a rounded ridge corresponding to a siphonal fasciole; aperture semilunate, rather narrow, produced and almost channeled in front; outer lip thin, areolate, simple, sharp, not reflected; pillar lip thin, straight, sharp, elevated, connected across the body by a thin layer of callus with the outer lip; pillar absolutely smooth and simple, without any trace of plaits; operculum wanting? Height of shell, 6.2; of last whorl, 5.5; of aperture, 3.5; maximum diameter, 4.0 mm.

Type.—Cat. No. 110653. U.S.N.M. U. S. S. Albatross Station 2936, off San Diego, California, in 359 fathoms, mud, bottom temperature 49° F. Also off the entrance to San Diego Harbor, in 80 fathoms: Prof. F. W. Kelsey.

This curious little shell would have been referred to the genus Cancellaria were it not for the total absence of columellar plaits. The type-specimen contains what seem to be the dry remains of the animal, but there is no indication of an operculum, which possibly might have sealed off in drying, but probably was never present. I find the Arctic species of Iphinoë have an operculum like other
Trichotropis. On the other hand, the species of Cancellaria most like the present shell, such as C. cumingiana Petit, have strong plaits and hardly any umbilicus in the very young stages, while their nucleus is of entirely different construction, the initial whorls being very minute, glassy and rather numerous, while the corresponding part of the present shell is chalky, swollen, and completes barely a single turn. I have not seen the unfigured *Alora* Adams, of which the type has an elevated spire, cancelled and lamellose whorls and small umbilicus with the pillar lip anteriorly somewhat reflected, but the diagnosis does not sound as if the present shell belonged to it.

Genus PHASIANELLA Lamarck.

Subgenus EULITHIDIUM Pilsbry.


This little group of depressed turbinates species extends farther north in America than the *Tricolia* group, and is represented in North Carolina on the east and Vancouver Island on the west coast of America, extending south to San Sebastian Island, Brazil, and to Peru, respectively.

The East American species are *E. brevissimum* Pilsbry (=*brevis* C. B. Adams, not Orbigny). *E. concolor* C. B. Adams, and perhaps *E. minutissimum* C. B. Adams.

On the Pacific Coast we have *E. variegaturn* Carpenter (not *Phasianella variegata* Lamarck), which may take the name of *E. typicum*, as the specific name is preoccupied, as already noted by Pilsbry: *E. substriaturn* Carpenter, originally described as a variety of the preceding species, but shown by more and better specimens to be quite distinct: *E. cyclostoma* Carpenter: *E. striaturn* Carpenter: *E. minimum* Philippi, and *E. luridurn* Dall. *Phasianella perforata* Reeve, not Philippi, *P. petiti* Craven, *P. minieri* Velain, and *P. tessellata* Potiez and Michaud, so far as may be judged from figures, also belong to *Eulithidium*. *Phasianella punctatura* Carpenter, not Risso, appears to be a *Tricolia* and may take the specific name of *Carpenteri*. Apparently Carpenter referred it to *Eucosmia* because it is umbilicate, like *P. pulchella* Adams, of the West Indies, but the species of *Eulithidium* are by no means all umbilicate. I have not seen *P. phasianella* C. B. Adams and *P. striaturn* Carpenter, which are referred to *Eucosmia* in Tryon's Manual.
PHASIANELLA (TRICOLIA) COMPTA Gould, new variety PRODUCTA Dall.


This is distinctly more elevated and slender than the typical form of the species, and, while the color pattern is very similar, the color is, in all the specimens seen, decidedly darker and more olivaceous.

**Genus TEINOSTOMA** A. Adams.


**TEINOSTOMA POLITUM** Adams.

St. Elena, Costa Rica, in 8 fathoms, Cuming: La Paz, Gulf of California, on the beach with hermit crabs, L. Belding.

This new locality extends the range of the type species a long distance to the northward.

**Genus FISSURELLA** Bruguière.

*Fissurella volcano* Reeve, new variety CRUCIFERA Dall.

*Fissurella volcano* Reeve, Conch. Icon. *Fissurella*, fig. 2. 1849.—Pilsbry, Man. Conch., XII, 1890, pl. lxx, figs. 16, 17, 18.

A peculiar color-variety of this species has been sent to me from the Pacific coast a number of times in the hope that it was something new, and it seems worthy of a varietal name. The shell is as usual, except in color, the ground color being a brownish gray, with darker maculae, while from the apex start four broad white rays at right angles to each other, the posterior ray rapidly becoming V-shaped, the others remaining entire, each ray reaching four or five millimeters in length, and the anterior and posterior rays being in the longer axis of the shell.

*Type.*—Cat. No. 199171, U.S.N.M.

A specimen from San Pedro, U. S. National Museum, 199171, may serve as a type of the variety, which also occurs at San Diego and on the Lower California peninsula.

**Genus YOLDIA** Möller.

Section SCISSULA Dall.

*Yoldia ensifera*, new variety PLENA Dall.

This species in its typical form is abundantly distinguished from the *Y. scissurata* Dall (which is the common Arctic species usually named *Y. lanceolata* in collections), especially by its form and the prominent blades upon the posterior dorsal margins, which are three times the size of the same parts in the Arctic species. The peculiar
grooving of the valves in ensifera is comparatively feeble, toward the ends especially, compared with that of scissurata, which is not only stronger but covers the whole valve except a small portion near the posterior end, while in ensifera both ends are usually free from grooves; but Professor Kelsey has dredged in 80 fathoms, off the entrance to San Diego Harbor, a variety which, while agreeing in form and hinge characters with ensifera, has the grooving extended to within 6 millimeters of the posterior extremity and over the whole anterior end in specimens 28 millimeters long, all of the specimens showing similar extension of the sculpture, while a large series from San Pedro to the Aleutian Islands does not afford a single instance of such extension. It seems, therefore, that the difference is marked enough to constitute a namable variety which may take the name of plena.

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NEW SPECIES OF CRETACEOUS INVERTEBRATES FROM NORTHERN COLORADO.

By Junius Henderson,
Curator of the Museum of the University of Colorado, Boulder

In working over collections of fossils recently made in northern Colorado by expeditions from the University of Colorado several species were found which are new to science. The types have been presented to the United States National Museum, and they are hereinafter described. The Acanthoceras is frequently found in a fragmentary condition at Left Hand Creek, a few miles north of Boulder, in the thin limestone bands which uniformly occur in the upper part of the Fort Benton shales along the base of the eastern Colorado foothills. The others came from the sandstone of Fossil Ridge, between Loveland and Fort Collins, which appears to be a continuation of the Hygiene sandstone described by Doctor Fenneman, occupying a position at about the base of the middle third of the Fort Pierre shales. The fauna of this sandstone is highly interesting. It includes about fifty species, quite a number of which have been reported from no other locality. Though the sandstone is so far down in the Pierre, a large proportion of the species are found also in the Fox Hills sandstones either in Colorado or in the upper Missouri and Yellowstone regions. A paper discussing this sandstone and its fauna has just been published.

ACANTHOCERAS COLORADOENSIS, new species.

Plate XIII, figs. 10, 11.

Shell discoidal; whorls convex, oblong in cross-section, their height greater than width; umbilicus well defined, about equal to the greater diameter of the outer whorl; abdomen rounded, ornamented by two rows of sharp, longitudinally compressed nodes, each about midway between the medial line and the peripheral margin; each side of whorls ornamented by two other sets of nodes, one at the margin of the umbilicus, the other near the abdomen; nodes of all four sets connected by costa which nearly encircle the whorls, some curving slightly but mostly passing somewhat forward in a straight diagonal.

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line as they pass from the umbilicus to the abdomen, the greater axes of the lateral nodes being parallel with the costae, while the greater axes of the abdominal nodes are at right angles to the costae; costae about as strong in proportion to size of whorl on the smallest whorl found exposed as on the largest whorls and the nodes develop at an early stage; septa can not be figured from the specimens at hand; diameter of the type specimen 80 mm., outer whorl 31 mm. high and 14 mm. wide between the nodes, some fragments being larger than this.

The type now in the U. S. National Museum (Cat. No. 30877) and quite a number of more fragmentary specimens in the University of Colorado were found by Prof. D. W. Spangler, of Longmont, Colorado, and the writer. 10 miles north of Boulder in one of the limestone bands of the upper Fort Benton shales, associated with *Inoceramus labiatus* and other Benton species.

**VOLUTODERMA CLATWORTHYI**, new species.

Plate XIII. figs. 1, 2.

Shell of medium size, spindle-shaped; spire elevated, less than aperture in length above the complete last whorl; whorls about seven, convex, the inner casts of the upper ones roundly so, the lower ones somewhat flattened above and below the peripheral nodes; suture distinct but not deep in the shell, though very deep in the internal cast; last whorl and next one above it have a broad, shallow sulcus just below the suture, due in part to the prominence of the row of nodes below, but not entirely so, as shown by the general flattening of that part of the inner cast; surface rough, ornamented by thirty or more strong, rounded, nearly equal revolving ribs, crossed by about fourteen strong, rather irregular, doubly-curved vertical costae, which develop into elongated nodes as they pass over the periphery, revolving and vertical costae both becoming nearly obsolete above the nodes on the type-specimen and a smaller one, but on a fragment of a larger specimen which probably belongs to this species there are weaker and more crowded revolving ribs above the nodes and a tendency toward the intercalation of additional ribs below the nodes; inner casts of the three lower whorls have protuberances corresponding to the nodes, but none corresponding to the revolving ribs; aperture elongated, widest above the middle; length of type specimen about 65 mm., greatest breadth 27 mm. In general form (which, however, is variable in the genus), the cancellated sculpture of intersecting costae developing into nodes at their intersections, the unglazed surface, the rather thick shell, conspicuous lines of growth and nearly straight pillar, this species shows its close relationship to the genus *Rostellites* Conrad as defined by Doctor
Dall. The same author has since shown that name to be preoccupied, and has accepted Gabb’s later name for the genus. In the only specimen of the present species yet found which preserves the beak the columellar plaits can not be detected, after cutting into the aperture as far as possible without risking the destruction of the specimen. The protoconch is also unknown. Therefore its assignment to this genus is tentative, though there is but little doubt about it. Among American species of _Volutoderma_, variously described as _Volutilithes_, _Rostellites_, _Scobinella_, _Fulgyvaria_, and _Volutoderma_, in general outline it agrees most nearly with _V. willistonii_ Logan from the Benton group of Kansas, but not in the shape of the whorls. The somewhat more angular periphery of the body whorl and greater proportionate length above the aperture distinguishes this shell from _V. ambigua_ Stanton, _V. dalli_ Stanton, _V. abbotti_ Gabb, and _V. gabbii_ White. In the former particular it is easily distinguished from _V. gracilis_ Stanton. From _V. dilleri_ White it differs greatly in the character of the costa. From _V. suciana_ Dall (= _V. navarrocensis_ of Whiteaves) it differs in its more angular outline and more numerous revolving ribs. From _V. bispinata_ Gabb it differs in the flattening of the body whorl above the nodes. _V. protracta_ Dall, _V. tecana_ Conrad, _V. nasutus_ Gabb, _V. angulatus_ Whitfield, _V. texturatus_ Whitfield, _V. biconatus_ Whitfield, and _V. ovatus_ Whitfield are mostly much narrower in proportion to height, with longer apertures, and usually have decidedly shouldered whorls.

The type and the large fragment hereinbefore mentioned, both now in the U. S. National Museum (Cat. No. 30878), and a smaller specimen in the University of Colorado cabinets, were broken from hard concretions in the sandstone member of the Fort Pierre Cretaceous at Fossil Ridge, about 7 miles south of Fort Collins, Colorado, by Mr. H. W. Chitworthy.

**CAPULUS SPANGLERI, new species.**

Plate XIII, figs. 5–7.

Shell of moderate size, length from apex to extreme margin of aperture a little less than width: spire curves strongly backward and twists to the left: aperture transversely and irregularly elliptical: surface ornamented by ten or twelve very prominent ridges radiating from the apex downward to the aperture, more crowded in front than at either side and only one or two faint ones behind in the excavation beneath the apex: otherwise the excavation is smooth except for the fine growth lines which are visible without a lens: height of the larger specimen measured vertically with the apertural margin in a horizontal position 17 mm., width of aperture 33 mm., length of aperture 28 mm., distance from apex to farthest margin of aperture.
32 mm. Prof. D. W. Spangler found one specimen and Mr. G. S. Dodds found another, both in the sandstone member of the Fort Pierre Cretaceous in Fossil Ridge, about 6 miles south of Fort Collins.

The type is now in the U. S. National Museum (Cat. No. 30879) and the cotype in the University of Colorado cabinets. A juvenile example found by the writer at the same place shows that the apex is rather sharp.

**ANATINA DODDSI, new species.**

Plate XIII, figs. 3, 4.

Shell of medium size, transversely ovate in outline, rather shortly rounded behind and more broadly so in front, very thin; posterior end gaping, gently contracted above and below to the meeting of the valves on the dorsal and ventral margins; dorsal margin deeply excavated immediately behind the beaks and slightly concave immediately in front, thence sloping gently away and rounding somewhat abruptly into the anterior margin; basal margin forming a broad curve, subemarginate as a result of the broad sulcus in each valve; beaks rather prominent, behind the middle, incurved and almost touching; valves moderately convex, greatest convexity behind the medial sulcus; surface marked by strong, rounded, equidistant concentric undulations which nearly disappear on the posterior half, the interspaces of about the same width as the undulations; growth lines on and between the undulations visible without a lens, giving the undulations a rather irregular appearance; sides of valves divided by a broad, shallow sulcus extending from the beaks to the ventral margin, in and behind which are a number of sharp raised lines radiating from the beaks, some prominent, others indistinct; length of type, restored by comparison with other examples, about 50 mm., height 35 mm., convexity of both valves united 17 mm. This shell closely resembles *A. sulcata* (Shumard) Whiteaves in outline, but differs from the latter in the somewhat narrower posterior margin, the proportionately broader sulcus, and in the radiating raised lines which are observed on all of our examples from three different localities and three horizons. The latter feature is not mentioned by Shumard or Whiteaves in their descriptions of *sulcata*, but White has described and figured a specimen from Sucia Island which bears *impressed* radiating lines, thus being the exact reverse of ours in this respect. A very young specimen is much more pointed both before and behind.

Mr. G. S. Dodds and the writer found the type-specimen, now in the U. S. National Museum (Cat. No. 30880) and another in the sandstone member of the Pierre Cretaceous at Fossil Ridge, 7 miles
south of Fort Collins, Colorado, the small one at the same horizon 6
miles north of Fort Collins, two medium examples in the bluffs
southeast of Windsor just below what is usually considered the di-
viding line between Pierre and Fox Hills strata, and another south-
west of Windsor at a slightly lower horizon. All but the type are
in the University of Colorado cabinets.

**Serpula Markmani**, new species.

Plate XIII, figs. 8, 9.

Tube irregular in form, sometimes abruptly bending, perfectly
circular in cross-section, tapering rapidly enough for the detection
of the larger and smaller ends of specimens only 5 mm. in length.
Outer surface of the larger specimens roughened by irregular, inter-
rupted transverse ridges, some of the larger ones appearing to encircle
the tube and possibly all doing so obscurely; no growth lines visible;
inside of tube perfectly smooth, showing no traces of the ridges or
other roughness, so that the surface of inner casts, though composed
of fine grains of sand, are as smooth as glass; walls of the tube rather
thin, exhibiting two layers, the inner one of much darker color than
the outer; tubes often attached to each other for considerable dis-
tances, but none found attached to other organic remains; length of
largest example 45 mm., diameter at larger end 6 mm., at smaller end
4.5 mm., while another example having the same diameter at the
respective ends is only 30 mm. long, thus showing much more rapid
tapering. Though fossil *Serpula* do not show characters of much
specific value, this species seems to be distinct from any American
Cretaceous species yet described, and can not be readily confused
with any except *S. plana* Logan from the Benton group of Kansas,
which it would certainly closely resemble if preserved under the
same exact conditions. The species is common in the sandstone mem-
er of the Pierre Cretaceous in Fossil Ridge from 5 to 7 miles south
of Fort Collins, Colorado, and less common at the same horizon 6
miles north of Fort Collins, but being fragile and occurring only in
hard concretions it is almost impossible to obtain perfect specimens.
I have seen none which appears to show either extremity. I have
named this in acknowledgment of the services of Mr. Harvey Mark-
man on the expedition which brought it to light.

The types are in the U. S. National Museum (Cat. No. 30881) and
many other specimens in the University of Colorado cabinets. In
Monograph XXVII of the U. S. Geological Survey a *Serpula* is
mentioned as occurring in the lower Pierre of the Denver Basin,
which may possibly be of this species, but it has not been described
and I have not seen it.

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*a* Page 78.
EXPLANATION OF PLATE XIII.


3-4. Anulina doddsi, new species. Cat. No. 30880, U.S.N.M. Two views of the type. Fig. 4 is slightly less than natural size.


8. Serpula markmani, new species. Cat. No. 30881, U.S.N.M. A small nearly straight specimen with a smaller tube attached, slightly less than natural size.


New Cretaceous Invertebrate Fossils from Colorado.

For explanation of plate see page 264.
SOME CASES OF ABNORMAL ARM STRUCTURE IN RECENT CRINOID S.

By Austin Hobart Clark,
Of the United States Bureau of Fisheries.

Several cases of abnormal arm structure among the recent crinoids, especially the comatulids, have been recorded by Dendy, Bateson, W. B. and P. H. Carpenter, Chadwick, and Sars; and it is the object of the present paper to put on record some additional cases which have recently come under the author's observation.

Rhizocrinus lofotensis M. Sars. Although Sars has shown that this species in the Lofoten Islands varies in the number of its arms from four to seven (recording, out of a total of seventy-five specimens, thirty-two with four, six, and seven arms, and forty-three with the normal five) those recorded from the American side of the Atlantic have all been five-armed. I have a specimen before me, however, from Albatross Station No. 2666, 30° 47' 30'' north latitude, 79° 49' 00'' west longitude (between the Bahamas and Cape Fear, North Carolina), 270 fathoms, which has six arms, showing that this variation, though comparatively rare, does occur on the American coast.

Pocilometra acosta (P. H. Carpenter). The only specimen of this species which was dredged by the Albatross off southern Japan has a third costal inserted between the normal two on one of the rays (fig. 1), as was the case in a specimen of Thaumatometra alternata dredged by the Challenger just north of New Guinea. The radials in this specimen are entirely hidden by the centro-dorsal. Mr. Frank Springer, in his monograph on Uinctocrinus, figures a specimen of U. socialis (Plate III, fig. 2) with four costals on one ray, an additional pair being inserted between the normal costals and the first brachials; from the shape and proportions of these additional costals in this specimen one might almost infer that they were united by syzygy, in which case the costal series would be directly comparable to the distichal series in comatulids with 4 \((3 + 4)\) distichals; the

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presence of $4 (3 + 4)$ costals has only once been detected, but there is no reason to believe that it does not more or less commonly occur.

*Himereometra stylifer* (A. H. Clark). (Fig. 2.) A specimen of this species from Kagoshima Bay, Japan, has one arm (arising on the inner side of an exterior palmar axillary) which divides at the sixty-fifth free brachial; this axillary joint bears a pinnule on the left side; on its distal faces it bears two brachials, that on the right side bearing a pinnule externally, that on the left with none; these are followed each by a syzygial pair, which, like the preceding joints, are interiorly united: that of the left-hand side bears a pinnule on its interior distal corner; the following joints on each arm are normal, and bear pinnules alternately, as usual, except that the pinnule of the second joint beyond the syzygial pair on the left side is only visible in ventral view, being forced from its usual position by the basal joints of the pinnule of the left syzygial pair, which have grown fast to its lateral border. In a dorsal view, it is seen that the left-hand arm continues the arm anterior to the axillary forward almost in a straight line, while the right is at a considerable angle; this is especially evident from an examination of the ambulacrum on the ventral side of the arm. From the presence of a pinnule on the axillary and on the opposite side one of the following joints, it is clear that this is an arm division in no way homologous to the arm division resulting from a costal or palmar series; the shape of the joints following this axillary also shows them to be distal brachials, and the tubercle always present at the junction of a first and second brachial in this species is lacking. It seems to be best interpreted as a case of arm splitting, where one of the distal brachials has, for some cause or other, divided (leaving its pinnule on the half opposite to the pinnule of the preceding joint, now become an axillary); the next joints (a syzygial pair) have become separated still more (only one of them bearing a pinnule), while from here onward each of these syzygial pairs bears a perfectly developed arm.

*Charitometra imbricata* (= *Antedon grandifera* P. H. Carpenter 1888, no *Antedon grandifera* Pourtalès 1878 = *Comatula brevipina* Pourtalès 1869 = *Antedon pourtalési* P. H. Carpenter 1888). (Fig. 3.) In this specimen the third and fourth brachials are not united by syzygy, as usual in an arm springing from a costal axillary, and the fourth brachial, instead of bearing a pinnule on the opposite
side from the second, as would be the case were the third and fourth united by syzygy, bears it on the same side, as is always the case when the second and third and third and fourth brachials are united by muscular articulation. But the third brachial is peculiar in bearing a pinnule on the same side as those of the second and fourth instead of on the opposite side.

_Heliometra tanneri_ (Hartlaub). (Fig. 4.) A specimen of this species in the collection of the University of California, for the privilege of examining which I am indebted to the kindness of Prof. W. E. Ritter, is peculiar in having an additional first and second brachial on one arm, inserted between the costal axillary and the normal first and second brachial. This interpolated pair of brachials is, in reality, a distichal series, but with the more distal of the pair not an axillary: following the costal axillary, the joints may be described as follows: First, a first brachial, apparently in every way normal: then a second brachial, but of the type belonging to the opposite arm of the pair, and therefore bearing the pinnule _interiorly_ instead of _exteriorly_; following this is a normal first brachial, succeeded by a normal second brachial, and the succeeding brachials as usual. This is interesting in being the only case in the thousands of specimens of species of this genus which I have examined in which a distichal series was present; and in this case it does not result in an extra arm, as the joint, which is in reality the distichal axillary, bears a pinnule instead of the normal arm. It strongly suggests that the power of producing a distichal series and additional arms, latent in many ten-armed species of different genera, and in the case of _Antedon bifida_ even in genera belonging to the same family, is quite absent in _Heliometra_.

_Heliometra maxima_ (A. H. Clark). (Fig. 5.) In a previous paper I restricted the family _Antedonidae_, making it equivalent to the "Tenella" and "Eschrichti" groups of Dr. P. H. Carpenter, and the genus _Promachocrinus_ as redefined by Minckert—that is, including only the species _kerqueleensis_ and _vankoffenianus_. This was done on the basis of arm and pinnule structure and the structure of the distal radial faces. I placed _Promachocrinus_ (restricted) next to _Heliometra_, believing it to be merely a meristic variation from that type, in the same way that _Decametrocrinus_ is a meristic variation from _Pentametrocrinus_. A specimen of _Heliometra maxima_, taken off the southern part of Sakalin Island, appears to corroborate my views as to the origin of _Promachocrinus_ from _Heliometra_, or some very similar form. This specimen has twelve arms, arising from six costal axillaries, which in turn rest upon six
first costals; the radials are, unfortunately, concealed. This twelve-armed condition is not due to the addition of an extra ray with a six-rayed rosette and six basal rays, as in the case of the six-rayed individuals of *Tropiometa carinata*, for two of the costal series are found between two of the small tubercles representing the ends of the basal rays, showing that these two series either both spring from a single radial or from a divided primitive radial. These costal series are also closely crowded, with their axes approximately at right angles, the adjacent sides of the first costals projecting considerably from the centro-dorsal, the opposite sides mainly concealed beneath it. The arms borne by these two costal series and the arms on the four other costal series are normal in structure; but the outer arm of the left-hand one of the double costal series has the first brachial fused with the axillary of the adjacent costal series, the second brachial fused with the dorsal surface of the first brachial and lower part of the second brachial of the same series, with its pinacle arising from a point over the second brachial of the normal arm, and its third and fourth brachials (syzygial pair) fused with the lateral edge of the second brachial of the normal arm; the remaining brachials of the two arms are free.

The only other recorded case where two costal series arise from a single radial is recorded by Dr. P. H. Carpenter in *Comaster alata* (Heliometra pulchella); but here the radial bears two costal series which are smaller than the others, while in the specimen of *Heliometra eschrichtii* the two costal series are just as well developed as the normal ones.

I consider this specimen of *Heliometra maxima* to be a variation toward the condition found in *Promachocrinus*; and it seems to show that *Promachocrinus* may be derived from *Heliometra* by a simple division, or doubling, of the radials at an early stage of growth, each resultant half of the primitive radial being of equal vegetative power. The basal rays of the adult *Promachocrinus* lie under one of a pair of radials, instead of between the pairs, as would naturally be expected, this change in position possibly occurring through a predominance of pressure on one side of the anal plate as the latter is lifted out from between the radials.

In *Decametacrocinus*, the ends of the basal rays are visible between the pairs of radials, and not under one of them, as in *Promachocrinus*. This suggests a fundamentally different condition in the early stages.
of *Decametrocrinus* from that found in *Promachoeerinus*. In *Helio- 
metra*, as in *Antedon bifida*, the only plate separating the radials in 
the young is the anal, and it is possibly to the resorption of this plate 
and the subsequent filling up of the resultant gap that the torsion of 
the calyx in *Promachoeerinus* is due; there is no such torsion in 
*Decametrocrinus*; might not the inference be made that in the young 
a similar plate occupied all the interradial areas? We get this state 
of affairs in *Thaumatoecrinus*, which I have already shown resembles 
the *Pentametrocrinidae* (*Pentametrocrinus* and *Decametrocrinus*) in 
arm structure; and it may well be that the young of *Pentametro-
crinus* and *Decametrocrinus* will be found to be very similar to, or 
identical with, *Thaumatoecrinus*.

Mr. Springer has recorded a number of abnormal arm structures in 
* Uintacrinus socialis*, and it is interesting to compare these with 
similar cases among recent comatulids. In *Uintacrinus* the lower 
pinnules are arranged somewhat differently from what they are in 
most comatulids; the first is on the outer side of the second joint from 
the costal axillary, the next on the inner side of the fourth joint, then 
on the outer side of the fifth, the inner side of the seventh, and then 
alternately on every joint (except hypozygals of syzygial pairs). 
This is not such an anomalous arrangement as it may seem at first 
sight, for it really means that the first two joints beyond the costal 
axillary are distichals, not true brachials, the joint corresponding to 
the distichal axillary merely bearing a pinnule, not another arm. 
This is similar to the case in *Eudioerinus* (as restricted), in which 
genus the costal "axillary" bears a pinnule instead of the second 
arm. The true free arm in * Uintacrinus*, therefore, starts at the third 
joint from the costal axillary, this being in reality the first free 
brachial; the fourth and fifth free brachials (sixth and seventh joints 
from the costal axillary) appear to form the first syzygial pair. In 
most comatulids the third and fourth free brachials constitute the 
first syzygial pair; but it need not surprise us to find the first brachial syzygy in *Uintacrinus* one joint farther on, as in its nearest relatives, 
the Comasteridae, the position of the first brachial syzygy is, according 
to species, between the first and second, second and third, or third and 
fourth brachials, while in the *Pentametrocrinidae* the first syzygy is 
between the fourth and fifth free brachials, just as in *Uintacrinus*.

Considering the first two joints beyond the costal axillary as in 
reality distichals, we should expect to find that occasionally an arm 
was developed here, instead of the more common pinnule; and Mr. 
Springer (Plate vi, fig. 9) figures a specimen in which this condition 
occurs. The left arm of this distichal pair has a pinnule on the first 
joint beyond the distichal axillary, but this is due to the omission of 
the preceding joint; this joint corresponds to the axillary of a *palmar 
series*, the free brachials beginning at the next joint.
In a genus in which the distichal "axillary" commonly bears a pinnule instead of a second arm, one might expect to find individuals in which the costal axillary was similarly altered: Mr. Springer (Plate vi, fig. 8) figures a case in which the second costal bears a pinnule; the two distichals are present as usual, the second bearing a pinnule on the opposite side from that of the second costal.

A rather peculiar condition is figured (Plate vi, fig. 7) where apparently the distichal pinnule is on the inside instead of the outside of the arm; in other words, the two offshoots from the second distichal, the arm and the pinnule, have exchanged places; this specimen is further abnormal in lacking the first distichal.

The distichal series of two joints of which the second is not an axillary, but bears a pinnule, like the second costal in Eudiocrinus, would seem to be a retrogressive character, as in all other comatulids the second distichal (or fourth when doubled—i.e., \(3+4\)) is axillary, just as the simple pinnule-bearing second costal of Eudiocrinus appears to be retrogressive; we should, therefore, expect that in the young Uintocrinus the second costal would appear more like an axillary than in the adult. On consulting Plate iii, fig. 4, and Plate vi, fig. 4, we find this to be the case; the second distichal has distinctly the appearance of an axillary joint.
THE CRINOID GENUS EUDIOCIRNUS. WITH DESCRIPTION OF A NEW SPECIES.

By Austin Hobart Clark.
Of the United States Bureau of Fisheries.

In 1868, Prof. C. Semper described a new genus of free crinoids, Ophiocrinus, which differed from all other comatulids in possessing five undivided arms. At the same time he described the type-species, O. indivisus. In 1882 Dr. P. H. Carpenter renamed the genus Eudiocrinus (Ophiocrinus being preoccupied) and described three additional species, E. varians, E. semperi, and E. japonicus, which were described in greater detail and figured in 1888. In 1883 Professor Perrier described E. atlanticus, and in 1894 Professor Bell E. granulatus; an additional species, E. tuberculatus, was described by the present author during the past year.

Among a large number of comatulids just received by the United States National Museum from Japan, as a deposit collection from Mr. Frank Springer, was a very singular specimen with but five arms, entirely different from the species of "Eudiocrinus" (sensu P. H. Carpenter), atlanticus, varians, tuberculatus, and japonicus, with which I was personally acquainted. It was obviously closely allied to the Japanese species of Zygometra, Z. hartlaubi, Z. rubroflava, and Z. kohleri, the chief difference being the possession of only five arms. Evidently, then, it could not be congeneric with the species of "Eudiocrinus," which I had previously studied. This led to a review of the whole matter.

The type-species of Eudiocrinus (E. indivisus) is described as follows:

Sechzehn Ranken stehen in einfacher Reihe um den flachen kleinen Knopf. Rankenglieder 18-20, sehr knotig, namentlich am Ursprung, die Verdickung entspricht den Gelenken; die zwei ersten Glieder niedrig, so hoch als breit, das 3te bis 6te die längsten, doppelt so lang als breit. Die letzten Glieder schwach comprimirt, glatt, das letzte hat ausser dem Endhaken einen starken Zahn.

Das erst Glied der direkt von Kelchknopfe entspringenden Arme trägt gleich eine Pinnula und hat ein Syzygium; das zweite ist ohne Pinnula; das dritte trägt eine solche und das vierte hat eine Pinnula und zugleich ein Syzygium. Num
folgen sich die Pinnulae regelmässig abwechselnd, und je ein Syzygium zwischen 3-5 Gliedern. Die Glieder der Arme sind fast doppelt so lang als hoch und keilen sich namentlich in der Mitte stark an den Seiten aus.

Die zwei ersten Pinnulae sind klein, die dritte und vierte die längsten, dann folgen kürzere, die allmählich gegen das Ende der Arme zu länger und zugleich dünner werden, während die ersten mit ziemlich breiter Basis entspringen. Länge der Arme 80 mm., der Ranken 9 mm., der längsten Pinnula 8 mm. Durchmesser des Rankenknopfes 2 mm.

Die Schiebe fehlt leider an dem einzigen Exemplar. Die Pinnulae sind hell und dunkel gelbbräun gesprüngelt; der Rücken der Arme ist durch zwei geschlängelte Linie bezeichnet.

It was at once evident that my specimen, though differing in details, resembled E. indivisis; also that Bell's E. granulatus resembled both. It was also clear that the relation between these three and the other "Eudiocrinus" species was very remote. The differences may be summed up as follows:

\[
\begin{align*}
\text{Eudiocrinus indivisis, E. granulatus, E., new species.} \\
\text{Eudiocrinus atlanticus, E. japonicus, E. varius, E. semperi, E. tuberculatus.}
\end{align*}
\]

Radial facets low, the muscular fossae very narrow and crescentic.
Centro-dorsal flat, with marginal cirrus sockets.
Cirrus joints shorter proximally than distally, expanding and slightly overlapping distally, very slightly flattened.
A stout opposing spine present.
Terminal claw stout, and strongly curved.
First two joints beyond the radials united by syzygy.
The third joint beyond the radial never bears a pinnule.
Arm joints strongly overlapping.
Disk small, not extending up on the arms.
Lower pinnules with rather short joints, and very stout.
Color variegated.

Radial facets high, the muscular fossae very large.
Centro-dorsal hemispherical, nearly covered with cirrus sockets.
Cirrus joints subequal, smooth, elongate, approximately oblong in lateral view, and flattened.
No opposing spine.
Terminal claw slender and nearly straight, at least proximally.
First two joints beyond the radials never united by syzygy.
The third joint beyond the radial may bear a pinnule.
Arm joints smooth.
Disk very large, extending far up on the arms.
Lower pinnules slender and elongated with elongated joints distally.
Color plain grayish.

In all the characters in the above list, the Eudiocrinus indivisis group agrees with the Japanese species of Zygometra, and the sum of those characters is found in no other genus of comatulids. We can, consequently, find no escape from the conclusion that the two are in reality closely related, the only real difference being that the E. indivisis group has but five arms and Zygometra ten or more.
The Eudiocrinus indivisus group is peculiar in lacking the pinnule on the third joint above the radial, while a pinnule is present on the joints on either side of it; the explanation, however, is simple: the first two joints beyond the radials represent the two costals of a ten-armed or multibrachiate comatulid; they are somewhat broader than the following, and are united by syzygy as in Zygoantra; the third joint, therefore, represents the first free brachial of a ten-armed form, and, as the first free brachial never bears a pinnule, we find it absent here also; the fourth joint (representing the second free brachial) bears a pinnule, and the fifth and sixth (i.e., third and fourth free brachials) are united by syzygy, as usual in all comatulids. Thus the species of the Eudiocrinus indivisus group are apparently derived by a reversion from a ten-armed type; and in this connection it is interesting to call to mind the specimen upon which Carpenter's "Antedon clementus" was based, which had one undivided ray, with a pinnule on the "second brachial," but none on the "third," exactly as in the E. indivisus group. No one can doubt that the single undivided arm in A. clementus is a derivation from a normally divided arm, and, as the arms in the E. indivisus type are similar in structure, it is reasonable to suppose that they, too, are derived from more complex arms.

Moreover, taking the type of articulation into consideration, the second and third (postradial) joints are joined in the same way as the first is joined to the radial; that is, by articulating faces made up of (dorsally) a large fossa lodging the dorsal ligament, ventral to which, on each side of the axial canal, lies a pair of fossae lodging the interarticular ligaments, and beyond them the muscular fossae: the third and fourth (postradial) joints are joined by an articulation consisting only of a pair of large pits lodging the interarticular ligament, separated by a ridge at right angles to the long (transverse) axis of the joint face, this constituting what has been called a synarthrial joint; the fourth and fifth joints are joined by a type of articulation first found between the second and third free brachials of most comatulids, namely, a modified form of that between the radials and next following joints, in which the transverse ridge separating the dorsal-ligament fossa from the fossae of the interarticular ligaments is strongly diagonal, so that one end is dorso-lateral in position and the opposite end ventro-lateral; the interarticular

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*In Bell's figure of the arm base of Eudiocrinus granulatus (Proc. Zool. Soc. London, 1894, Plate XXIII, fig. 3) the first pinnule is omitted; he describes the species as having "the first pinnule on the left side of the second brachial;" but according to his figure it must have been on the right side, as the second pinnule (the lowest shown) is on the left. Attention should be called to the fact that there is a serious discrepancy between the size of E. granulatus as described and as figured.*

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ular and muscular fossae are similarly, to a greater or less extent, misplaced. The remaining brachial articulations are all of this type, except, of course, in the case of syzygia. This offers another means of arriving at the homologies of the joints; granting that the articulation between the fourth and fifth joints corresponds to that always found (in a ten-armed type) between the second and third free brachials, and counting backward, we find that the preceding joint is the equivalent of the first free brachial, the one before that of the costal axillary, which in this case is united to the first costal by syzygy, therefore reaching exactly the same result as we did through a consideration of the pinnule arrangement, and the arrangement of the first two syzygia.

The *Endiocrinus japonicus* group, however, differs from the *E. indivisus* group in the enormous disk, which is black, and extends far up on the arms, and in the great amount of separation of adjacent radial facets (figs. 1, 2) from all other comatulids, except *Decametrocrinus*. The long, brittle, and slender, much compressed cirri, with a long, nearly straight, terminal claw, are very characteristic, though an approach to these conditions is found in *Thysanometra*. Judging from the character of the radial facets and the extensive central cavity of the centro-dorsal, the *E. japonicus* group and *Decametrocrinus* come nearest to certain genera of the Antedonidae, such as *Thauamometra, Psathyrometra* (fig. 3), etc., and it is found that the general character of the pinnules, arms, and cirri also suggest the same relationship.

The proximal arm structure of the *Endiocrinus japonicus* group and of *Decametrocrinus* is, however, radically different from that of all other comatulids, except *Thauamometra*, with which genus it agrees.

In the ordinary type of comatulid with ten arms (fig. 4) there are two costals, united by synarthrial articulation, the median ridge on the joint faces appearing externally in the middle of the line of articulation, its position being usually marked by more or less of a dorsal tubercle. On each of the distal faces of the axillary (second) costal is a first brachial, the articulation between the two being the same as that between the radial and first costal: this joint never bears a pinnule; articulating with the first brachial on its distal face is the second brachial, the articulation between the two being synarthrial, as between the two costals: but the articulation between the second and third (and all succeeding brachials, except syzygial pairs) is of the same type as that between the radials and first costals.
and costal axillaries and first brachials, except that the transverse ridge separating the dorsal-ligament fossa from the interarticular ligament fossa is strongly diagonal, and the other elements making up the sculpture of the joint face are correspondingly misplaced. The diagonal position of the transverse ridges always alternates on succeeding joints, the external position of these ridges being marked by a series of more or less prominent alternating tubercles along the arm, the first of these tubercles being always exterior, in reference to the last axillary.

It will now be seen that, judging from the types of articulations, the two costals are merely repetitions of the first two brachials, interpolated between them and the radials; in the cases where the arms divide more than once, the distichals, palmars, postpalmars, etc., are really additional repetitions of the first two brachials, for we always find the first two brachials of a free arm the same, no matter how many division series may intervene between them and the radials; in the cases where the division series are 4 (3 + 4), there is merely a double instead of a single repetition of the first two brachials, for the first two joints are here united by synarthry into one pair, the last two united by syzygy into another pair; but the two pairs are united by an articulation resembling that found between the radials and first costals, and between all axillaries and the succeeding joints.

Additional evidence that this is really the case is found in the cases where, as in Perometra diomede, there is an extravagantly elongated tubercle on the articulation between the first two brachials: this is repeated between the costals; or, as in Tropiometa, where the first two brachials are greatly enlarged: the costals are very large also: or in various species of Charitometra and Thalassometra, where the first two brachials are highly ornamented: the costals and division series are always similarly ornamented.

In Decametrocrinus and in the Eudicocrinus japonicus group (fig. 5) we find the articulation between the first two post-radial joints to be exactly like that between the first two brachials, or the costals, in any ten-armed comatulid, i.e., a synarthry: but the articulation between the second and third and all succeeding joints corresponds to the articulations between the second and third and all succeeding brachials in the free arms of ordinary comatulids. Thus, then, the arms of these forms are strictly homologous to the arms of other comatulids beyond the last axillary: it is as if the arm of a Heliometra
ceschrichtii or an Antedon bifida were cut off at the costal axillary, the costals removed, and the arm (the first brachial) grafted onto the radial. This arm arrangement occurs only in Thaumatoecrinus, Decametrocrinus, and in “Eudiocrinus” atlanticus, japonicus, semperi, tuberculatus, and varians.

Additional proof of the correctness of this interpretation of the arm structure of Decametrocrinus and the species of “Eudiocrinus” mentioned is found in the arrangement of the pinnules: for when a species like Decametrocrinus naresi or “Eudiocrinus” varians bears a pinnule on the second post-radial joint there is always one on the following joint and on all succeeding, excepting, of course, the hypozygals of syzygial pairs.

Since these five species of “Eudiocrinus” are really in no way related to the type-species (E. indivisus), but belong to an entirely different family, they require a new generic name, and for them I have proposed the name of Pentametrocrinus as suggesting their five-armed condition, and also their affinity to the closely related Decametrocrinus, with ten arms.

This involves a redefinition of two families and two genera, as follows:

Family ZYGOMETRIDE.

A family of Comatulida in which the radial faces are broad and low, in lateral apposition (figs. 6, 7), the muscular fossae small, narrow, and crescentic, curving upward and outward from the ridge surrounding the central canal to the antero-exterior corner of the radial faces, and entirely separated from each other by a deep median cleft: the costals are united by syzygy, but the first two brachials by bifascial articulation: disk plated, but pinnule ambulacra naked; five to ninety arms.

Color variegated and usually brilliant, consisting of red, yellow, purple, brown, and white.

Habitat.—Northern Australia northward to Japan; littoral, and down to 60 fathoms.

Included genera.—Zygometra; Eudiocrinus.

Genus EUDIOCRINUS (emended.)

A genus of Zygometridae in which the arms are five in number, the second costal not being an axillary (fig. 8): cirri short and stout, the joints swollen distally, the opposing spine stout and well developed; arm and pinnule joints overlapping.
THE CRINOID GENUS EUDIOCRINUS—CLARK.

Genotype.—Ophiocrinus indivisus Semper, 1868.

Habitat.—Philippines; Macclesfield Bank; Japan: 30 to 60 fathoms.

The species included in the genus Eudiocrinus as here emended are:

Eudiocrinus indivisus (Semper).
Eudiocrinus granulatus Bell.
Eudiocrinus variegatus, new species.

Family PENTAMETROCRINIDÆ.

A family of Comatulida in which the radial faces are very high, entirely and rather widely separated, the muscular fosse very large, rounded-triangular, separated interiorly by a strong median ridge; the first brachials articulate directly with the radials, without the intervention of costals; orals absent; disk very large, black, extending far up on the arms, naked or more or less covered with small calcareous plates; cirri with elongate subequal compressed joints; no opposing spine; terminal claw long.

Color grayish, tinged with purplish; disk black.

Habitat.—Crozet Islands and seas south of Australia northward to the West Indies, Gulf of Gascony, Indian Ocean, Japan, and the Hawaiian Islands: 103 to 1,800 fathoms; mainly abyssal.

Included genera.—Pentametrocrinus; Decametrocrinus.

This is identical with the family for which I previously proposed the name Eudicrinidae, owing to a misconception of the genus Eudiocrinus.

Genus PENTAMETROCRINUS.

A genus of Pentametrocrinidae in which the arms are five in number.

Genotype.—Eudiocrinus japonicus P. H. Carpenter, 1882.

Habitat.—West Indies; coasts of southern Europe; east coast of Africa eastward to Australia, and northward to Japan: 103 to 1,050 fathoms (mainly abyssal).

The species included in the genus Pentametrocrinus are:

Pentametrocrinus atlanticus (Perrier).
Pentametrocrinus japonicus (P. H. Carpenter).
Pentametrocrinus semperi (P. H. Carpenter).
Pentametrocrinus tuberculatus (A. H. Clark).
Pentametrocrinus varians (P. H. Carpenter).

The new species of Eudiocrinus (emended) from Japan may be known as
EUDIOCRINUS VARIEGATUS, new species.

Centro-dorsal discoidal, rather thick, with somewhat sloping sides, the broad polar area flat, the cirrus sockets arranged in two crowded, more or less irregular, rows.

Cirri about twenty-five in number, 7 mm. long, with fifteen joints, the first not so long as broad, the remainder squarish (fig. 9); the fourth and fifth joints have their distal ends expanded and projecting somewhat dorsally, this character gradually becoming less and less marked distally; there are no dorsal spines, but the opposing spine is prominent, arising from the entire surface of the joint, the apex opposite the middle of the joint; terminal claw rather stout and well curved, about as long as the penultimate joint.

Radials even with the centro-dorsal: first costal short, about four times as broad as long, united to the second by syzygy; there is a well-marked rounded median tubercle; second costal slightly longer than the first, but similar to it, and not an axillary; it bears a pinnule. Five arms 75 mm. long, of overlapping joints: the first two brachials, like the two costals, have their lateral edges slightly turned outward, forming a slight narrow lateral border: first and second brachials slightly over twice as broad as long, the distal edges rather prominent, with a rounded median tubercle; third and fourth brachials (syzygial pair) not quite so long as broad, slightly longer on one side than on the other, with a low rounded median keel: following two brachials wedge-shaped, not so long as broad, then becoming triangular, about as long as broad, soon becoming obliquely wedge-shaped, and longer than broad and distally less obliquely wedge-shaped and elongate; the brachials up to the sixth or seventh have a low rounded median keel, marked by a series of longitudinally elongate tubercles, one on each joint; from this point onward the keel becomes less marked (only faintly visible) and assumes a peculiar zigzag form, owing to its oblique position on each joint; it is traceable to at least the distal third of the arm; the distal ends of the joints in the lower part of the arm project somewhat, but this dies away after about the middle.

Costal pinnule 4 mm. long, stout, triangular, with nine squarish joints; pinnule on second brachial similar (the first brachial has no
pinnule); pinnule on fourth (epizygal) brachial 6 mm. long, much stouter than the costal pinnule, with twelve joints, the first three approximately squarish, the remainder longer than broad, but not elongated; the pinnule is rounded, and all the joints overlap strongly, and have serrate distal ends (figs. 10, 11); following pinnules about 4.5 mm. long, but much more slender than the pinnules on the fourth (epizygal) and fifth brachials, with about twelve joints, the first very short, the next two squarish, the remainder elongate, the articulations somewhat swollen; the lower joints have overlapping and spinous distal edges; the distal pinnules are 9 mm. long, slender, the first joint short, the second squarish, the remainder much elongated, with expanded articulations.

Color (in formalin) purplish brown, the skeleton lighter, the cirri white, the enlarged lower pinnules (on the fourth and fifth brachials) purple, the arms and pinnules banded with purple and whitish.

Type.—Cat. No. 25326, U.S.N.M. (Owston Coll. No. 6931), from 34° 59' north latitude, 139° 34' east longitude (Sagami Bay, Japan); 60 fathoms.
ON SOME NEW AND OLD SPECIES OF CARBONIFEROUS FOSSILS.

By George H. Girty,

The contents of the accompanying paper are of a miscellaneous character, but may be classified from one point of view into species which I expect to discuss before long in other reports and which are not provided with illustrations in the present one, and those which are not included in plans for the immediate future and are consequently illustrated in this place. These last group themselves into several categories.

Several years ago when collecting in Kansas I obtained at a locality near Chanute some fossil sponges in unusual abundance and perfection of preservation. A careful study of these forms seems to justify recognizing among them four new genera, five new species, and one new variety.

Over half a century has elapsed since Isaac Lea published his brief paper on the occurrence of fossil mollusks in the anthracite seams of the Carboniferous at Wilkesbarre. Though our knowledge of the coal plants of the anthracite region has since become very extensive, time has brought out few facts relating to the invertebrates of that place and period. The fauna of the Mill Creek limestone has subsequently been discovered and partially described, but it is evident that this fauna is not the same as that which furnished Lea's specimens. It is unfortunate, therefore, that the last-named author does not state more precisely where and from what seam his material had its source, doubly unfortunate in view of the fact that even his poor figures show plainly that his species were in some cases based upon mere fragments.

When a storage box containing miscellaneous and some unlabeled specimens was unpacked several years ago a small slab of black sandy

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shale with invertebrate fossils was fortunately recognized as containing the types of all Lea's species, and these upon the present occasion it is my purpose to supply with somewhat better illustrations than the original ones. There is little remedy in prospect for the imperfectness of the type-specimens themselves, since, as just stated, the original locality was not described and the horizon has not been rediscovered, so that the species can not be rehabilitated upon better material.

Of the five invertebrate species described in Lea's paper two are based upon such mere fragments that it is doubtful if they could be definitely fixed, even with additional material from the same fauna. A single species is unquestionably valid, while of the two remaining, one is with little doubt identical with it and the other is probably the same as a species already in the literature.

Lea's remark, therefore, that "As these forms are the only ones yet found that I am acquainted with, I have deemed it better to give an exact representation of the specimen itself and to give provisional names, that geologists may be able to recognize them when met with again," seems tinged with unconscious irony.

The remaining species, three in number, are of somewhat unusual interest. One of these belongs to the genus Harttina, a type of structure hitherto known only in Nova Scotia, while the two others, which represent the genus Tegulifera, are interesting not only on their own account but because that genus has as yet been found only in Europe, the original species having been obtained in the Carnic Alps, while a second doubtful representative has been described from the Ural Mountains.

HETEROCELIA, new genus.

General shape moniliform, consisting of subspherical units joined end to end in straight or nearly straight lines; sometimes branching. Each unit consists of a spherical outer wall interrupted at both ends by the passage of a large cylindrical cloaca, which is continuous from cell to cell. The outer wall is interrupted also by large spout-like ostia.

The mode of growth of this organism is not quite clear from the material examined. There is some evidence that the cylindrical cloaca may have been first prolonged, or in perfect specimens may normally have projected from the upper end, and that upon this the spherical outer wall was formed. The constituent spheres are sometimes just in contact, but sometimes also they appear to be separated by an interval bridged only by what seems to be a section of the cloaca. On the other hand, two consecutive spheres may overlap, in which case the lower end of the upper or younger one is invaginated. In any event the two cells even when in contact have discrete spherical walls throughout. The cylindrical cloacal walls seem to be
continuous from cell to cell, but not only do the cloace of the entire
system, so far as observed, merge into a continuous tube, but they
seem also to merge with the spherical walls, which, as above remarked,
are distinct from one another.

The walls of the cloace are pierced by closely arranged round
pores by which the cloacal tube communicates with the cavity of the
sphere. The latter communicates with the exterior by means of the
large spout-like ostia, which are few in number and fairly constant
in arrangement. The outer walls of the spheres are probably solid
(i. e., without pores). In some specimens the wall clearly appears
to be solid, but in others the evidence is more ambiguous. In no in-
stance has conclusive evidence of porous structure come to light, such
as is unquestionably presented by the cloacal tube. The large ostia
probably furnished all the direct communication that was needed
between the internal cavity, which, save for the cloacal tube, appears
to have been empty, and the external medium. Indirect communica-
tion was furnished through the cloaca. The cloaca also served to
connect with one another the several units between which direct com-
unication seems to have been wanting.

The interesting fossil for which this generic name is introduced
resembles several established genera, while presenting characters in-
compatible with any of them. Probably that whose relationship is
most close is Steinmann’s genus Sollasia, from the province of Astu-
rias, in Spain. Heterocelia differs from Sollasia in the fact that the
successive oscula are connected by internal walls into a central tube
surrounding the cloaca, whereas in Sollasia the central cavity is unoc-
cupied. There is no inclosed cloaca, and the oscula are not connected.

From Amblysiphonella the present type differs in being more dis-
tinctly composed of separate segments. This is shown by the fact that
the lower wall of each spherical portion is repeated, so that where two
units are in contact they are separated by a double partition. In
Amblysiphonella the upper surface of one segment forms the lower
boundary of the succeeding one. The party wall is not double, and
the internal or cloacal wall connects above, but not below, with the
outer wall. The interior of Amblysiphonella is more or less vesicu-
lose, which is not the case with Heterocelia. Furthermore, the latter
appears to have spout-like ostia but not dermal pores, whereas Ambly-
siphonella has dermal pores but no ostia. Much the same differences
exist between Heterocelia and Sollasia.

Another related genus is Waagen and Wentzel’s Steinmannia, from
the Permian of India. Here again the Kansas form is distinguished
by having ostia without pores, instead of pores without ostia, and
there are also no internal vesicles. There seems to be the further dif-
ference that the party wall is double in the present genus and in Stein-
mannia single, as in Amblysiphonella and Sollasia.

Type of the genus.—Heterocelia beedeli.
HETEROCELIA BEEDEI, new species.

Plate XIV, figs. 1-8.


Many of the characters of this species are implied in the foregoing generic description. The constriction marking the union of two adjacent cells is deep and the general shape strongly moniliform. The stems are usually straight, but sometimes much contorted, and a few instances have been noted in which branching occurs. The size of the individual segments is rather small, seldom exceeding 10 mm. The osculum is large. The ostia are also rather large and spout-like. They are few in number and rather uniform in size and distribution. It is difficult to determine the exact number, but there seem to be six or eight, arranged transversely at nearly equal intervals, usually along the median line. Frequently the arrangement of these structures is sufficiently systematic for those of several consecutive chambers to form longitudinal rows.

If there is little doubt that this is the same form which Mr. Beede identified as Amblysiphonella proscri in the work cited above, there can be no question that it belongs to a different species as well as to a different genus from the form described by Clarke.

Locality and horizon.—Allen limestone: cut on the Santa Fe railroad, 6 miles southwest of Chanute, Kansas.

Type-specimens.—Cat. No. 53471, U.S.N.M.

MÆANDROSTIA, new genus.

This type consists of subcylindrical, stem-like, more or less bent, occasionally branching bodies. A central tube-like cloaca traverses the entire axial portion. The rather thick walls are intersected by vermiform chambers, which communicate with the surrounding median through numerous circular ostia, and with each other and with the cloaca by means of frequent though irregular apertures. The partitions between adjacent chambers, between the chambers and the cloaca, and between the chambers and the exterior are of the same character, apparently structureless and imperforate.

Though both sponges are at present preserved as carbonate of lime, Calcicladia, in strong contrast with Mæandrostia, retains its spicular mesh-like structure, while the walls of the latter are to all appearance solid and structureless. In this respect Mæandrostia agrees with Heterocelia, and also in the general plan of construction, consisting, as it does, of separate though irregular chambers.

Heterocelia is so related to other genera which are usually looked upon as belonging to the Calcispongiae that it can pretty safely be regarded as belonging to the same group. On account of its re-
semblance to *Heterococlia* and its difference from *Callocladia* it seems probable that *Maandrostia* also is one of the *Calcispongiae*.

*Maandrostia* more nearly resembles a sponge from the Guadalupe Mountains for which I have proposed the name *CyxtotJudamiania* than any other genus known to me. Some of the differences which can be noted are these: *CyxtotJudamiania* seems to be without a persistent central cloaca. The outer wall appears to be porous instead of solid. The ostia are prolonged as spout-like projections. The chambers produce swellings upon the exterior, to which they give a cystose appearance. The differences last mentioned may perhaps be regarded as only specific, but the first two are clearly generic. The material from the Guadalupe Mountains, however, is not well preserved, and it is impossible to state with complete certainty that there is no persistent cloaca, though the porosity of the outer wall is open to but little question. It hardly seems permissible, therefore, to regard the present type as generically the same as *CyxtotJudamiania*.

**Type of the genus—*Maandrostia kansasensis***

*MAandrostia kansasensis*, new species.

Plate XV, figs. 1-7.

The form for which this name is proposed consists of slender, subcylindrical, occasionally branching bodies, which rarely exceed 13 mm. in diameter, but are often much smaller. As a rule they are nearly straight, but may be considerably contorted. The exterior is made irregular by inequalities of growth, and further roughened by large numbers of ostia, some of which appear to have slightly elevated margins. The ostia are circular, and average about 0.75 mm. in diameter. The interior is occupied by a central tubular cloaca, which apparently passes uninterruptedly through the complete length of the stem. The space between the cloaca and the periphery is filled in by vermiform chambers, which communicate with the exterior by means of the ostia and also intercommunicating with each other and with the cloaca by frequent irregular apertures in the walls. In different specimens, and probably in the same specimen at different points, this structure while the same in principle varies considerably in detail. A tube-like cloaca is usually a striking feature, but occasionally it is hardly to be distinguished from the generally irregular porous structure. The cloaca varies considerably in size, sometimes occupying less than one-third the entire diameter, at others having only a thin rim of wall about it. Similarly, in some sections the partitions are so developed at the expense of the chambers that the stem appears to be well-nigh solid. In others the partitions are thin and disconnected, leaving the interior all but open.

The walls appear structureless, and but for the openings already described are imperforate. The outer wall especially is pierced by
ostia, though not by pores, and against the surrounding matrix makes a sharply defined if somewhat irregular boundary.

Locality and horizon.—Allen limestone; out on the Santa Fe Railroad, 6 miles southwest of Chanute, Kansas.

Type-specimens.—Cat. No. 53468, U.S.N.M.

**STEINMANNIA BENJAMINI**, new species.

Plate XV. fig. 8.

Of this species we have but a single specimen, exposed on a fractured rock surface. It consists of spheres placed end to end and partially embracing, so that an elongate subcylindrical body is produced, with more or less pronounced constrictions which mark the constituent segments. The theoretical spheres overlap so that usually the height of each chamber is only about half of the width. The party wall is single, formed by what was the terminal wall of the preceding segment. The constituent spheres vary in size between wide extremes and the growth of the organism as a whole is contorted and irregular. The length of the fragment is 55 mm. and the greatest diameter 10 mm. The interior of the chambers is almost empty, and I am not entirely satisfied that such apparent partitions as occur are not either adventitious or due to chambers coordinate with the larger ones. Presumably each chamber communicated with those adjacent by means of a central osculum, but this is not shown by the fracture section of our specimen. The walls are perforated by numerous large pores, but only one size of these has been observed, though thin sections might show others. Chambers communicate by means of these pores as well as by the oscula.

One feature of the specimen should not be passed over, though it may be adventitious. On both sides, following their windings rather closely and separated from the perforated wall by a narrow interval filled with matrix, is a thin outer wall (?) of the same general character as the inner one but imperforate.

It seems probable that this form belongs to the Salt Range genus *Steinmannia*, though it shows certain differences which if real are important. Oscula appear to be absent, but might readily fail to be shown by the specimen in its present condition. The rarity or absence of internal vesicles may be only a specific character, and can hardly be regarded as invalidating the generic identification. The most important difference doubtless is the apparent presence of but one set of perforations, and this is also the most well established. Aside from *Steinmannia*, the genus which the present form most resembles is *Sollasia*, and from *Sollasia* it differs importantly in the absence of ostia and the presence of perforations. If not a *Steinmannia* the present form is, therefore, probably a new genus, but I would certainly regard it as inadvisable to introduce a new generic term under present circumstances.
Steinmannia benjaminii is clearly more closely related to S. salinaris of the two Indian species. It is distinguished by the less extensive development of internal vesicles, the presence apparently of pores of but one size, and the fact, so far as I can determine from the figures, that they are larger than those of the Indian species. The American form is also as a whole smaller.

It gives me great pleasure to name this species in honor of Dr. Marcus Benjamin, editor of the U. S. National Museum.

Locality and horizon.—Allen limestone; cut on the Santa Fe Railroad, 6 miles southwest of Chanute, Kansas.

Type-Specimen.—Cat. No. 53467, U.S.N.M.

Cœlocladia, new genus.

Of this genus only a single species is known, and consequently only a partial generic description can be drawn up embodying those features which are shown by the form in question and which would presumably be possessed by congeneric species.

The growth is more or less arborescent, the branches cylindrical, with a large, uninterrupted cloaca. The walls are more or less thick, composed of consolidated spicules, probably tetracts, and pierced by numerous ostia, which sometimes ramify toward the outer surface. In the typical species the ostia are extended outward as spiniform processes. An epidermal layer of some sort was probably present.

The specimens representing this genus are preserved in such a different manner from those of the associated Heterocladia, which probably represents the Sycones of the Calcispongiae, that they may justly be inferred to belong to the Pharetronces, or else, though at present calcareous in chemical composition, to the Silicispongiae. The Pharetronces seem largely restricted to the Mesozoic, and upon the whole it is rather more probable that the present type belongs to the Silicispongiae. The spicular structure and the general arrangement of the canal system seem to make it probable that it is related to the Lithistida, rather than to the Hexactinellida. Owing to the difficulty of determining the exact character of the spicular element it is impossible to reach a satisfactory conclusion in regard to the more intimate relationship of Cœlocladia among the Lithistida. It is, however, distinct from a considerable number of genera with which comparisons have been made, chiefly in the cylindrical mode of growth. Doryderma is like it in this respect, but probably has a different spicular element and possesses a large number of axial canals instead of a large central cloaca. Cylindrophyma, of the upper Jurassic, is perhaps the most closely similar in every respect. Apparently the spicular unit and mode of consolidation are different in the present form.

Type of genus.—Cœlocladia spinosa.
**Cæolcladia Spinosa**, new species.

Plate XVI. figs. 1-7.

This species consists of rather straight cylindrical fragments which rarely exceed 10 mm. in diameter. They are calibrated, the inner cavity having, on well-preserved specimens, sharply defined straight boundaries essentially parallel to the outer circumference. The thickness of the walls varies greatly in different specimens. It is rarely equal to the diameter of the cloaca and is sometimes quite thin. The external surface is roughened by the development of great numbers of spiniform ostia, whose size can not well be stated because they taper toward the outer end. The wall structure consists of a spiculär network which it is difficult to analyze into its individual elements. The spicules appear to be rather large and somewhat irregularly cemented one to another by the extremities of their arms. As combinations of three rays diverging at approximately equal angles are of frequent occurrence, it is probable that the unit is a tetract. There seems to have been a dermal layer covering the exterior, as the outline of this surface against the inclosing rock is smooth (aside from the ostia). The inner wall bounding the cloaca, however, is minutely ragged, owing to the projecting rays of the spicules. The spiculär layer of which the walls consist is rather open and is pierced by the tubular ostia, which apparently, after passing part way through to the outer side, ramify more or less, decreasing in diameter in the process.

These bodies occur in lengths up to 55 mm. and more, but seldom show signs of branching. In some cases, however, they appear to have branched rather freely, and perhaps the original growth was distinctly ramose, although at present it seems improbable that they formed extensive dendroid growths.

*Locality and horizon.*—Allen limestone; cut on the Santa Fe Railroad, 6 miles southwest of Chanute, Kansas.

*Type-specimens.*—Cat. No. 53469, U.S.N.M.

**Heliospongia**, new genus.

This genus includes rather large dendroid sponges having a persistent central cloaca and a hexactinellid spicular unit. The branches are cylindrical, freely dividing, more or less completely coalescent when by chance they come into contact. The cloaca is rather small and apparently uninterrupted and continuous from top to bottom. The spicules are so oriented that their arms are rather regularly continuous in longitudinal and radiating lines. The third set of rays should make concentric lines, but although suggestions of regular concentric structure are not wanting, it is not conspicuous in the thin sections seen. It is, however, a striking feature of weathered
specimens. The longitudinal lines are slightly oblique, rising from the
doclinal to the exterior surface, and probably slightly bending out-
ward as they go. The transverse lines are also oblique and curved,
having their convex sides uppermost and passing downward from the
doclinal to the exterior. Between the arms of the large spicules thus
disposed are freely connecting radial canals which open upon the
outer surface in small circular pores. What I regard as true ostia
are absent.

In general character this genus is very suggestive of Coelocladia,
but after due consideration I am fairly satisfied that they are dis-

tinct. As to the specific distinction of the genotypes there can be no
question. Both have somewhat the same mode of growth; the
spicules in both may possibly be hexacts, although in Coelocladia
it seemed more probable that they are tetracts. They are of much
larger size in Heliospongia ramosa and their arrangement is also
much more regular. In Coelocladia spinosa there is hardly ever a
trace of the longitudinal and radial lines which make such a striking
feature in the structure of Heliospongia ramosa. The latter does
not show the spine-like ostia of Coelocladia, but this would probably
be only a specific difference were it not that true ostia, I believe, are
entirely absent from Heliospongia as well as the large canals which
lead from them, for I can not regard the relatively large canals
which interrupt the spicular network in Coelocladia and terminate
on the surface in spout-like ostia as homologous with the relatively
small openings which pass between the arms of the regularly ar-
 ranged spicules in Heliospongia and open upon the surface in the
characteristic pores.

Type of the genus.—Heliospongia ramosa.

HELIOSPONGIA RAMOSA, new species.

Plate XVI, figs. 8, 9; Plate XVII.

This species forms large bushy bodies consisting of freely branch-
ing cylindrical stems which attain a diameter of 23 mm., but are
usually somewhat smaller. Sometimes the branches are in contact,
in which case they appear to coalesce, producing, temporarily at least,
 somewhat flabelliform shapes. The individual branches are pierced,
probably from end to end, by cylindrical cloacæ, which are relatively
of variable size, but usually, if not always, less than one-third the
entire diameter.

The spicular element is large and without much doubt a hexact.
The combined effect of the spicules is to produce more or less continu-
ous radiating and longitudinal lines. The radiating lines are oblique,
with the outer end lower than the inner, and they are somewhat
curved, the convex side uppermost. The longitudinal series of rays
are also probably somewhat oblique, sloping outward very gradually

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as they rise from the rim of the cloaca, and probably slightly curving
in the process. This arrangement is regular and tends to produce
radiating pores from the cloaca to the periphery. Canals or cham-
bbers, properly speaking, appear to be absent. What look like vermi-
form canals are probably mere color markings, which wind among
the spicules without interrupting them. These radiating pores pro-
duce upon the outer surface small, more or less circular openings, but
ostia, strictly speaking, are probably absent. Certain larger openings
appear to be superficial and to be produced by the absence of a spicu-
lar arm, such as in other instances serves to separate adjacent pores.

Locality and horizon.—Allen limestone: cut on the Santa Fe Rail-
road, 5 miles southwest of Chanute, Kansas.

_Type-specimens._—Cat. No. 53472, U.S.N.M.

**HELIOSPONGIA RAMOSA**, var. PARALLELEA, new variety.

_Plate XVI, fig. 10, Plate XVIII._

This form seems to agree in all respects with the foregoing except
in the mode of growth, the typical one bifurcating freely while the
present variety appears to have a principal stem which gives off long,
parallel branches.

Locality and horizon.—Allen limestone: cut on the Santa Fe Rail-
road, 6 miles southwest of Chanute, Kansas.

_Type-specimen._—Cat. No. 53473, U.S.N.M.

**MYALINA WYOMINGENSIS** Lea.

_Plate XIX, figs. 2, 3._


"Testa laevi triangulari, infernè compresso-alatâ; unbonibus
elevatis, acúte angulatis.

"Remarks.—This is a broad flat species, very different from the
minor, which is on the same specimen. These are parts of four
distinct specimens on this small piece of slate, which is represented
of the natural size."

Lea's description and remarks are given above. Part of the inclos-
ing rock having been removed the type-specimen proves to have the
following characters:

Shell of medium size, subtriangular. Hinge but slightly shorter
than the extreme width. Length and maximum width about equal.
Umbonal ridge prominent, sigmoid, rounded sharply above, more
broadly below, where it is almost marginal, descending abruptly on the anterior side and very gradually behind. Beak nearly terminal, leaving, for the genus, a rather large lobe in front. Anterior outline sinuous, posterior outline gently convex. Anterior-superior angle rounded, posterior-superior angle obtuse. Inferior angle strongly rounded. Surface marked by sublamellose growth lines.

Several other specimens of various sizes and degrees of fragmentariness occur on the same slab. One of these, an imperfect mold of the exterior, seems to have been the original of Lea’s Modiola minor. On the slab this specimen occurs near the posterior-superior angle of M. wyomingensis, but Lea shows it not in his figure of the whole slab but in a separate figure (fig. 2). Originally it bore a very close resemblance to Lea’s illustration, but by removing part of the rock its appearance has been changed and its general resemblance of M. wyomingensis so enhanced as to leave scarcely a doubt that it belongs to the same species.

M. wyomingensis proves to have had a very extensive distribution, since what appears to have been the same species has been identified in Colorado. Lea’s description of Modiola minor, which is here regarded as a synonym of Myalina wyomingensis, is as follows:

“Testa infernè striata, elliptica, subplanulata; antico latere rotundato.

“Remarks.—A single specimen only was found of this species, and the umbones are obliterated. The lower part, as represented, is perfect, and very distinctly marked.”

Locality and horizon.—Pennsylvania; Wilkes-barre, Pennsylvania. Type-specimens.—Cat. Nos. 33899 and 33900, U.S.N.M.

MODIOLA MINOR Lea.

This species is based upon an external mold of an imperfect valve. The type-specimen occurs in association with Myalina wyomingensis, which appears to have been abundant, and as it agrees with that species in such characters as can be determined, it will be reasonably safe, as well as advantageous, to regard it as identical with M. wyomingensis and the name as a synonym.

DELTOPECTEN CLATHRATUS Lea.

Plate XIX, fig. 1.


The characters of this species are much in doubt. The types consist of two specimens lying close together and possibly even representing different valves of the same individual. One, which appears to be smaller but may only be imperfect, is almost certainly a representative of the genus Deltopecten. It has a broad, oblique cardinal area, with a large triangular cartilage pit beneath the beak. The
surface is marked by rather large, not very well-defined ribs arranged in pairs. So far as can be determined, this shell has all the characters of the right value of *D. occidentalis*, which is the commonest Pennsylvanian species of *Deltopecten* and occurs associated with *M. wyomingensis* in Colorado.

The second specimen is obliquely crushed and at present furnishes scarcely a clue to the original shape. The sculpture consists of somewhat broad, flat ribs, which are strongly alternating, every other one being considerably larger.

I hardly know what course to regard best in the present contingency. It seems rather probable that both specimens belong to the same species, and I have little doubt that one of them is the form better known as *Ariculipecten occidentalis*. Unfortunately, *Deltopecten clathratus* antedates the description of *D. occidentalis* by several years, and it seems a pity to replace Shumard's name by that of a form which was inadequately described, whose characters are not readily determined from the types, and of whose identity with the better known form there may be some, if only slight, doubt.

**Locality and horizon.**—Pennsylvanian: Wilkesbarre, Pennsylvania.  
**Type-specimen.**—Cat. No. 33901, U.S.N.M.

**PLEUROTOMARIA ? DISTANS Lea.**

Plate XIX, fig. 4.


"Like the above, there was but a small portion of a valve found. It has longitudinal strie, somewhat like *perstriata*, but the striae are more distinct and distant, amounting almost to ribs."

The original of Lea's *Posidonia ? distans* is such a mere fragment that it can hardly be stated with certainty to which division of the animal kingdom it belongs. It seems to be a portion of a whorl of a Pleurotomarioid, but nothing further can be said on that point. It has an irregular shape, with five gently curved, slightly converging lirae, which are thin, rounded, and separated by flattened interspaces several times their own diameter. The interspaces are not of equal sizes, and one, possibly two, are divided by lirae much finer than the others.

**Locality and horizon.**—Pennsylvanian, Wilkesbarre, Pennsylvania.  
**Type-specimen.**—Cat. No. 33903, U.S.N.M.

**EDMONDIA ? PERSTRIATA Lea.**

Plate XIX, fig. 5.


The type of this species also is a mere fragment, unquestionably a pelecypod, probably the anterior extremity of some such form as
Edmondia, or possibly Schizodus. The lire are fine, narrow, separated by relatively wide, flat interspaces or striae. The following is Lea's original account of this form:

"There is too small a portion of this species remaining on the surface of the specimen to characterize it by a proper diagnosis. Perhaps a third of the valve only remains, but this is perfect, and beautifully and transversely striate—the striae being parallel."

Locality and horizon.—Pennsylvanian. Wilkesbarre, Pennsylvania. Type-specimen.—Cat. No. 33902, U.S.N.M.

**HARTTINA INDIANENSIS**, new species.

Plate XIX, figs. 6-15.

Shell terebratuliform, of medium size, oval to subpentagonal in outline, moderately convex or rather strongly gibbous. Greatest width about midway or a little below. A sinus is developed in the anterior half of the ventral valve which is sometimes broad and shallow, sometimes narrower and deeper. A corresponding fold seems to be lacking in the dorsal valve, of which the anterior portion is either slightly flattened or sometimes marked by another sinus, which runs but a short distance back from the anterior margin. The anterior outline is often more or less reentrant. Shell finely punctate.

Upon the interior the ventral valve is provided with two well-developed dental plates. In the dorsal valve there is probably a small hinge plate, from which proceeds a single rather short median septum about one-third as long as the entire valve. The auxiliary septa and platform characteristic of the genus *Dielasma* are not found.

The type material of this species was obtained from Pella, Marion County, Iowa, but the same form is represented also at Spergen Hill. I suspect that this species has sometimes been mistaken for *Dielasma turgidum*, which Hall and Clarke say is a typical *Dielasma*. It is possible that Whitfield's figures and those of Cumings and Beede copied from him were drawn from a specimen of the present species. It seems impossible to doubt that *Harttina indianensis* is a representative of a different genus from typical *Dielasma turgidum*, and even upon its external and specific characters it has not proved difficult to separate our material. *H. indianensis* is a larger form, less gibbous, seldom developing a sinus in the dorsal valve, and never developing a fold in the dorsal sinus, as is often the case in *D. turgidum*.

The configuration is so different from *Harttina anna*, the type of the genus and the only other North American species, that a discussion of the differences is not necessary. Although the configuration of the two species is so different, it seems necessary to refer the present

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one to Harttina, with which it agrees in internal structure certainly more closely than with any other Terebratuloid genus known to me. Harttina indianaensis seems to be the first occurrence of this genus noted in the Mississippi Valley and is of somewhat especial interest on that account.

Locality and horizon.—St. Louis group; Pella, Marion County, Iowa.

Type-specimens.—Cat. No. 9288, U.S.N.M.

TEGULIFERA ARMATA, new species.

Plate XX, figs. 1-11.

Shell rather small, generally conical but very irregular. Rapidly expanding. The blunt cone has no distinct apex, and in fact the apex is more or less truncated, owing to what appears to be a surface of attachment.

The rim, especially toward the front and sides, is armed with large stout spines, which sometimes project upward and sometimes inward over the aperture. The rim is occasionally double, or even treble, consisting of independent concentric plates with spaces between. One or all of them apparently may be spiniferous, or the spines may project from the inner surface of the aperture. Sometimes, though very rarely, the development of the spines is attended by the appearance of costae, which are rather few and faint and restricted to the vicinity of the rim.

The rest of the surface is marked by fine, irregular incremental lines, by irregular varices of growth, and by a few small spines, which are not mounted upon spine bases. There are also frequently two or three irregularly disposed, buttress-like ridges, chiefly developed near the area of attachment, which are possibly spines adnate to the surface. Whether the consecutive lamellae which sometimes appear at the aperture are due to the overlapping of different layers of shell, as was observed by Schellwein in Tegulifera deformis, or to a cessation of growth and a renewal within from a lower level than the aperture, a process not infrequently observable in the cup corals, has not been determined.

The dorsal valve is oval in shape, with a very short hinge line, nearly flat, slightly concave and of opercular form. It is situated well down near the base of the conical ventral valve and is marked only by fine incremental lines.

Apparently the ventral valve in process of growth wraps around the dorsal valve and around itself also. The lower portion of the ventral valve is, therefore, rather thick and in some cases diminished suddenly at the level of the dorsal, forming a sort of shelf or platform, from which some of the spines are developed. The thickened lower portion is sometimes occupied by a few large cysts.

\[k. k. Geol. Reichsanstalt, Abhand., XVI, Heft 1. 1900, p. 59 et seq.\]
Internal structures not known, probably Productoid and not strongly developed.

This interesting type at once suggests the genus Richthofenia, and, as already pointed out by Schellwien, Tegulifera is without much question closely related to that genus. There is, however, a less complete development of vesicular tissue, joined with less pronounced internal structures, and above all an absence of the enveloped area and pseudodeltidium. Tegulifera may possibly be considered a Productus (Marginifera) which has assumed the habit of self-envelopment, while Richthofenia may possibly be that of an Aulosteges (Strophalosia) which has done the same thing.

T. armata is therefore a Tegulifera, rather than a Richthofenia, and apparently a true representative of Schellwien's genus. It is clearly distinct from the typical and previously only known species of Tegulifera, however. T. deformis comprises elongate, more slender shells, which are without apertural spines. T. armata seems also to be more completely self-invested, since the whole primitive shell appears to be enveloped by later deposits. At least I have seen no instance such as Schellwien has figured of the original ventral shell distinct from and surrounded by later growths.

Locality and horizon.—Pennsylvania: La Salle, Illinois.

Type-specimens.—Cat. No. 37758, U.S.N.M.

TEGULIFERA KANSASENSIS, new species.

Plate XXI, figs. 1–7.

This species is so related to the preceding one that to some the advisability of separating them may seem doubtful. It forms a larger and considerably more elongate shell, also one which is apt to be more irregular and contorted in its growth. Fine radial costae are usually present, though sometimes not very distinct; yet in most cases they can be observed. While it is true that the specimens of T. kansasensis are not preserved favorably for showing this feature, the large spines which project from the aperture of T. armata appear to be entirely lacking from them. On these accounts it has seemed desirable to separate the Kansas form as a distinct species. It appears to be more nearly allied to T. typicalis than T. armata, but is believed to be distinct, by reason of its more or less strongly costate surface.

It was this species which in listing the fauna of the Kansas Pennsylvanian in 1903 I referred to as Proboscidella sp. With but little question it should not be placed with Proboscidella.

Locality and horizon.—Piqua limestone (?): 2½ miles west of Crane, Kansas.

Type-specimens.—Cat. No. 53470, U.S.N.M.

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\(^{a}\) U. S. Geol. Surv., Bull. 211, 1903, p. 79.
PUGNAX WEEKSI, new species.

Shell large, varying in shape from subtriangular or subovate to subpentagonal, and from elongate to transverse. As a rule highly gibbous, but sometimes of lower convexity, probably as a persistence of an immature character, young shells being usually discoidal. Ventral beak large, pointed, suberect, flattened, and spreading at the sides. Foramen apparently triangular and open. Dorsal beak rather inconspicuous, and strongly incurved. Fold and sinus very strong, usually broad and subquadrate, but sometimes narrow and sometimes rounded; typically divided by a medium sulcus so that it bears two plications, but occasionally the sulcus is so faint that the fold appears to be simple. Much more rarely three plications are found upon specimens referred to this species. There is always one rather distinct lateral plication on each side of the fold, with usually a second, which is also sometimes distinct but may be obscure. All the plications are confined to the marginal portions of the shell, and they vary in different specimens not only as to distinctness but also as to being angular or rounded. In young specimens the shell is broadly oval and discoidal. The fold develops first, and later its median sulcus and the lateral plications.

Upon the interior the ventral valve is provided with dental lamellae and the dorsal valve apparently with strongly diverging socket plates connecting with a hinge plate, which is also joined to a fairly long, high, median septum.

The posterior portion, especially of the ventral valve, is rather thick shelled, and moderately strong though not well-defined muscular imprints are retained in many instances.

In general appearance certain variants of this form are very suggestive of some species of Athyroids, as, for instance, Composita trinuclea, but more especially the forms grouped by Abich under the title Spirigera protea; some of which, unlike C. trinuclea, have lateral plications. Aside, however, from the fact that these shells appear to be without spiralea, the configuration of the beak of the ventral valve indicates almost to a certainty that we have not to do here with an Athyroid. In fact, there can be but little doubt that this form is one of the Rhynchonellidae. I have, however, been in some doubt as to what genus it would best be cited under. The choice seems to lie between Rhynchonella s. s. and Pugnax. The type species of Rhynchonella and Pugnax are very similar in external form, but Rhynchonella Iovia has a septum in the dorsal valve, while Pugnax pugnax is without that structure. In general appearance, therefore, R. weeksi

a Geologische Forschungen in den Kaukasischen Ländern, 1 Thell, Eine Bergkalkfaune aus der Araxesenge bei Djounfa in Armenien, Wien, 1878, p. 52 et seq.
could be referred to either genus with almost equal propriety, but it possesses a pretty well-developed dorsal septum. On that account it might best, perhaps, be referred to Rhynchonella, although internally and externally it appears to be generically related to certain Carboniferous shells which Hall and Clarke have placed with Pugnax.

This species is so dissimilar to any of our American Rhynchonelloids that a comparison with them is scarcely necessary. Tschernyschew has figured a similar species from the Gschel-stufe of Russia as *Pugnax connicus*. Some enlarged figures of *Pugnax dawsoniana* given by Davidson resemble the present species in a remarkable degree. I have not had specimens of *P. dawsoniana* for comparison, but in view of the great difference in size of the two species, their wide geographic separation, and their probable great difference in geological age and faunal association, such a comparison would. I believe, show them to be distinct. Hall and Clarke have figured a form from Windsor, Nova Scotia, referring it to Davidson's species, which if correctly identified clearly shows that the latter is distinct from *P. weeksi*.

This species is named in honor of Mr. F. B. Weeks, who, together with Mr. W. F. Ferrier, collected most of our material from the phosphate beds of Idaho.

**Locality and horizon.—** Phosphate beds: Montpelier, Idaho.  
**Type-specimens.—** Cat. No. 53466, U.S.N.M.

**Omphalotrochus Ferrieri**, new species.

Shell rather small, consisting of 6 or 7 volutions. Diameter rarely if ever in excess of 30 mm. and usually 25 mm. or less. Height about half the diameter, variable. Spire low, with flatish top and rounded sides. Suture more or less strongly indented. Umbilicus deep and broad. Peritreme section from subcircular to transversely subelliptical, sometimes more or less quadrangular, with a distinct peripheral carina. The horizontal axis of the peritreme section is almost perpendicular to the axis of revolution. The upper external portion of the peritreme between the carina and the suture is gently convex. It is marked by a revolving ridge, which is sometimes very indistinct, although internally it was given by Davidson as resembling the present species.

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*Tschermyschew. Com. Geol. [St. Petersburg], Mem., XVI, No. 2, 1902, p. 483, pl. I, figs. 12, 13, 19, 20.*


*Hall and Clarke. Geol. Surv. New York, Pal., VIII, Pl. 2, pl. lxii, figs. 30-33.*

*The term "phosphate beds" refers to a phosphate-bearing horizon in the Upper Carboniferous of Utah and Idaho which has not yet received a formation name. It will be fully described by Mr. F. B. Weeks in a forthcoming publication of the U. S. Geological Survey.—G. H. G.*
situated rather nearer to the carina than to the suture. Both above and below the revolving ridge the shell is depressed, but it rounds out again at the suture. The lower sulcus, that between the carina and the revolving ridge, is narrower and stronger than the one above the latter. In proportion as these two sulci are evanescent, the revolving ridge is distinct or obscure, and to some extent the carina is affected in the same manner. Usually the upper part of one volution projects somewhat above the preceding one, so that the suture is well marked. The junction of the two volutions is sometimes more precise, in which case the suture is less depressed. When this occurs, and when the sides are unusually flat, without a distinct revolving ridge, shells have a rather individual expression, and they may possibly deserve to be discriminated as a variety. On the lower side the shell is gently convex and regularly so, except for a shallow groove, more distinct in some specimens than in others, which occurs a little below the carina and helps to define it. The upper internal side is gently concave, by reason of conforming its shape to the preceding volution.

This description refers to the later or mature volutions, the earlier ones showing considerable variation. The earliest whorls, one or two in number, appear to have been nearly circular and complanate, so that the spire was really depressed. Then the shell became flattened on top, with a relatively deep median depression. The upper surface of the volutions here lay in the same plane, which was perpendicular to the axis of revolution. Then the upper or exposed surface became considerably broader, oblique, and much less strongly and sharply depressed. Finally, an elevation of its median or submedian portion into a revolving ridge gave it in the main a gently convex, instead of a concave, outline. It is due to the character of the early development that the spire is truncated on top, as if broken off, and owing to the same cause young shells are more discoidal than mature ones.

The growth lines in some specimens extend forward from the suture for a short distance, bending backward with a sharp turn on the little shoulder, which occurs just below the suture. In others their course appears to be backward from the start. About midway on the outer side, or just above the revolving ridge, they again assume a forward direction, which is reversed at the carina or immediately above it. On the under side the lines are gently sigmoid, but more or less backward in general direction. Thus the aperture would have had a projecting outline at the carina, with a strong sinus above and a shallow one on the under side. The growth lines are fine and regular, becoming strongly fasciculate and more or less sublamellose in older volutions.

*Omphalotrochus ferrieri* is extremely variable in all its characters, passing into types which approach more or less closely to *O. conoides*. It is named in honor of Mr. W. F. Ferrier, who, with Mr. F. B.
Weeks, collected most of our material from the phosphate beds of Idaho.

Locality and horizon.—Phosphate beds, Montpelier, Idaho.
Type-specimens.—Cat. No. 53465, U.S.N.M.

**Omphalotroechus conoideus**, new species.

Shell rather small, seldom exceeding 25 mm. in diameter, consisting of 7 or 8 volutions. Spire high, 19 mm. in one large specimen, but about 15 mm. in most cases. Umbilicus large, open. General outline conical, with sides nearly flat from apex to base. The peritreme section is approximately tetragonal, the upper and lower surfaces being more or less flat and subparallel, the inner surface nearly flat and perpendicular to them, and the outer also nearly flat, making an angle of about 60 degrees with the base. The junction of the external and lower surfaces forms a sharp, somewhat projecting carina, emphasized above and below by shallow indistinct grooves. A low ridge is usually developed on the external side of the peritreme slightly below the middle. Each of the mature volutions projects at its base a little beyond the upper edge of that which follows it. In but few instances is the upper edge of one volution flush with that which preceded, and in none has it been observed to extend beyond. The internal outline is circular, the shell being thickened to form the carina, and at the three other angles made by the surfaces of the peritreme.

The growth lines indicate that the aperture had a sinus above and below the carina, with a projection along it.

In most of the characters enumerated there is more or less variation. The lateral surface of the peritreme is usually slightly concave, but sometimes flat or convex. The lower surface also is in some cases more strongly rounded than in others, thus affecting the prominence and sharpness of the carina. The revolving ridge of the lateral surface is sometimes obscure, though usually distinguishable.

In all other characters, as well as some of those enumerated, this species is closely allied to *O. ferrieri*, so that the description of the former may be used for *O. conoideus*, with the following modifications: Like *O. ferrieri*, the spire of the present form is truncated, and owing to the same cause. The height of the peritreme is considerably greater than in *O. ferrieri*, because of the fact that the lateral surface is considerably oblique to the axis. It is, at the same time, slightly concave or flat, instead of being convex, although a slightly convex condition has sometimes been observed in shells referred to this species. The height of the shell is relatively considerably greater than in *O. ferrieri* for these reasons. The upper volution, instead of the lower, projects at the suture. The lower surface is flatter than in *O.*
*ferrieri*, which fact, joined with the flatter lateral surface, makes the carina sharper and more prominent.

Although the relationship of this form to *O. ferrieri* is very obvious, and although both forms vary so much that the extremes approach each other in some particulars, *O. conoideus* is a fairly well-marked form, deserving, it seems to me, specific distinction.

Locality and horizon.—Phosphate beds; Montpelier, Idaho.

Type-specimens.—Cat. No. 53464, U.S.N.M.

**EXPLANATION OF PLATES.**

**PLATE XIV.**

*Heteroceratia becdei*, new species.

Fig. 1. A fracture section through a specimen which seems to show branching X 2.

2. A partly weathered specimen showing the position of the spout-like ostia which have been almost worn away.

3. Thin section longitudinally cutting a distorted specimen. This section shows the general structure and especially the perforated cloacal tube X 3.

4. A weathered specimen showing the structure X 2.

5. A fracture section through a specimen in rock, showing the length of the spout-like ostia X 2.

6. A fracture section through a specimen X 2.

7. A weathered surface showing several specimens and their manner of occurrence.

8. Longitudinal section through a specimen which has weathered free. This also shows the perforated cloacal tube X 2.

Allen limestone, Chanute, Kansas.

**PLATE XV.**

*Mackrostia kansasensis*, new species.

Fig. 1. A thin section somewhat obliquely through a specimen. The cloaca shows in the lower part X 2. The dark material is rock, and the light, fossil.

2. Another longitudinal section X 2.

3. A well-preserved specimen partly overgrown by a bryozoan. Some of the ostia are shown.

4. Transverse section showing well-defined cloaca and about the usual amount of sponge tissue.

5. Longitudinal section showing the cloaca and irregularly chambered walls X 2. As this is a ground surface, the sponge tissue, which is transparent in thin sections, is dark and the rock light.

6. A transverse section, also ground, so that the light material represents rock X 2. The sponge tissue is here well developed with small chambers and cloaca.

7. A thin section, transverse, with very open structure X 2.

Allen limestone, Chanute, Kansas.

**Steinmannia benjamini**, new species.

8. A fracture section longitudinally through a specimen X 2. The light-colored material is in this case rock.

Allen limestone, Chanute, Kansas.
Plate XVI.

*Calocladia spinosa*, new species.

Fig. 1. Thin section, transverse, showing the well-defined cloaca surrounded by a thick wall composed of a mesh of consolidated spicules, pierced and interrupted by branching canals which terminate in spiniform ostia \( \times 4 \).

2. Part of a branch with the spiniform ostia well preserved.

3. Longitudinal section through a specimen similar to fig. 1, \( \times 4 \). The regularity of the spicules in this specimen suggests the structure of *Heliospongia*.

4. Longitudinal section through a branch showing the general relations of the cloaca, the walls, the branching canals, and the spiniform ostia \( \times 2 \). This is drawn from a polished surface and the spicules appear of a dark color instead of transparent, as in the thin sections.

5. Thin section longitudinal through another specimen \( \times 4 \).

6. Another thin section cut transversely through a branch \( \times 4 \).

7. A thin section tangential, showing the somewhat irregular spicular network \( \times 4 \).
   Allen limestone, Chanute, Kansas.

*Heliospongia ramosa*, new species.

8. Longitudinal section through a fragment referred to this species.

9. Transverse section through the same \( \times 2 \). These sections show fairly well the regular arrangement of the large spicules. The cloaca, though shown in a general way, is not clearly defined.
   Allen limestone, Chanute, Kansas.

*Heliospongia ramosa*, var. *parallela*, new variety.

10. Transverse section across one of the branches of the specimen represented on plate 5, \( \times 2 \). The structure here is of the same type as that shown by figs. 8 and 9.
   Allen limestone, Chanute, Kansas.

Plate XVII.

*Heliospongia ramosa*, new species.

Fig. 1. The type-specimen, natural size, showing the large size, the branching habit of growth, and the regular arrangement of the large spicules such that their arms make transverse and longitudinal lines.
   Allen limestone, Chanute, Kansas.

Plate XVIII.

*Heliospongia ramosa*, var. *parallela*, new variety.

Fig. 1. The type-specimen, natural size, showing the peculiar branching, different from the typical variety. A thin section from this specimen is illustrated on Plate XXV. This same slab shows several specimens of *Heterocelidium beechii*.
   Allen limestone, Chanute, Kansas.
PLATE XIX.

*Deltopecten clathratus* Lea.

Fig. 1. The typical specimen × 2. These two shells possibly belong together. That to the right, which is clearly a right valve, shows the characteristic hinge structure of *Deltopecten*.

*Myalina wyomingensis* Lea.

2. The type-specimen, freed from the matrix by which it was artially concealed in the original figure.

3. The type-specimen of Lea's *Mylolita minor*. The original, which is an external mold, crushed and imperfect, is probably a young example of *Myalina wyomingensis*.

*Pleurotomaria? distans* Lea.

4. The type-specimen × 2. A mere fragment, probably of a gastropod, though originally placed with the pelecypods.

*Edmondia? perstriato* Lea.

5. The type-specimen × 2. A mere fragment, probably the anterior end of a pelecypod.

Pennsylvanian, Wilkes-Barre, Pennsylvania.

*Harttina indistinctns*, new species.

6. A specimen with rather indistinct dorsal sinus; ventral view.

7. Dorsal view.

8. Dorsal view of a specimen with distinct dorsal sinus.

9. Ventral view of same.

10. An ovate specimen with imperfectly developed sinus; ventral view.

11. Dorsal view.

12. Ventral view of a broad variety with distinct dorsal sinus.


14. Specimen with the posterior portion ground down to show the internal structures. The ventral valve is seen to have two strong dental plates. In the dorsal valve the section passes below (interior to) the short low medium septum × 3.

15. Another specimen similarly prepared × 3. The dorsal valve is seen to have a single septal plate, neither very long nor very high, without any trace of the lateral septa and platform characteristic of *Dielasma*. The section touches the apex of the ventral valve and shows the beginnings of the dental plates.

St. Louis group, Marion County, Iowa.

PLATE XX.

*Tegulifera armata*, new species.

Fig. 1. Dorsal view of a small specimen retaining both valves in place × 2.

2. Ventral view × 2.

3. Anterior view of ventral valve of a specimen with apertural spines and basal ridges × 2.

4. Posterior view of same × 2.

5. Same, seen from below.
6. A characteristic specimen with both valves in place. Ventral view × 2.
7. Dorsal view showing the narrow hinge and the spines along the margin of the ventral valve × 2.
8. View obliquely down into the interior of a ventral valve, showing the spines developed within the cavity × 2.
10. Ventral view × 2.
11. Anterior view of a large specimen with concentric spiniferous layers at the aperture × 2.


Plate XXI.

_Tegulifera kansasensis_, new species.

**Fig. 1.** A slab of limestone containing two specimens. Side view showing one of them × 2.
2. Side view showing both specimens. The apical portion has been broken off in both instances × 2.
3. Ventral view of apical cap of one of the specimens represented by figure 2. There seems to be a flattened area of attachment × 4.
4. View of internal or dorsal side of same × 4.
5. A large specimen preserved in a manner similar to the last. Posterior view with the apical cap attached × 2.
6. Lower or ventral side with apical cap attached × 2.
7. Same with apical cap removed. What is here shown is the inner surface of the dorsal valve with the ventral valve surrounding it × 2.

Piqua limestone, Crane, Kansas.
The Carboniferous Sponge, Heterocelis Beedei.

For explanation of plate see page 300.
The Carboniferous Sponges, *Meadrostia* and *Steinmannia*.

For explanation of plate see page 300.
The Carboniferous Sponges, Ccelocladia and Heliospongia.

For explanation of plate see page 301.
The Carboniferous Sponge Heliozoa ramusa.
The Carboniferous Sponge, Heliospongia ramosa, var. parallela.

For explanation of plate see page 301.
Carboniferous Fossils from Wilkesbarre, Pennsylvania, and the Brachiopod, Harttina indianaensis.

For explanation of plate see page 302.
The Carboniferous Brachiopod, *Tegulifera armata.*

For explanation of plate see pages 302-303.
The Carboniferous Brachiopod, Tegulifera kansasensis.

For explanation of plate see page 303.
ON A COLLECTION OF FEATHER STARS, OR COMATULIDS, FROM JAPAN.

By Austin Hobart Clark.
Of the United States Bureau of Fisheries.

The United States National Museum has recently received from Mr. Alan Owston, of Yokohama, a small, but very interesting, collection of unstalked crinoids made by Mr. Owston in Tokyo and Sagami bays and in Suruga Gulf, deposited by Mr. Frank Springer for study in connection with the material obtained in somewhat deeper water by the U. S. Fisheries steamer Albatross.

Although containing only one hundred and thirty-one specimens, including forty-eight of Calometra multicolor and thirty of Cyllometra albowurpuraea, there are three species new to science, Comaster imbricata, Eudiocrinus variegatus, and Thalassometra komachi, one which was previously known only from a single Challenger specimen, Charitometra distincta, two previously known only from the types in the Museum of Comparative Zoology, Compsometra serrata and Iridometra psyche, and three, Himerometra subcarinata, Thalassometra aster, and Charitometra lata, known only from the types in the U. S. National Museum. Of especial interest also is a series of seven specimens of Tropiometra afr£a, affording an opportunity for a direct comparison of Australian and Japanese examples of this remarkable species.

Order COMATULIDA.

Family COMASTERIDÆ.

Genus COMASTER L. Agassiz.

COMASTER ROBUSTIPINNA (P. H. Carpenter.)

Sagami Bay; 35° 06' north latitude, 139° 42' east longitude; 30 fathoms; April 24, 1902. (Owston collection, No. 7215.)

One specimen, with 38 arms.

Sagami Bay, off Yenoshima; "probably 50 fathoms;" May 17, 1902. (Owston collection, No. 7217.)

One specimen, with 40 arms.

Sagami Bay, off Yenoshima; March 27, 1905. (Owston collection, No. 9275.)

Two large specimens.
Sagami Bay: 35° 11' north latitude, 139° 45' east longitude; 50 fathoms; June 30, 1901. (Owston collection, No. 6147.)
One specimen.

Suruga Gulf: April 12, 1903. (Owston collection, No. 7892.)
One specimen.

**COMASTER JAPONICA** (J. Müller).

Tokyo Gulf; Uraga channel; 25 fathoms; June 16, 1901.
One specimen with 22 arms.

Sagami Bay: 35° 11' north latitude, 139° 44' east longitude; 140 fathoms; May 25, 1902. (Owston collection, No. 6929.)
One specimen, approaching *C. solaster*, with 20 arms.

Sagami Bay: 300 fathoms (?); May 5, 1902. (Owston collection, No. 6932.)
One specimen, approaching *C. robustipinna*, with 29 arms.

Sagami Bay: 35° 04' north latitude, 138° 48' east longitude; 80 fathoms; August 10, 1902. (Owston collection, No. 7194.)
One specimen, with the carination of the proximal pinnule joints much more marked than usual.

Sagami Bay: 35° 03' north latitude, 138° 47' east longitude; 110 fathoms; August 15, 1902. (Owston collection, No. 7011.)
One specimen.

**COMASTER PARVICIRRA** (J. Müller).

Sagami Bay: 35° 02' north latitude, 138° 50' east longitude; 55 fathoms. (Owston collection, No. 7636.)
One specimen with exactly 30 arms, the distichals 4 (3+4), the palmars, which are only developed on the inside of the rays, in 1, 2, 2, 1 order, 2.

Sagami Bay: 35° 06' north latitude, 139° 42' east longitude; 30 fathoms: April 24, 1902 (Owston collection, No. 7215); or 34° 59' north latitude, 139° 33' east longitude; 60 fathoms: April 20, 1902. (Owston collection, No. 7214.)
One specimen with 30 arms, similar to the preceding.

**COMASTER IMBRICATA**, new species.

The centro-dorsal is large, discoidal, the dorsal surface flat, bearing a single, somewhat irregular, row of cirrus sockets.

There are twenty-five cirri, 20 mm. to 30 mm. long, with twenty-two to thirty (usually about twenty-five) joints; those in the basal half are squarish, those in the distal are not quite so long as broad; after the eighth joint the distal edges begin to project dorsally in the shape of a broadly rounded serrate ridge, appearing like a spine in lateral view; this ridge gradually moves nearer and nearer the middle of the dorsal surface, and in the terminal joints occupies...
a median position; the opposing spine is short and transversely linear, forming a ridge across the entire dorsal surface of the joint; the terminal claw is stout, moderately curved, about equal to the penultimate joint in length; the ventral distal ends of the cirrus joints are more prominent than usual, and show a tendency to overlap.

The radials are concealed; the first costals are short and broad, partially united laterally; the costal axillaries are very broadly pentagonal or almost triangular, about twice as broad as long, widely separated laterally; eight of the ten distichal series are 4 (3+4), the remaining two being 2: these last bear no palmars; there are six palmar series of 2 and two of 1 (3+4); there is a single post-palmar series of 4 (3+4) following a palmar series of 2. There are about 30 arms 90 mm. long, all the joints with very strongly produced and overlapping distal edges; the first three or four joints are discoidal, the remainder quadrate or almost triangular, about twice as broad as long. The first syzygy is between the third and fourth brachials, the next near the eleventh and twelfth, and syzygia occur distally at intervals of about four oblique musculare articulations.

The distichal pinnule is about 16 mm. long, and not especially stout, the proximal joints with rather prominent distal ends, but not carinate; the first and second brachial pinnules are similar, but shorter, and the third is but 5 mm. long; the distal pinnules have the basal joints with prominent distal ends.

Color (in spirits).—Brownish yellow, the cirri lighter with occasional dark bands.

Type.—Cat. No. 22697, U.S.N.M.

Sagami Bay; 35° 06' north latitude, 139° 42' east longitude; 50 fathoms. (Owston collection, No. 7216.)

The very strong imbrication of the brachials, and the broad, rounded, transverse ridge, appearing spine-like in lateral view, on the cirrus joints, separate this species from all the other Pacific species of the genus, while the method of arm-division and the position of the first syzygy separate it from all the species known from the Atlantic.

Family ZYGOMETRID.E.

Genus EUDIOCRINUS P. H. Carpenter.

EUDIOCRINUS VARIEGATUS A. H. Clark.

Sagami Bay; 34° 59' north latitude, 139° 34' east longitude; 60 fathoms; April 17, 1902. (Owston collection, No. 6931.)

One specimen (the type).
Family HIMEROMETRIDÆ.

Genus HIMEROMETRA A. H. Clark.

HIMEROMETRA SUBCARINATA A. H. Clark.

Tokyo Gulf: Uraga channel; 25 fathoms; May 26, 1901. (Owston collection, No. 6067.)

One specimen, resembling the type, but very dark, nearly black in color.

Tokyo Gulf: Uraga channel; 30 fathoms; May 17, 1901. (Owston collection, No. 6052.)

Two specimens, resembling the preceding.

Sagami Bay; 34° 47' north latitude; 138° 44' east longitude; 56 fathoms; August 20, 1902. (Owston collection, No. 7173.)

One specimen, resembling the preceding.

Sagami Bay; 35° 02' north latitude, 138° 52' east longitude; 50 fathoms; August 6, 1902. (Owston collection, No. 7016.)

Three specimens, resembling the preceding.

This species was previously known only from the southern part of the Sea of Japan.

Genus OLIGOMETRA A. H. Clark.

OLIGOMETRA JAPONICA (Hartlaub).

Sagami Bay; 35° 02' north latitude, 138° 50' east longitude; 55 fathoms. (Owston collection, No. 7036.)

The collection contains one specimen, agreeing well with Hartlaub's original description. There are twenty-seven cirri, 10 mm. long, with sixteen to twenty-one (most commonly eighteen or nineteen) joints, all subequal, approximately squarish, the fourth and fifth and those following bearing a low transverse serrate ridge, situated in the middle of the joint, appearing as a short dorsal spine in lateral view. The opposing spine is short, but prominent, rather less than half the diameter of the penultimate joint in height, situated in the middle of the dorsal side. The terminal claw is about equal in length to the penultimate joint, moderately stout, and rather abruptly curved.

Arms about 40 mm. long, as in Hartlaub's specimen; the proximal brachials are smooth, the middle and distal somewhat overlapping; syzygia occur between the third and fourth brachials, again between the ninth and tenth to fifteenth and sixteenth, and distally at intervals of five to nine (usually six) oblique muscular articulations.

The first three pinnules are approximately equal in length, 8 mm. long, with about fifteen joints, the first short, the second squarish, the remainder elongate; the joints in the proximal half are smooth,
those in the distal with strongly produced and overlapping spinous distal edges; the fourth pinnule is only 5 mm. long, and the following increase rather rapidly to 8 mm., which length they maintain almost to the end of the arm.

Color (in formalin).—Purple, the cirri yellow with a broad purple band about the middle of each joint; two regenerated arms are yellow.

The equality in size of the three proximal pinnules and the proportionately long cirrus joints appear to be constant characters for the differentiation of this species from _O. serripinna._

**Genus CYLLOMETRA A. H. Clark.**

**CYLLOMETRA ALBOPURPUREA A. H. Clark.**

_Sagami Bay; 35° 02' north latitude, 138° 50' east longitude; 55 fathoms._ (Owston collection. No. 7036.)

Eleven small specimens: four with 10 arms; two with 11; two with 12; two with 13; one with 14.

_Sagami Bay; off Sunosaki; 55 fathoms; May 8, 1899._ (Owston collection. No. 5417.)

One specimen with 16 arms.

_Sagami Bay; 35° 06' north latitude, 139° 42' east longitude; 30 fathoms; April 24, 1902_ (Owston collection. No. 7215); or _34° 50' north latitude, 139° 33' east longitude; 60 fathoms; April 20, 1902._ (Owston collection. No. 7214.)

Two small specimens, one with 10, the other with 15 arms.

_Sagami Bay; 34° 58' north latitude, 138° 45' east longitude; 77 fathoms; August 13, 1902._ (Owston collection. No. 9274.)

One specimen.

_Sagami Bay; 35° 13' north latitude, 139° 45' east longitude; 40 fathoms; November 9, 1902._ (Owston collection. No. 7283.)

One specimen.

_Sagami Bay; 35° 11' north latitude, 138° 43' east longitude; 30 fathoms; December 1, 1901._ (Owston collection. No. 6659.)

Five specimens: one with 14 arms; one with 18; two with 20; one with 21: the last has the single palmar series developed on the outer side of one of the rays; on one arm the syzygial pair consisting of the third and fourth brachials is repeated, neither bearing a pinnule.

_Sagami Bay; 55° 13' north latitude, 139° 45' east longitude; 40 fathoms; November 9, 1902._ (Owston collection. No. 7283.)

One specimen with 20 arms.

_Sagami Bay; off Aburatsubo; 60 fathoms; April 2, 1899._ (Owston collection. No. 5417.)

One specimen.

_Sagami Bay; 35° 11' north latitude, 139° 45' east longitude; 50 fathoms; June 30, 1901._ (Owston collection. No. 6106.)

One specimen with 20 arms.
Sagami Bay; 34° 59' north latitude, 139° 34' east longitude; 55 fathoms; April 23, 1902. (Owston collection, No. 6332.)

One small specimen with 13 arms.

Tokyo Gulf; Uraga Channel; 25 fathoms; May 26, 1901. (Owston collection, No. 6067.)

One specimen with 13 arms.

Tokyo Gulf; Uraga Channel; 20 to 30 fathoms; April 21, 1901. (Owston collection, No. 5780.)

One specimen with 20 arms.

Tokyo Gulf; 8 to 12 fathoms; October 22, 1899. (Owston collection, No. 5586.)

One specimen with 20 arms, large and richly colored.

Tokyo Gulf; Uraga Channel; 80 fathoms; June 8, 1900. (Owston collection, No. 6357.)

Two small specimens, one with 15, the other with 20 arms.

Family THALASSOMETRIDE.

Genus THALASSOMETRA A. H. Clark.

THALASSOMETRA ORION (A. H. Clark).

Sagami Bay; 35° 03' north latitude, 138° 47' east longitude; 85 fathoms. (Owston collection, No. 7010.)

One specimen.

THALASSOMETRA QUINQUECOSTATA (P. H. Carpenter).

Sagami Bay; 35° 03' north latitude, 138° 47' east longitude; 110 fathoms. (Owston collection, No. 7189.)

One specimen, yellow, a broad median line on costals, distichals, and arms, and a lateral line on arms, white; cirri banded yellow and white; pinnules blotched yellow and white.

Sagami Bay; off Yenoshima; April, 1896. (Owston collection, No. 6275.)

One specimen, colored like the preceding.

Sagami Bay; 35° 04' north latitude, 138° 48' east longitude; 80 fathoms; August 8, 1902.

One specimen, colored like the preceding.

THALASSOMETRA ASTER (A. H. Clark).

Sagami Bay; off Okinose; 400 fathoms; March, 1900. (Owston collection, No. 6679.)

One fine large specimen, much larger than the type, but exhibiting the same characters.
The centro-dorsal is bluntly conical or short-columnar, the cirrus sockets closely crowded and arranged roughly in three columns in each radial area, two to a column; the bare polar area is granulose.

The cirri are twenty-five in number with forty to fifty-five joints. 40 mm. long for the longer, 25 mm. for the shorter, basally slender and rounded, becoming much compressed and broad distally; the first four or five joints are about twice as broad as long; the next joint is squarish; the next is about twice as long as its proximal diameter, decreasing in diameter distally; the cirrus decreases in diameter at this point, the elongated transition joint being dull and dark like the preceding in its anterior two-thirds, and highly polished like the succeeding in its distal third; the joints following the transition joint are approximately squarish (the first being usually longer than broad), gradually becoming shorter and very short distally; at about the fourth joint beyond the transition the distal dorsal edge begins to project, soon becoming a deep dorsal spine, which arises from the whole of the dorsal border; the dorsal spines on the terminal joints decrease in height; the opposing spine is short and blunt, terminally situated, not reaching half the breadth of the penultimate joint in height; the terminal claw is stout and moderately curved, rather longer than the penultimate joint.

The disk is scantily plated, except along the ambulacra, but the brachial and pinnule ambulacra are well plated. The sacculi are abundant on the brachial and pinnule ambulacra.

The ends of the basal rays are visible as prominent, though small, tubercles in the angles of the calyx; the radials have a strongly curved distal border, not visible in the median line, but extending far up in the angles of the calyx and surrounding the ends of the basal rays, reaching as high as the lateral angles of the costal axillaries; the first costals are laterally concealed by the interradial anterior extension of the radials and are visible as a triangle (apex downward) in the median line, the edges everted and roughened; the costal axillary is over twice as broad as long, rhombic, rising to a low tubercle with the first costal, the edges all around everted and roughened, the dorsal surface (as in the first costal) perfectly smooth; the distichals are 2, present on all the arms, resembling the costals; there are no palmars. There are twenty arms, 125 mm. long; the first brachial is wedge-shaped, the longer side out; the second brachial is nearly twice as large, but similar; the following to about the tenth are oblong, about twice as broad as long, soon becoming triangular, broader than long, gradually becoming as long as broad, and distally wedge-shaped again and more or less elongate. The oblong joints in the lower part of the arm have both the anterior and posterior edges
everted and roughened; this soon changes to an eversion of the distal ends of the joints, which are finely spinous, and then to a strong overlapping of the distal ends; the joints in the proximal third of the arm have the dorsal surface perfectly smooth; in the outer two-thirds the dorsal surface is thickly set with longitudinal lines of fine spines directed forward, giving the outer part of the arms a peculiar velvety appearance. The costals, distichals, and first two brachials are in close apposition and sharply flattened laterally; the proximal third of the arm is remarkably deep and compressed, the outer two-thirds dorsally somewhat sharply rounded.

The first pinnule is 8 mm. long with twenty joints, the first three not so long as broad, with the corners cut away, the following squarish, gradually becoming elongate, and distally about twice as long as broad; this pinnule is considerably longer and stouter than the following, stout basally, tapering gradually to a slender and delicate tip; it is, on the outer side of the rays, sharply flattened exteriorly; the next three pinnules are 6 mm. long with fifteen joints, most of them squarish, the basal two or three rather shorter, the distal rather longer; the following pinnules are of the same length, but rather broader and more sharply carinate, distally becoming rather longer, but remaining comparatively stout; the distal pinnules are 9 mm. or 10 mm. long, the first joint rounded-triangular, concave anteriorly, the second squarish, the remainder longer than broad, becoming about twice as long as broad distally.

Color (in spirits).—Yellowish brown; the containing liquid is stained the same color.

Type.—Cat. No. 22696, U.S.N.M. From Misaki, Sagami Bay, Japan. (Owston collection, No. 8141.)

Genus CHARITOMETRA A. H. Clark.

CHARITOMETRA DISTINCTA (P. H. Carpenter).

"Sagami Bay,"
One perfect specimen, agreeing with Carpenter's description and figure, but possessing 33 arms.

CHARITOMETRA LATA (A. H. Clark).

*Sagami Bay;* off Misaki: July, 1902. (Owston collection, No. 6969.)
One specimen, larger than the type, but with the calyx and arm bases slightly less rugged, and yellow in color; probably not quite mature.
Family TROPIOMETRIDEÆ.

Genus CALOMETRA A. H. Clark.

CALOMETRA FLAVOPURPUREA (A. H. Clark).

Sagami Bay; 35° 03' north latitude, 138° 47' east longitude; 85 fathoms. (Owston collection, No. 7010.)
One specimen.

Sagami Bay; 35° 04' north latitude, 138° 41' east longitude; 110 fathoms; August 6, 1902. (Owston collection, No. 7061.)
Six specimens.

Sagami Bay; 35° 03' north latitude, 138° 47' east longitude; 110 fathoms; August 28, 1902. (Owston collection, No. 7189.)
One specimen.

CALOMETRA SEPARATA (A. H. Clark).

Sagami Bay; 34° 59' north latitude, 139° 34' east longitude; 55 fathoms; April 23, 1902. (Owston collection, No. 6332.)
Two specimens.

CALOMETRA MULTICOLOR (A. H. Clark).

Sagami Bay; 35° 08' north latitude, 139° 42' east longitude; 30 fathoms; October 12, 1902. (Owston collection, No. 7282.)
Three specimens.

Sagami Bay; same locality and depth; May 25, 1902. (Owston collection, No. 6930.)
Two specimens.

Sagami Bay; off Okinose; 55 fathoms; October 27, 1901. (Owston collection, Nos. 5417 and 6358.)
Three specimens.

Sagami Bay; 35° 02' north latitude, 138° 50' east longitude; 55 fathoms. (Owston collection, No. 7036.)
One 10-armed young.

Sagami Bay; off Sunosaki; 55 fathoms; May 8, 1899. (Owston collection, No. 5417.)
One very small 10-armed young.

Sagami Bay; 35° 06' north latitude, 139° 42' east longitude; 30 fathoms; April 24, 1902 (Owston collection, No. 7215): or 34° 59' north latitude, 139° 33' east longitude; 60 fathoms; April 20, 1902. (Owston collection, No. 7214.)
Thirteen specimens.

Sagami Bay; 34° 58' north latitude, 138° 45' east longitude; 77 fathoms; August 13, 1902. (Owston collection, No. 9274.)
One specimen.
Sagami Bay; 35° 13' north latitude, 139° 45' east longitude; 40 fathoms; November 9, 1902. (Owston collection, No. 7283.)
One specimen.

Sagami Bay; 34° 59' north latitude, 139° 34' east longitude; 60 fathoms; April 17, 1902. (Owston collection, No. 6931.)
Six specimens, including one 10-armed young.

Sagami Bay; 35° 08' north latitude, 139° 42' east longitude; 30 fathoms; May 25, 1902. (Owston collection, No. 6930.)
Two specimens.

Sagami Bay; 35° 04' north latitude, 138° 41' east longitude; 110 fathoms; August 6, 1902. (Owston collection, No. 7061.)
One specimen.

Sagami Bay; 35° 11' north latitude, 139° 45' east longitude; 50 fathoms; June 30, 1901.
Three specimens.

Sagami Bay; 35° 09' north latitude, 139° 42' east longitude; 30 to 40 fathoms; May 4, 1902. (Owston collection, No. 6428.)
One specimen.

Sagami Bay; 34° 59' north latitude, 139° 34' east longitude; 55 fathoms; April 23, 1902. (Owston collection, No. 6332.)
Two specimens.

Sagami Bay; 35° 08' north latitude, 139° 42' east longitude; 30 fathoms; October 12, 1902. (Owston collection, No. 7282.)
One specimen.

Sagami Bay; same locality and depth; May 25, 1902. (Owston collection, No. 6930.)
One specimen.

Sagami Bay; 35° 03' north latitude, 139° 42' east longitude; 30 fathoms; October 12, 1902. (Owston collection, No. 7283.)
One specimen.

Sagami Bay; 35° 13' north latitude, 139° 45' east longitude; 40 fathoms; November 9, 1902. (Owston collection, No. 7283.)
One specimen.

Tokyo Bay; Uraga Channel; 25 fathoms; May 26, 1901. (Owston collection, No. 6067.)
One large 10-armed specimen.

Tokyo Bay; Uraga Channel; 20 to 30 fathoms; April 21, 1901. (Owston collection, No. 5781.)
One specimen.

Tokyo Bay; Uraga Channel; 30 fathoms; May 17, 1901. (Owston collection, No. 6052.)
Two specimens.
Genus TROPIOMETRA A. H. Clark.

TROPIOMETRA AFRA (Hartlaub).

The collection contains seven specimens of this interesting species. In view of its apparent rarity, the following notes may prove of interest:

Sagami Bay; 37° 07' north latitude, 139° 44' east longitude; 21 fathoms. November 11, 1901. (Owston collection, No. 5915.)

Four specimens, all deep purple in color.

No. 1.—The arms are 210 mm. long, the calyx 30 mm. in diameter at the level of the first syzygy; there are thirty-six cirri 50 mm. long, with thirty-seven to forty-three (usually about forty) joints; two of the cirri have the distal portion broken off and regenerated, though the regenerated portion has not yet reached the normal stoutness. Regeneration of the cirri appears to be rare among the comatulids, having been heretofore reported only in Tropiometra carinata, and, more recently, in Deacetecoverinae vanhoffeniana. The first pinnule is 23 mm. long with thirty to thirty-five joints; the second pinnule is rather stouter, 24 mm. long, with a similar number of joints; the third pinnule is similar to the second; the following pinnules gradually decrease in length, the sixth being 22 mm. long, the eighth 18 mm., and the ninth 16 mm.

No. 2.—The arms are 180 mm. long, the calyx 25 mm. in diameter at the level of the first syzygy; there are twenty-four cirri 40 mm. long with thirty-four to thirty-eight (usually thirty-seven) joints; the lower pinnules are all broken.

No. 3.—The arms are 170 mm. long, the calyx 23 mm. in diameter at the level of the first syzygy; there are twenty-five cirri 40 mm. long with thirty-four to thirty-seven (usually nearer the latter) joints.

No. 4.—The arms are 130 mm. long, the calyx 20 mm. in diameter at the level of the first syzygy; there are twenty-eight cirri 40 mm. long with thirty-four joints.

Sagami Bay; off Misaki. (Owston collection, No. 8139.)

One specimen with arms 210 mm. long; it has twenty-eight cirri 40 mm. long with thirty to thirty-five (usually thirty-four) joints; the pinnules are as in No. 1 from the preceding station. The color (in formalin) is yellow.

Sagami Bay; off Misaki; June, 1903.

One specimen with arms 230 mm. long; it has twenty-eight cirri 40 mm. long with twenty-nine to thirty-five (usually nearer the latter) joints.

Sagami Bay; 35° 15' north latitude, 139° 48' east longitude; 10 fathoms; November 23, 1902. (Owston collection, No. 7285.)
One specimen with arms 200 mm. long; there are thirty-five cirri 40 mm. long, with twenty-seven to thirty-six (usually about thirty-three) joints.

I cannot find any tangible difference between the Japanese form described in 1805 by Hara under the name of *macrodiscus*, and the Australian *afra* described by Hartlaub two years earlier, of which the U. S. National Museum possesses a dried specimen from the South Pacific. The latter agrees in all particulars with the Japanese specimens, and has rather more cirrus joints than did Hartlaub's type, these numbering about thirty-three, as stated in Hara's description of *macrodiscus*.

**Family ANTEDONIDÆ.**

**Genus PEROMETRA A. H. Clark.**

**PEROMETRA DIOMEDES (A. H. Clark).**

*Sagami Bay; 35° 03' north latitude, 138° 47' east longitude; 85 fathoms.* (Owston collection, No. 7010.)

One large and pale specimen: one ray is dwarfed, the arms being about half the size of the others; the first costal is lacking, the costal axillary springing direct from the radial; there is no trace of any tubercular elevation; between the first and second brachials on the left arm of this ray there is a partial additional second brachial, which is visible externally dorsally from the outer side of the arm to the median line, its length in the direction of the long axis of the arm being about half as great; this partial joint rises to a strong tubercle proximally, and a less strong tubercle distally; it does not bear a pinnule.

*Sagami Bay; 35° 04' north latitude, 138° 41' east longitude; 110 fathoms; August 6, 1902.* (Owston collection, No. 7061.)

One large and pale specimen.

**Genus ERYTHROMETRA A. H. Clark.**

**ERYTHROMETRA RUBER (A. H. Clark).**

*Sagami Bay; 34° 59' north latitude, 139° 34' east longitude; 55 fathoms; April 23, 1902.* (Owston collection, No. 6332.)

One specimen, resembling the type.

**Genus COMPSOMETRA A. H. Clark.**

**COMPSOMETRA SERRATA (A. H. Clark).**

*Tokyo Bay; 8–12 fathoms; October 22, 1899.* (Owston collection, No. 5361.)

One specimen, resembling the type in the Museum of Comparative Zoology, which was taken at the same time and place.
Genus IRIDOMETRA A. H. Clark.

IRIDOMETRA PSYCHE (A. H. Clark).

*Sagami Bay*: 35° 06' north latitude, 139° 42' east longitude; 30 fathoms; April 24, 1902. (Owston collection, No. 7215.)

A single specimen somewhat smaller than the type and white in color, the arms crossed at the second syzygy with a purple band 2 mm. broad, and two narrower additional purple bands distally.

In addition to these comatulids Mr. Owston has frequently taken *Metacrinius rotundus* off the southern coast of Hondo, of which species I examined some very fine specimens when looking over his material in Yokohama.

**ADDITIONAL JAPANESE SPECIES.**

In order to emphasize the uncertainty of securing any given species of comatulid in an area where it is known to occur, as well as to complete the list of species occurring along the southern shores of Japan from the Korean Straits to Tokyo Bay, I append the following list of species known from Japan, but not found by Mr. Owston during the course of his investigations, although occurring at such depths as to be accessible to him.

**Family COMASTERID.E.**

Genus COMATULA Lamarck.

*Comatula paucicirra* (Bell).

Genus COMASTER L. Agassiz.

*Comaster marie* (A. H. Clark).
*Comaster multiradiata* (Linnaeus).
*Comaster serrata* (A. H. Clark).
*Comaster solaster* (A. H. Clark).

**Family ZYGOMETRID.E.**

Genus CATOPTOMETRA A. H. Clark.

*Catoptometra hartlaubi* (A. H. Clark).
*Catoptometra kochleri* (A. H. Clark).
*Catoptometra rubroflava* (A. H. Clark).

**Family HIMEROMETRID.E.**

Genus HIMEROMETRA A. H. Clark.

*Himerometra delicatissima* (A. H. Clark).
*Himerometra döderleinii* (de Loriol).
*Himerometra stylifer* (A. H. Clark).
Genus CYLLOMETRA A. H. Clark.

Cyllometra tigrina (A. H. Clark).

Family THALASSOMETRIDÆ.

Genus THALASSOMETRA A. H. Clark.

Thalassometra alboflava (A. H. Clark).
Thalassometra diadema (A. H. Clark).
Thalassometra hana (A. H. Clark).
Thalassometra latipinna (P. H. Carpenter).
Thalassometra pubescens (A. H. Clark).

Genus CHARITOMETRA A. H. Clark.

Charitometra garrettiana (A. H. Clark).
Charitometra hepburniama (A. H. Clark).

Genus PÆCILOMETRA A. H. Clark.

Pæcilometra avala (P. H. Carpenter).

Family TROPIOMETRIDÆ.

Genus CALOMETRA A. H. Clark.

Calometra callista (A. H. Clark).
Calometra versicolor (A. H. Clark).

Genus ASTEROMETRA A. H. Clark.

Asterometra anthus (A. H. Clark).
Asterometra macropoda (A. H. Clark).

Family ANTEDONIDÆ.

Genus NANOMETRA A. H. Clark.

Nanometra bowersi (A. H. Clark).

Genus IRIDOMETRA A. H. Clark.

Iridometra adrestine (A. H. Clark).
Iridometra briscis (A. H. Clark).
Iridometra minuta (A. H. Clark).

Genus THAUMATOMETRA A. H. Clark.

Thaumatometra alternata (P. H. Carpenter)
Thaumatomeira parra (A. H. Clark).

Genus HELIOMETRA A. H. Clark.

Heliometra elio (A. H. Clark).
Heliometra laodice (A. H. Clark).
Heliometra marie (A. H. Clark).
Genus THYSANOMETRA A. H. Clark.

*Thysanometra tenelloides* (A. H. Clark).

Family PENTAMETROCRINIDÆ.

Genus DECAMETROCRINUS Miinekert.

*Decametrocrinus borealis* (A. H. Clark).

Genus PENTAMETROCRINUS A. H. Clark.

*Pentametrocrinus diomedae* (A. H. Clark).
*Pentametrocrinus japonicus* (P. H. Carpenter).
*Pentametrocrinus tuberolatus* (A. H. Clark).
*Pentametrocrinus varians* (P. H. Carpenter).

The stalked crinoids known from the seas about southern Japan are:

*Metacrinus angulatus* (P. H. Carpenter).
*Metacrinus rotundus* (P. H. Carpenter).
*Metacrinus superbus* (P. H. Carpenter).
*Carpentcrocrinus mollis* (P. H. Carpenter).
*Phrynocrinus nudus* (A. H. Clark).
*Bathyocrinus pacificus* (A. H. Clark).

I have examined the following species labeled, probably erroneously, as from Japan:

*Himerometra crassipinna* (Hartlaub).

The United States National Museum possesses Japanese specimens of all the stalked crinoids listed, and of all the comatulids except *Comaster multiradiata, Himerometra döderleini, Thalassometra latipinna, and Thaumatometra alternata*.

There can be no doubt that there are yet many crinoids, especially comatulids, occurring about Japan of which we have no knowledge.
DECORATIVE DESIGNS OF ALASKAN NEEDLECASES: A STUDY IN THE HISTORY OF CONVENTIONAL DESIGNS, BASED ON MATERIALS IN THE U. S. NATIONAL MUSEUM.

By FRANZ BOAS,

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In 1877, Prof. F. W. Putnam a described in detail the decorative designs found in the pottery of the Chiriqui Indians, and was the first, I believe, to propound clearly the theory that conventional designs develop from attempts at realistic representations, which gradually degenerate so that ultimately a purely conventional design remains, in which the realistic origin can hardly be recognized. Since that time this theory has been independently stated by a number of investigators, particularly by H. Stolpe b and H. Balfour. c It has been applied extensively to explanations of primitive designs. The most noteworthy contributions on this subject are those by Karl von den Steinen, d on the art of the Brazilian Indians, and by A. C. Haddon, e on the art of the natives of New Guinea.

Opposed to this view has been the theory propounded by Semper, who emphasizes the influence of material upon the development of the design, and that proposed by Cushing and Holmes, f who emphasize the importance of technic upon the development of geometrical design. More recently Karl von den Steinen g has also emphasized the importance of technical conditions upon the development of design, and his arguments have been followed and elaborated by Max Schmidt in discussions of South American designs. Th. Koch follows in the same line of argument, showing that at least in Brazil a consid-

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b Entwicklungserscheinungen in der Ornamentik der Naturvölker, Mit. d. anthrop. Ges. in Wien, 1892, pp. 19 et seq.
c The Evolution of Decorative Art, 1893.
d Unter den Naturvölkern Zentral-Brasiliens, 1894, pp. 258 et seq.
e Correspondenzblatt der deutschen anthropologischen Gesellschaft, 1905.
g Correspondenzblatt der deutschen anthropologischen Gesellschaft, 1905.
erable number of cases may be found in which designs that have developed from technical motives receive a realistic significance.

From a wider point of view, the secondary development of motives and their re-interpretation as realistic designs have been claimed by Heinrich Schurz \(^a\) and by Professor Hamlin \(^b\) in a discussion of the development of architectural decorative designs. The secondary character of symbolic interpretation has also been set forth by A. L. Kroeber,\(^c\) Clark Wissler,\(^d\) and by myself.\(^e\)

We have therefore at the present time three distinct theories regarding the development of decorative design: First, the theory of the realistic origin of conventional motives; second, that of the technical origin of conventional motives; and, third, the theory that the explanations of conventional motives are essentially secondary in character, and due to a later association of the existing decorative forms with realistic forms.

I shall discuss in the following pages the decorative designs of Alaskan needlecases, largely from the region between the mouth of the Yukon River and the western part of Norton Sound, which seem to throw considerable light upon the history of decorative design, and illustrate the applicability of these various theories.

Among the carvings of Alaskan Eskimo we find a very large number of needlecases of peculiar form. They are of the characteristic tubular type of the Eskimo needlecase, in which the needle is inserted in a strip of skin pulled into a tube, which protects the needle against breakage. The peculiar type to which I here refer has, on the whole, a tube slightly bulging in the middle, and expanding into two wings or flanges at the upper end. It is characteristic of almost all these specimens that at a short distance below the flanges there are two small knobs on opposite sides of the tube. In some cases these are well marked, while in other cases they are so diminutive that they can not be seen at all, although they can be felt when moving the finger gently over the surface of the tube. They must be considered as one of the characteristic features of this type, which is so well defined, and whose distribution is so restricted that there can not be the slightest doubt as to the unity of its origin.

These needlecases have also a characteristic decoration. On the whole, there is a tendency to set off a slightly concave surface, which extends along the faces of the tube, between the flanges and farther down. This concave face may be observed on many of the needle-

\(^a\) Urgeschichte der Kultur, p. 540.
\(^b\) The American Architect and Building News, 1898.
\(^c\) Decorative symbolism of the Arapaho, Am. Anthr., n. s. III, p. 329.
\(^e\) The Decorative Art of the North American Indians, Pop. Science Monthly, 1903, pp. 481 et seq.
cases shown on Plates XXII and XXIII (see Plate XXII, figs. 6, 7, 9, 10; Plate XXIII, figs. 1–4, 6, 8, 9, 11, 12). The flanges and the upper border of the tube are generally decorated by a design consisting of a number of parallel lines, which is repeated near the lower end of the flanges, where the parallel lines almost always slope slightly downward towards the tube. Similar line designs are also found on the concave face of the tube. In many cases these lines meet the lower lines on the flanges at an angle, being incised so that they slope downward from the middle line of the tube outward (Plate XXII, figs. 1–6). In other cases they continue in the same direction as the lines on the flanges (Plate XXII, figs. 7, 8; Plate XXIII, figs. 2–4, 6–12). Many of the needlecases are so much polished and rubbed off by use that the design lines can not be recognized distinctly. In other cases broken ends have been cut off (Plate XXII, fig. 7), with the result that the characteristic decorative traits have become obscure. It would seem, however, that in all the better specimens of this simple type the central concave face of the needlecase is set off more definitely by two parallel incised lines, which extend downward to about the middle of the tubing, and which end at this place in two or three small spurs (Plate XXII, figs. 4, 6, 7, 9, 10; Plate XXIII, figs. 2, 6, 8–12). The border design on the flanges is not continued over the space between the lines just referred to and the concave face of the tube. The parallel lines near the lower border of the flanges are also generally interrupted at this place. There is only a single specimen, among the simple needlecases, on which they run continuously (Plate XXIII, fig. 7).

Another characteristic decorative design of these needlecases is a narrow band extending around the lower end. This consists always, wherever it can be distinctly recognized, of two parallel lines with short alternating spurs directed toward the space between the two lines. Whenever these spurs are given a greater width this design assumes more or less the form of a zigzag band. A comparison of a considerable number of these designs shows clearly, however, that the primary idea is not the zigzag band, but rather the two lines with alternating spurs. This is best shown by the fact that in those cases where the lines are thin the alternation is often quite irregular. This may be observed, for instance, in the specimen shown on Plate XXII, fig. 2. On the whole, however, an alternation is observed. Bands of this kind may be recognized clearly on Plate XXII, figs. 3–6, 9, 10; Plate XXIII, figs. 6, 8–10. Sometimes the band at the lower end appears doubled, or elaborated by the addition of short vertical lines with short spurs at their ends (Plate XXII, fig. 9; Plate XXIII, figs. 11, 12; Plate XXIV, figs. 1, 2; Plate XXV, figs. 2, 3, 5, 6). These lines are four in number, except in the last three cases. In the specimen shown on Plate XXV,
The features here enumerated comprise those of the most generalized type of these needlecases. They may be briefly summed up as (1) a tube slightly bulging in the middle, (2) flanges at the upper end, (3) small knobs under the flanges, (4) a long concave face at the upper end of the tube, (5) long parallel lines with small forks at their lower ends setting off the concave face, (6) border designs consisting of lines at the upper and lower ends of the flanges and on the concave face, and (7) an alternate-spur band at the lower end of the tube.

In order to understand the significance of this peculiar type of needlecase, we must bear in mind that the two design elements which are most characteristic of this specimen—namely, the line design with short branches and the alternate-spur design—are characteristic Eskimo motives over the greater part of the Arctic coast. The alternate-spur band design has been found by me on a number of very old specimens from Southampton Island and Lyons Inlet, collected by Capt. G. Comer, which are reproduced here in fig. 2, a and c. In the same region the forked-line
design is found on bone engravings (fig. 2, b) and it may be observed in a few of the specimens found by Parry in Fury and Hecla Strait in 1820. Besides this, this design is commonly found in tattooings, the form of which is almost everywhere very stable. It occurs in the tattooings from the west coast of Hudson Bay, as well as in those from Baflin Land (fig. 3). Unfortunately I have not had opportunity to examine extensive collections from Greenland, in order to ascertain the occurrence of these designs. In view of their wide distribution over the whole Eskimo area, it seems justifiable to consider them as a very old possession of the Eskimo, and to assume that originally they bore no relation to the needlecases on which they are found with such great regularity. Incidentally it may be remarked that the explanations of these forms as bushes and whales' tails, which are given by the Alaskan Eskimo, appear so one-sided that they can not be accepted as a general interpretation.

It is important to note that the designs here mentioned do not seem to occur in parts of America or Asia which are outside of Eskimo influence. I have not been able to discover them on any objects of Indian manufacture except on a few specimens from the Yukon River made by Athapaskan tribes directly under Eskimo influence. In Asia the same designs occur among the Koryak and Chukchee (fig. 4), while farther to the west and south I have not been able to find them. I am not certain whether the alternate-spur-line design does occur in the art of the Samoyed, but I have not discovered a single example in a large collection of Yakut specimens brought together by Mr. Jochelson; and it does not seem to occur among the Gilyak, Ainu, and southeastern Tungus tribes. It seems that the design occurs occasionally in Polynesian and Micronesian art, but I should not venture to conclude from this an historical relation, notwithstanding the rather
large number of peculiar analogies between the northeast coast of the Pacific Ocean and the islands northeast of Australia.

Considering the continuous area in which the two designs occur, we may say that their essential home seems to be the Eskimo region, beginning with Alaska, and extending eastward and northeastward to Hudson Bay and Smith Sound, and that a few of the neighboring Indian tribes may have adopted them, and that they also occur among the neighboring Chukchee and Koryak.

One needlecase that has been found in the region of Southampton Island seems to me of particular importance in this connection (fig. 5, a). It will be seen that this needlecase also consists of a tube, like most Eskimo needlecases; that it expands into wide flanges near its upper end, the whole tube being flattened; and that near the middle there are two large wings, which correspond in their position to the small knobs of the Alaskan needlecases. This specimen has also the characteristic alternate-spur band of the Alaskan needlecases at its upper end, and the decoration is repeated here in two parallel lines. Attention may be called to the occurrence of the same pattern at the same place in a number of the more complex specimens from Alaska, shown on Plate XXIV, figs. 2, 5, 8; Plate XXV, figs. 1-3, 7, 9; Plate XXVI, fig. 4. These and other similar occurrences show that the Eskimo often substituted this design for the single parallel lines.

The alternate-spur-band design is related to the single spurred line, a pattern which is very common in many parts of the world. In the decorative art of the Eskimo it appears often in place of the alternate-spur band; for instance, on some needlecases of the type here discussed (see fig. 6; also Plate XXII, fig. 1; Plate XXV, fig. 4). In other cases the alternate-spur band is replaced by a ladder design.
(Plate XXV, fig. 6), which, on account of its rarity, may be considered as a degenerate form of the alternate-spur band.

A group of needlecases similar to the one just described from Southampton Island has been found in the district between Southampton Island and Smith Sound. The only type of needlecase known from Smith Sound has this peculiar character. Unfortunately the specimens which I have seen are all exceedingly rough; but they all consist of a flattened tube, very wide at the upper end, and small and round at the lower end, provided at the sides with two characteristic wings (fig. 7). The same type with some dot decorations has been collected at Ponds Bay in the northern part of Baffin Land (fig. 5, e), while the older specimens from the northern part of Hudson Bay are much more elongated, and have the wings and flanges set off more clearly from the body of the needlecase (fig. 5, d, e).

It seems to me very plausible that the Alaskan type and the Eastern type represent specialized developments of the same older type of needlecase, and that the flanges and diminutive knobs of the Alaskan specimens are homologous to the flanges and large wings of the Eastern specimens. When the first specimens of this kind were collected, Prof. O. T. Mason, according to information which he has kindly given to me, was inclined to believe that they were of foreign origin. In a note on the specimen shown on Plate XXV, fig. 2, he wrote at that time:

This specimen is a needlecase from St. Michael, Alaska. It is made of walrus ivory and carved in a form which suggests the butt end of an arrow, with two feathers projecting from opposite sides on the shaft. The likeness is made more striking by the fluting on the butt end, which resembles the nock of the arrow. A little in front of the two feathers are projecting bosses. The tube of the needlecase is slightly expanded in the middle and contracted at the smaller end. The
ornamentation consists of narrow bands across the shaft, and the feathers at their extremities cut out in zigzag line very much in the style of Polynesian ornamentation. At the smaller end there is also a similarly ornamented band from which rise four symbols of shrubs. An exactly similar piece is figured in Nordenskiöld and labeled "knife handle from Port Clarence." There are four of these objects in the U. S. National Museum, and, compared with hundreds of others, they place themselves unmistakably in the class of needlecases. There is no doubt that these six specimens—five in the U. S. National Museum and one shown by Nordenskiöld—are not aboriginal in form or ornament; that they belong to a style of art introduced into Alaska after the advent of the Russians.

In Seebohm will be seen the figure of a Samoyed needlecase with a tube of metal, inclosed at its top in a belt, and riveted along the side. The suggestion is here thrown out that the Eskimo artist has endeavored to reproduce, in ivory, a facsimile of this metal tube and a portion of the leather belt, even to the projecting rivets. The Nordenskiöld specimen has, in addition, walrus heads and seals carved on the side of the tube.

This Polynesian style of ornamentation is common on hundreds of Eskimo objects in and about St. Michael; for, after the advent of the Russians and intercourse with sailors of the Pacific Ocean, the arts of the two areas became very much entangled.

Considering the antiquity of the eastern specimens, it does not seem plausible that the Alaskan specimens are a newly developed type. Their great frequency and the fixity of the type are also not in favor of this view.

It might perhaps also be argued that the knobs serve for firmly attaching the needlecase to a skin strap, but there is no evidence whatever that the needlecases were thus suspended. On the contrary, they seem to have been carried like all other Eskimo needlecases, by an attachment to the strip of skin into which the needles are inserted.

It seems certain, therefore, that the diminutive knob of the Alaskan needlecase serves no practical end whatever, and that it is a purely conventional feature in the form of the utensil. It is true that the large wings and flanges of the Eastern needlecases also serve no practical end; but it seems well to bear in mind the close resemblance of the two types.

It is important and interesting to compare the simple types heretofore described to a number of more complex needlecases which clearly belong to the same type.

It would seem that, first of all, the strong inclination of the Alaskan Eskimo to decorate carved objects by means of incised designs has led to further developments of the patterns heretofore described. Examples of this kind may be observed on Plates XXIV and XXV. In Plate XXIV, fig. 2, the same typical arrangement of flanges, knobs, and faces may be observed; but the concave face and vertical line are further decorated by oblique spurs placed in pairs, and the

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*b* Siberia in Asia, London, 1882, p. 56.
lower border design of the flange is elaborated into a single line with double oblique spurs also. On both sides of the needlecase, and surrounded by the line running downward along the lower border of the flange and on the body of the tube, is a design of what seems to be a human being with a caribou head, which stands on a line extending across the side of the needlecase, just over two knobs, the single knob on each side being doubled in this case. On the lowest point of the line surrounding the concave face stands a quadruped with long body and bent legs. Another type of elaboration and modification of the design is shown in Plate XXIV, fig. 1, where the lines with pairs of oblique spurs have also been made use of. The needlecases illustrated on Plate XXIV, figs. 3, 4, 6, are so much worn down that the designs have become very indistinct; but in these specimens, as well as in the one shown on the same plate, fig. 5, the middle concave face was never well marked. In the last-named specimen the border lines of the flanges are continued across the whole needlecase (compare Plate XXIII, fig. 7). While these specimens resemble in general shape the characteristic designs, the forms are rounded off, and have lost many of their decorative traits. On the reverse side of the specimen shown in Plate XXIV, fig. 4, a double line with oblique spurs running outward from the lines is shown, but not in the middle of the needlecase. Its position is so irregular that it can not be compared with the decorations of the specimens heretofore described. It will be observed that the same specimen has quite an irregular line decoration on the flanges. Plate XXIV, fig. 7, is a roughly finished specimen of the usual type. The concave face is hollowed out deeply, and the flanges are set off more markedly than in the majority of specimens. The knobs have been moved very far downward. This specimen seems to be modern and very roughly finished. Plate XXIV, fig. 8, also seems to be a modern specimen, in which the vertical border lines of the concave face have been moved toward the border of the flange, and where the upper border is replaced by an alternate-spur band. In this specimen the knobs are also moved very far downward. The specimen shown in fig. 9, Plate XXIV, resembles in many respects the one shown in fig. 7 of the same plate, particularly in the depth of the concave faces and in the sharp angle formed by the flanges where they are set off from the body of the tube.

Plate XXV, fig. 1, represents a specimen which is also presumably quite modern, and shows material deviations from the type. Here, instead of the middle concave face, we have a narrow flat surface with a single vertical forked line, the occurrence of which is obviously a survival of the older concave field with its two-forked border lines. On the sides of this needlecase, just under the flanges, is also a vertical forked line, which extends a little lower than the medial forked line. The knobs on the sides are very indistinct and marked only
by the sudden transition of the faces cut out under the flanges on each side into the tubular lower portion of the specimen. In Plate XXV, fig. 2, the border lines of the concave face consist of two forked lines on each side, and the border lines of the flanges have been transformed into alternate-spur bands. In fig. 4 of this plate the same lines are etched as spur bands, and the forked-line design is placed on the flanges. There is no indication of knobs. In the specimen shown in fig. 5 we find on the concave face of the tube an alternate-spur band added, which ends below, on the reverse and the obverse, with two parallel cross-lines. On the lower part of the flanges is shown, on one side a double alternate-spur band, while the opposite side is laid out on the same plan, with the only exception that the cross-lines between the lowest pair of border lines are drawn right across (as in the bands in Plate XXV, fig. 6). The whole side of this needlecase is flattened, beginning under the flange, down to the lower border. This flat field is occupied in its whole length by an alternate-spur band.

The bands in fig. 6, Plate XXV, are occupied by ladder designs instead of alternate-spur designs. Presumably this is the result of careless execution of the older spur design. Fig. 7 shows a very careful technique, and it is characterized by a strict adherence to the general type, extreme smallness of the knobs, and elaboration of the single decorative motives. Thus the upper border consists here of two alternate-spur bands; the lower border of the flanges of a number of parallel lines which are very close together. The same kind of lines occur on the middle field. The decorative band at the lower end is also doubled, and repeated at a short distance above the lower end.

Other modifications are found in the following specimens. In fig. 8 there is no middle concave face, but in its place we find two parallel lines which are carried down to the lower border. There are also two parallel lines on each side running down from the flanges to the lower border, and to the upper and lower border lines of the flanges are added vertical border lines, so that the whole flanges appear framed. The cross-section of this specimen is angular. In fig. 9 two parallel lines are substituted for the concave face, as in the specimen just described. The sides of this needlecase are also flat, while the back shows no vertical design and a rounded surface. Its only decoration consists of a continuous alternate-spur band design on top and at the lower end of the small flanges, continuing the corresponding bands on the front of the specimen and on the narrow sides of the flanges. This specimen has no indication of knobs.

Plate XXV, fig. 10, is in many respects peculiar, particularly in so far as the two small knobs are not on the same level. The middle concave field is carried down to the lower end of the needlecase, as in the two preceding cases, and the whole needlecase is angular in cross-section. It has eight faces, which taper down toward the
lower end. On the three faces on the right-hand side is the small double-angle decoration which has been indicated in our illustration. A double angle turned with its apex downward is also found on the lateral face on the right-hand side. As shown in the illustration, the flanges do not extend up to the top of the needlecase, as is the case in most specimens.

The needlecase represented in Plate XXV, fig. 11, illustrates a very peculiar reduction in the general form. The flanges have almost disappeared, and with them the upper and lower decorative border, as well as the border at the lower end of the tube; and all that remains to remind us of the form here discussed are four parallel forked lines, which, however, are continued beyond the forks. Nevertheless the impression given by the specimen in connection with the whole series is such that I do not doubt for a moment that it belonged originally to the series under discussion.

The series represented on Plates XXVI–XXVIII seems to me of special importance, and interesting from a theoretical point of view. The identity of the types of needlecases here shown and the preceding ones is perfectly obvious. The specimens collected on Plate XXVI show with perfect distinctness the bulging tube, the flange with its decoration, the knobs, and the concave face of the tube. Here part of the specimen seems to be conceived of as an animal. The bulging tube is the body of the animal, whose head has been added at the lower end of the tube. Although the transformation of the lower end of the needlecase into an animal has been perfected, it does not seem likely that the whole object was conceived as an animal form. If this were the case, the flanges, when transformed into the tail of a sea mammal, would probably have been modified, and the position of the head would be so changed as to be in proper relation to the tail.

It seems to my mind entirely artificial to assume that in this case the animal form as such could possibly have preceded the typical needlecase as before described, but that we are dealing here evidently with a secondary interpretation of the design, which finds expression in the addition of the animal head and in other later additions to the whole form. In Plate XXVI, figs. 2, 3, 5, 6, and 7, the entire old design may be recognized in all its details; even the alternate-spur band remains, although it interferes with the form of the seal's head which has been added. In fig. 3 the head of the animal has been turned, so that the lower part of the needlecase looks like a sea animal swimming on its back. A similar specimen from the Royal Ethnographical Museum in Berlin is shown in fig. 8. It has a unilateral small knob. In fig. 1 of Plate XXVI we find what may be a still further development of the original design here described. The seal's head has disappeared again, and in its place we find a simple knob. There are three parallel lines near the lower end of this knob,
which make the whole area, seen from the top, look a little like a small crustacean. The knobs in this specimen are very small. I consider it quite possible that here we may have a case where, under the stress of older forms of the needlecases, a partial reversion to the original type has taken place.

The strong tendency of the Eskimo to utilize animal motives has found expression in another manner in the specimen represented in Plate XXVI, fig. 4. Here the small lateral knobs have been considerably enlarged and have been given the form of seals' heads (see also p. 333). I believe that here also there can be no doubt in regard to the question whether the seal's head or the knobs are older. If the knob had to be considered as a degenerate form of the seal's head, it would hardly be intelligible why only one or two specimens out of a great number should retain the heads in this place, while in practically all other cases the reduction to a simple knob, sometimes so small that it can hardly be felt, should have occurred. It seems quite evident that in this case the imagination of the artist was stimulated by the traditional knob, and that it has been developed, owing to a desire to further decorate the utensil, into seals' heads. The modification of the central concave face of this specimen is quite in accord with other modifications of the same surface, which have been described before. On the reverse of this needlecase the pairs of oblique spurs attached to the converging lines are directed toward the upper part of the needlecase.

On Plates XXVII and XXVIII a number of specimens have been collected, in which another part of the needlecase has been modified through the general tendency of the Eskimo artists to introduce animal designs. Instead of the lower end, the flange has been thus developed. The procedure appears perhaps clearest in the specimen shown in Plate XXVII, fig. 3, where on one side the flange shows a number of perforations and modifications, by means of which it has been developed into a quadruped, while on the other side a walrus head has been developed by making a long slit along the body of the tube and by inserting an eye, the lines indicating nostrils and mouth, near the upper border. Thus the outer sides of the flanges form the tusks of the walrus head, while the top forms the head itself. The specimen here referred to shows clearly its close relation to the original type of needlecase. The decoration of the lower part, and the concave face, may still be observed. The characteristic decorations of the concave face are also indicated. In figs. 1, 5, and 6 of the same plate we find the same type of needlecase with a
double walrus head at the top. It would seem that in most of the specimens the tusks have been broken off. In fig. 5 the small knobs under the lower end of the tusks may be observed quite distinctly. In this specimen traces of the vertical forked lines bordering the middle field also remain. In these three specimens the middle concave face is quite distinct. In figs. 2 and 4 of the same plate two specimens are represented which combine a modification of the lower end of the needlecase with that of the upper end. At the lower end a seal head is represented at one side, as in the specimens previously discussed, while in the upper end the double walrus head is found. In these specimens also the middle concave face is well marked, although in fig. 4 it is not bordered by an incised line.

The next group of modifications of the old type of needlecase follows out the same direction as those just described, the flanges being modified so as to represent an animal on each side. A specimen of this type is shown in fig. 9, where a walrus with head stretched forward is shown. The tusks touch the upper end of the tube, while the two flippers are shown at the lower end. Two seals are shown in the same position in fig. 10 and on Plate XXVIII, fig. 7, while two quadrupeds occupy the position of the flanges in figs. 1 and 6 of Plate XXVIII. In fig. 4 of the same plate the quadrupeds appear doubled; and in fig. 8 the seals have so much increased in size that they occupy the whole side of the needlecase. However, in this case also, the close relation between all these types can easily be demonstrated by an examination of Plate XXVIII, figs. 4 and 7, which retain all the characteristic traits of the simple type. The two animals in fig. 6 of this plate seem to represent lemmings. They are placed somewhat differently from the ordinary form of the flanges, but are evidently developed from forms like these shown in figs. 1 and 7 of this plate. A specimen in which the one side of the needlecase retains the ordinary shape, while the opposite side of the flange has been transformed into an animal, is represented on Plate XXVI, fig. 8.

In this case also it would seem exceedingly difficult to interpret the simple geometrical form of the needlecase as a later development from the animal representations here discussed. In this case, similarities of the decorative designs on the tubings would be entirely unintelligible, while the assumption that the animal forms have developed from the geomet-

Fig. 9.—Needle-case (Royal Ethnog. Mus., Berlin, No. IV A 5491).

Fig. 10.—Needle-case (Royal Ethnog. Mus., Berlin, No. IV A 2991).
rical forms seems to give a very plausible explanation of the forms of these specimens.

The specimens in which the upper end has been so modified as to become a double walrus head lead us to another group in which the walrus head is repeated a number of times along the sides of the tube. Specimens of this kind are represented on Plate XXVIII, figs. 2 and 3. In both of these traces of the old upper and lower border decoration remain, and fig. 3 also shows the typical oblique spurs in pairs in the same position which has been described several times. It therefore seems perfectly natural to interpret figs. 2 and 3 as the result of repetitions of the animal design, which was first developed from the flanges of the old needlecase. Figs. 3 and 5 differ from other specimens of their kind in that they have the walrus head developed only on one side, while on the opposite side the flange is suppressed.

As has been indicated, the geometrical decorations of the typical flanged needlecases reappear in many of these highly modified specimens. Attention may also be called to the forked-line designs which rise from the lower border in the usual number in the specimens shown in figs. 4, 6 and 7 of this plate. In fig. 7 the number of these lines is five. The specimen, however, is very crude and quite modern, and the deviation in number may be due to inaccuracy in laying out the ornament. In fig. 4 there are two forked designs on opposite sides, while from the tails of the animals down to the lower border runs an alternate-spur band. Between the alternate spur-bands and the long forked lines there are short forked lines, as indicated in the illustration. Only in fig. 8 do we find an important modification of the lower end of the needlecase, which forms a ring. That in our specimen has been broken. The backs of the two needlecases shown in figs. 3 and 5 are somewhat flat. It is of interest to compare the line decoration of the latter needlecase with the one shown in fig. 11, which is a simple modification of the fundamental type.

The illustrations, figs. 1 and 2 on Plate XXIX, of two needlecases in human form, are not quite as convincing as the specimens themselves; but a comparison of these forms with the other needlecases of this series seems to me to suggest with great force that the human figures here shown are related to the same type of needlecase that we are discussing here. The whole human figure is treated as a tube, and it is my opinion that the bulging hips correspond to the bulging middle part of the needlecase, while the arms correspond to the flanges, and perhaps more particularly to developments of the flanges.

Fig. 11.—Needle-case (Royal Ethnog. Mus., Berlin, No. IV 38921).
similar to the walrus-head developments, while the head is a later development of the upper border, suggested by the perception of the similarity of the whole form to a human figure. I do not wish to imply that the human figure in this case has necessarily developed from the type of needlecase first discussed; but it seems plausible to me that an assimilation between the human figure and this type has taken place in the two specimens here illustrated. It seems likely that the animal figure shown in fig. 12 must be considered in a similar manner. There is no doubt that the vivid representation of the animal lying down has very little to do with our type of needlecase; but nevertheless I can not free myself from the impression that the artist, in his treatment of the subject, has been influenced by the treatment of the flanges of needlecases and by the general form of this utensil. There is a certain similarity between the position of the feet and the positions of the walrus tusks shown on Plates XXVII and XXVIII, which is not explained by a realistic treatment of the animal alone; and the same is true of the position of the neck and head and of the curves in the hind part of the body.

The similarities which I am discussing here are even less clear in some of the other specimens represented on Plate XXIX. Fig. 3 of this plate evidently represents a human leg, the design on one side being a representation of tattooing. In this case faint traces of the upper border design and of the lower border design remain, and the outline of the whole specimen still recalls to a certain extent the bulging tube below and the wider part with its flanges above. If we agree to consider this specimen as belonging to the present series, the specimen shown in fig. 5 must be considered as belonging here also. There is no doubt that fig. 4 of this plate belongs to our series. The tube and the knobs are the same as those occurring in the most typical specimens. Instead of the concave faces, we have merely flat surfaces, and the flanges have been much reduced in size, but are perfectly distinct and sharply set off. The ornamentation, however, differs on the flanges and concave faces from the ordinary decoration. Besides the designs shown in the illustration, we have, on the back of the flange to the right, a line with two pairs of one-sided oblique spurs running downward and a forked line running down from the black ring, like the one shown on the right-hand side of the illustration. On the right-hand side of the lower part of the needlecase an etched design, representing a quadruped with long tail, will be observed. Fig. 6, Plate XXIX, shows a simple tube with four groups of knobs, which may have been suggested by the knobs of the specimens here described. Figs. 7 and 8, Plate XXIX,
represent a needlecase, which on one side shows the typical form of the flanged specimens, while on the opposite side the head, neck, and forepaws of an animal are set off.

Another geometrical development of the ordinary type is represented in fig. 13. In this specimen the general outline of the flanged tube is readily recognized, but all the other characteristic features have disappeared.

On Plate XXX five specimens are illustrated whose relation to the flanged type is very doubtful. The knobs in fig. 1 of this plate, which are doubled in the axial direction and appear on four sides of the tube, are analogous to those shown in fig. 6 of Plate XXIX; and these two types are undoubtedly closely related. Attention may be called to the awl-like implement illustrated in fig. 14, which shows the same four knobs here described, and which therefore in its origin may well be related to the decorative designs on the needlecases. The animal types on Plate XXX, figs. 2-6 and in fig. 15, diverge so much from the flanged type that their relationship seems very doubtful. Still I can not free myself from the impression of a certain influence of the flanged types upon these forms also. This becomes apparent by a comparison of the needlecase shown in fig. 16 with the animal types here discussed. It is quite evident that this specimen has its affiliations both with the animal types and the walrus-head types shown on Plate XXVII. It is, however, also possible that its form has originated by assimilation of two distinct types.

The conclusion which I draw from a comparison of the types of needlecases here represented is that the flanged needlecase represents
an old conventional style, which is ever present in the mind of the
Eskimo artist who sets about to carve a needlecase. The various parts
of the flanged needlecase excite the imagination of the artist; and a
geometrical element here or there is developed by him, in accordance
with the general tendencies of Eskimo art, into the representation
of whole animals or of parts of animals. In this manner small knobs
or the flanges are developed into heads or animals. After this modifi-
cation has once set in, the animal figures may be repeated in other
parts of the implement. Besides this, associations between animal
forms and the form of the whole needlecase seem to have taken place,
which have to a certain extent modified the manner of representing
animals which were adapted to use as needlecases; so that the old
form and style of the needlecase determined the treatment of the
animal form.

If we were to apply to the present series the theory of the origin
of conventional form from realistic motives, it would be exceed-
ingly difficult to account for the general uniformity of fundamental
type. It seems to me that, on the basis of this theory, we could not
account for the diversity of realistic forms and the uniformity of
general type. Neither does it seem possible to account for the series
of types by assumption of any influence of technic: and my impres-
sion is that the only satisfactory explanation lies in the assumption
that the multifarious forms are due to the play of the imagination
with a fixed old conventional form, the origin of which remains
totally obscure. This I freely acknowledge. If, however, we
are to form an acceptable theory of the origin of decorative
designs, it seems a safer method to form our judgment based on ex-
amples the history of which can be traced with a fair degree of cer-
tainty, rather than on speculations in regard to the origin of remote
forms for the development of which no data are available.

I believe a considerable amount of other evidence can be brought
forward sustaining the point of view that I have tried to develop,
namely, that decorative forms may be largely explained as results
of the play of the imagination under the restricting influence of a
fixed conventional style. Looking at this matter from a purely theo-
retical point of view, it is quite obvious that in any series in which
we have at one end a realistic figure and at the other end a conven-
tional figure, the arrangement is due entirely to our judgment regard-
ing similarities. If, without further proof, we interpret such a series
as a genetic series, we simply substitute for the classificatory prin-
ciple which has guided us in the arrangement of the series a new
principle which has nothing to do with the principle of our classifi-
cation. No proof whatever can be given that the series selected ac-
cording to similarities really represents an historical sequence. It is
just as conceivable that the same series may begin at the conventional
end and that realistic forms have been read into it, and we might

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interpret the series, therefore, as an historical series beginning at the opposite end. Since both of these tendencies are active in the human mind at the present time, it seems much more likely that both processes have been at work constantly, and that neither the one nor the other theory really represents the historical development of decorative design.

The assumption of a development from realistic design to conventional design also omits the consideration of one exceedingly important element, namely, the style of convention that prevails in the types of art of different areas. If geometrical designs developed from realistic motives the world over, it still would remain to be proved why a certain style of conventionalism belongs to one art and another style to another art: and in order to explain in a satisfactory way the different styles of art, we should have to accept these as given at a very early stage during the process of conventionalization of realistic designs.

The attempt to explain the processes of conventionalization by the theory of the influence of technical motives does not seem to offer an entirely adequate solution of this problem. It is true that certain very simple designs seem to be due almost entirely to the influence of technic upon simple decorative tendencies. This influence, however, does not reach so far as to determine in detail the character of design in the same kind of material or in the same technic. As an example of such differences may be mentioned, for instance, the designs in woven checkered mattings from West Africa, where peculiar realistic figures alternate with geometrical band designs: the designs of cedar-bark mattings of the Ojibwa and of those of the North Pacific coast, and of designs made in the same technic by the South American Indians. In all these cases the technical conditions are practically the same, but the styles differ vastly. It seems necessary, therefore, to assume in the development of design the existence of tendencies which are due to causes different from the technic, and unrelated to the realistic motives which may be current or may have been current.

I have no theory to offer in regard to the origin of these types of convention, which presumably was connected with a whole series of activities determining the perception and reproduction of forms; but it seems desirable to point out by a number of instances the fixity of these conventional forms and the deep influence that they have had even in apparently realistic forms. I have pointed out in the discussion of the designs of the blankets of the Chilkat Indians that a great many of the older forms can be reduced to two fundamental types, and that, no matter what animal may be represented in the art of the weaver, it is almost always reduced to one of these two forms. In

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the same place I have shown that the treatment of the animal figure on carved boxes of the Tlingit has other fixed conventional forms, which, although closely related to the blanket design, are quite permanent and applied only in the manufacture of boxes.a

In a quite different region, among the Tungus tribes of the Amur River, Dr. Berthold Laufer has shown that one of the essential types determining the whole arrangement of decorative designs, which consist of realistic figures as well as of curved lines, is based on the type of “cocks combatant.” b

It is also important to note that figures conforming to such fundamental types may be interpreted in a great variety of ways by the people who use them. I have pointed out such a similarity of type and fundamental difference of interpretation in explanations given by the Huichol Indians.c Here we find practically the same figure once interpreted as the fresh-water crab, and then as oak leaves and stems. Other more extended series of such ambiguous interpretations may be found in the art of the Plains Indians as well as in those of other parts of the world.d

I have suggested before that in many cases these forms seem to compel us to assume that the interpretations of many simple forms are entirely secondary; that often the forms have been borrowed; and that later on, according to their use in the life of the people, they have been given a fitting interpretation.c

I think evidence can be brought forward also to show that the tendency to play, and the play of the imagination with existing forms, have deeply influenced the decorative art of primitive tribes as we find it at the present time.

The first of these traits appears with particular clearness in the tendency to use rhythmical repetitions of varying forms. Bead necklaces are one of the most striking examples of the pleasure that man receives through the use of rhythmical repetition of colors and forms. It is very important to notice that among primitive tribes the rhythmic and symmetrical order of such arrangements are often exceedingly complex,—so complex, in fact, that they can be recognized by us only by a close study of the arrangement. A case of this kind occurs in the fringe on a pair of leggings collected among the Thompson Indians, which I have described.f In this specimen we have a fringe which

b Publications of the Jesup North Pacific Expedition, IV, pp. 22 et seq.  
e Franz Boas, The Decorative Art of the North American Indians, Popular Science Monthly, LXIII.  
f Publications of the Jesup North Pacific Expedition, I, p. 384, fig. 313.
hangs down in a very disorderly fashion, so that the constituent elements can not be seen distinctly. Nevertheless a most painstaking arrangement of the component elements is adhered to, the rhythmic unit consisting of five elements,—one string having one glass bead and two bone beads in alternating order; one undecorated string; one having alternating glass and bone beads, one undecorated, and one having one glass bead and two bone beads in alternating order. I have found still more complex rhythmic repetitions and symmetrical arrangements on the embroidered borders of coats of the Koryak. These contained sometimes ten and more elements in one group. Still another case of similar kind, from Peru, has been described by Mr. Mead. Here a rhythmic repetition of six units seems to be very common.

I consider it particularly important to observe that in the first of these specimens the rhythmic repetition can not be seen when the leggings are in use, because this suggests strongly that the reason for the application of the rhythmic repetition is not the aesthetic pleasure in the effect which it produces, but the pleasure felt by the maker. If this is true, then we do not need to assume that in the other cases a much more highly developed appreciation of complex rhythm is found among primitive people than the one we possess. Corroborative evidence in regard to this point is offered by the basketry of the Thompson and Lillooet Indians. I have noticed that here, where in a fine imbricated technique color bands are produced, the basket weavers tend to use with great regularity certain groupings of the number of stitches belonging to each color, although, owing to the irregularity of the size of the stitches, these modifications can hardly be observed. If these facts have a wider application, it would seem that on the whole the pleasure given by much of the decorative work of primitive people must not be looked for in the beauty of the finished product, but rather in the enjoyment which the maker feels at his own cleverness in playing with the technical elements that he is using. In other words, one of the most important sources in the development of primitive decorative art is analogous to the pleasure that is given by the achievements of the virtuoso.

Examples may also be given illustrating the effect of the play of imagination upon the development of design. One of the best examples of this kind is offered by the decorated bag of the Thompson Indians illustrated by Professor Farrand. The analogy of this soft rectangular bag, which is decorated with rows of large dia-

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Publications of the Jesup North Pacific Expedition, VI, pp. 689 et seq.

b Boas Anniversary Volume, pp. 193 et seq.


d Idem. I, pl. xxxiii. fig. 1.
monds, to other similar bags shows quite clearly that the rows of diamonds have the same origin as the rows of diamonds which are painted on parfleches of the Plains Indians. In this case the diamonds suggested the idea of ponds; and, in order to emphasize this idea, which came to the mind of the woman who used the bag, she added a number of birds flying toward these ponds. Other examples of this kind have been mentioned by Doctor Koch in his observations on the drawings of South American Indians. The development of the triangles in the designs of the Plains Indians to tent designs or cloud designs brings out similar points.

Thus it would seem that the development of decorative designs can not be simply interpreted by the assumption of a general tendency toward conventionalism or by the theory of an evolution of technical motives into realistic motives by a process of reading in, but that a considerable number of other psychic processes must be taken into consideration if we desire to obtain a clear insight into the history of art.

EXPLANATION OF PLATES.

PLATE XXII.—NEEDLECASES.

Fig. 1. Ancient specimen from the mouth of the Yukon River, Alaska. Cat. No. 38758, U.S.N.M.


PLATE XXIII.—NEEDLECASES.

Fig. 1. From Razboinski, Lower Yukon River, Alaska. E. W. Nelson, collector. Cat. No. 48806, U.S.N.M.


Fig. 4. From Sledge Island, west of Cape Nome, Alaska. E. W. Nelson, collector. Cat. No. 44744, U.S.N.M.

Plate XXIV.—Needlecases.

Fig. 1. From Kwilkpak, Lower Yukon River, Alaska. E. W. Nelson, collector. Original number, 3972, U.S.N.M.

Plate XXV.—Needlecases.

Fig. 1. From St. Michael, Norton Sound, Alaska. Lucien M. Turner, collector. Cat. No. 176289, U.S.N.M.
Fig. 7. From Unalaklik, eastern shore of Norton Sound, Alaska. E. W. Nelson, collector. Cat. No. 33636, U.S.N.M.


Plate XXVI.—Needlecases.

Fig. 1. Peabody Museum, Cambridge, Mass. Cat. No. 63563.


Plate XXVII.—Needlecases.

Fig. 1. From the Lower Yukon River, Alaska. E. W. Nelson, collector. Cat. No. 38363, U.S.N.M.


Plate XXVIII.—Needlecases.

Fig. 1. From Sledge Island, west of Cape Nome, Alaska. E. W. Nelson, collector. Cat. No. 44731, U.S.N.M.


Fig. 6. From Beatam Inlet, east of Kotzebue Sound, Alaska. E. W. Nelson, collector. Cat. No. 64164, U.S.N.M.


PLATE XXIX.—NEEDLECASES.

Fig. 1. From the Lower Yukon, Alaska. E. W. Nelson, collector. Cat. No. 38364, U.S.N.M.


PLATE XXX.—NEEDLECASES.

Fig. 1. From Sledge Island, west of Cape Nome, Alaska. E. W. Nelson, collector. Cat. No. 55167, U.S.N.M.


Decorated Alaskan Needlecases.

For explanation of plate see page 341.
Decorated Alaskan Needlecases.

For explanation of plate see pages 340, 341.
Decorated Alaskan Needlecases.

For explanation of plate see page 342.
Decorated Alaskan Needlecases.
For explanation of plate see pages 342, 343.
Decorated Alaskan Needlecases.

For explanation of plate see page 343.
Decorated Alaskan Needlecases.

For explanation of plate see page 343.
Decorated Alaskan Needlecases.

For explanation of plate see pages 343, 344.
Decorated Alaskan Needlecases.

For explanation of plate see page 344.
DESCRIPTIONS OF NEW CRETACEOUS AND TERTIARY FOSSILS FROM THE SANTA CRUZ MOUNTAINS, CALIFORNIA.

By Ralph Arnold,

INTRODUCTION.

During the past seventeen years the professors and students in the geologic department of Leland Stanford Junior University have brought together from the Santa Cruz Mountains and adjacent regions a large lot of paleontological material which is now the property of the university. In addition to this the writer has made extensive collections in the same region for the United States Geological Survey. All of this material is now being worked over by the writer for a monograph on the paleontology of the Santa Cruz quadrangle, within the boundaries of which the greater part of the Santa Cruz Range lies. The Santa Cruz folio, embracing maps, geologic sections, a plate of the characteristic or common fossils of the region, and text devoted to a description of the geology of the quadrangle, is now ready for the press. Many of the species of fossils figured on the folio plate are new, and in order to avoid the confusion in nomenclature which might arise should this folio (which is written jointly by J. C. Branner, J. F. Newsom, and Ralph Arnold) be published before the appearance of the monograph describing the fossils, it has been deemed expedient to prepare the present preliminary paper describing those of the new species which are figured in the folio. A list of some of the previously described species associated with the new forms will be included in this report, together with a brief description of the various formations from which the fossils have been obtained, to make clearer the relations of the faunas involved. A few of the old species will also be figured for the same reason.

The writer wishes to acknowledge his indebtedness to Dr. William H. Dall, Dr. T. W. Stanton, Dr. James Perrin Smith, Dr. John C. Merriam, and Dr. Hubert Lyman Clark for assistance in determining the genera and zoologic relations of some of the new forms, and to
Dr. John C. Brauner, Dr. J. F. Newsom, and the many students who have assisted in accumulating the collection, for the privilege of working over the material.

GEOLOGIC FORMATIONS.

General statement.—There are thirteen distinct formations involved in the geology of the Santa Cruz quadrangle. Of these the oldest is the basement complex of granitic rocks, schists, and limestone. Above these are the Franciscan, probably of upper Jurassic age; Knoxville, lower Cretaceous; Chico, upper Cretaceous; undifferentiated Eocene, probably representing the lower part of this epoch; probable lower Oligocene sandstone and San Lorenzo formation, Oligocene; Vaqueros, lower Miocene; Monterey, middle Miocene; Santa Margarita, upper Miocene; Purisima, upper Miocene to middle Pliocene; Merced, marine upper Pliocene and Pleistocene; fresh water upper Pliocene and Pleistocene, and Quaternary.

CRETACEOUS.

Knoxville formation, lower Cretaceous.—The beds of Knoxville age in the Santa Cruz Mountains are made up of conglomerate, sandstone, and shale. They cover only small areas in the Santa Cruz quadrangle and are confined entirely to the northeastern or Santa Clara Valley side of the mountain range. The fauna is small but very characteristic, and contains species that are usually found at the fossiliferous localities of the Knoxville in other parts of the State. The fauna of this formation as represented in the Santa Cruz quadrangle is as follows:

List of Knoxville, lower Cretaceous, fossils from the Santa Cruz quadrangle.

PELECYPODA.

Aucella crassicollis Keyserling.

Aucella piochii Gabb.

GASTEROPoda.

Amberlyta diliteri Stanton.

CEPHALOPODA.

?Hoplitites, species.

Chico formation, upper Cretaceous.—The only fossiliferous Chico rocks exposed in the quadrangle extend along the coast from near the mouth of Pescadero Creek southward to Año Nuevo Bay, a distance of 12 miles. This area varies in width from one-half to 2½ miles, and is at places covered partially by a thin layer of Quaternary gravels and sands. The Chico strata along the coast are made up for the most part of hard siliceous shales, sandstones, and massive, coarse conglomerate. The total thickness exposed is believed to be about 9,400 feet. The strata dip at high angles, and have been sharply
folded and faulted in places, thereby making the thickness appear greater than it is. Areas of supposed Chico are found in the low hills west of Redwood and west of Stanford University, but no important faunas have been obtained from these exposures. The Chico beds in the vicinity of Pigeon Point have yielded the following species:

List of Chico, upper Cretaceous, fossils from the Santa Cruz quadrangle.

PELECYPODA.

Anatina trygoniana Gabb.

Area vanconvercensis Meek.

Cucullia bowersiana Cooper.

Glycymeris valetchii (Gabb).

Inoceramus subandatus Meek.

Mactra stantoni, new species.

Nucula truncata Gabb.

GASTROPODA.

Cinulia obliqua Gabb.

Lunatia, new species, p.

Margaritella, new species, a.

CRUSTACEA.

Archaeopus antennatus Rathbun.

TERTIARY.

Undifferentiated Eocene.—The diabase dike exposed north of the headwaters of Pescadero Creek has brought up some considerable inclusions of impure limestone which, from the fossils found in them, appear to be of Eocene age. Obviously the stratigraphic relations of this great limestone inclusion are unknown, but the fossils indicate its Eocene age and that it probably belongs in the lower part of the formation. The following fauna occurs in this limestone:

List of lower Eocene fossils from the Santa Cruz quadrangle.

ECHINOIDEA.

Cidaris merriami, new species.

BRACHIOPODA.

Terebratula, new species, m.

Terebratula, new species, p.

PELECYPODA.

Pecten proarvus Arnold.

GASTROPODA.

Chlorostoma, new species, c.

Cylindrites brevis (?) Gabb.

Fissurella perrini, new species.

Hipponyx carpenteri, new species.

Odostomia, new species, b.

List of lower Eocene fossils from the Santa Cruz quadrangle.

ECHINOIDEA.

Cidaris merriami, new species.

BRACHIOPODA.

Terebratula, new species, m.

Terebratula, new species, p.

PELECYPODA.

Pecten proarvus Arnold.

GASTROPODA.

Chlorostoma, new species, c.

Cylindrites brevis (?) Gabb.

Fissurella perrini, new species.

Hipponyx carpenteri, new species.

Odostomia, new species, b.
OLIGOCENE.

Probable lower Oligocene sandstone.—This formation is composed of medium to coarse-grained massive brown and buff sandstone, and outcrops in a triangular area, the eastern portion of which is at the San Lorenzo River 4 miles north of the town of Boulder Creek. It attains a maximum thickness of at least 2,100 feet, and as the base of this section was not exposed it is probably some thicker. The formation conformably underlies the San Lorenzo shale, but its base is unknown, unless it is represented by the upper member of the unconformity exposed immediately south of the mouth of Pescadero Creek. No fossils have been found in the main area of the formation, but the outcrop near the mouth of Pescadero Creek has yielded several forms, among which are Pecten, closely allied to P. sanctacruzensis Arnold, a fragment of a huge Venericardia, a large Turritella, and an echinoderm suggesting Clypeaster.

San Lorenzo formation.—The San Lorenzo formation, within the limits of the Santa Cruz quadrangle, is characteristically of shale and fine sand. It outcrops in the region north of Ben Lomond Mountain and between the latter and Castle Rock Ridge, its areal distribution being controlled by the northwest-southeast folds which are the prominent structural features of this portion of the quadrangle. The formation attains a maximum thickness of about 2,500 feet on Kings Creek. The most abundantly fossiliferous localities are on the San Lorenzo River, Kings Creek, and Two Bar Creek, and also along the south side of the Big Basin. The following fauna has been obtained from the San Lorenzo in various parts of the Santa Cruz quadrangle:

List of San Lorenzo, Oligocene, fossils from the Santa Cruz quadrangle.

ECHINOIDEA.
Cidaris brunneri, new species.

PELICYPODA.
Cardium cooperi Gabb, var. lorentzianum, new variety.
Cardium, species, a.
Leida, new species, a.
Lithophaga, species, a.
Muletia echalensis, new species.
Mundidae muzianus Arnold.
Mullia, (? ) species, a.
Venera, new species, a.

PELICYPODA.

Nucula dalli, new species.
Pecten peckhami Gabb.
Pecten sanctacruzensis Arnold.
Phacoides, species, a.
Solen, species, a.
Tellina albaria Conrad.
Tellina lorentzianensis, new species.
Tellina, new species, a.
Yoldia impressa Conrad.

GASTEROPoda.
Acteon, species, A.

Dentilum, new species, l.

Architectonica lorentzianensis, new species.

Dentilum substratum Conrad.
Fusus corpulentus Conrad.
Fusus geniculatus Conrad.
Fusus feculi, new species.
**NEW CRETACEOUS AND TERTIARY FOSSILS—ARNOLD.** 349

**Fusus sanctacrucis,** new species.

**Gaterus eccentricus (?), Gabb.**

**Haminae petrosa Conrad.**

**Lamia, new species, l.**

**Nativa oregonensis** Conrad.

**Lirita fusus ashleyi,** new species.

**Pleurotoma, new species, a.**

**Pleurotoma, new species, b.**

**Pleurotoma newsomi,** new species.

**Pleurotoma perissobrachoides,** new species.

**Pleurotoma sanctacrucis,** new species.

**Scala, species, A.**

**Sigaretus scopulosus Conrad.**

**Strepsidura californica,** new species.

**Turricane sanctacruciana,** new species.

**CEPHALOPODA.**

Ataria ziezec Sowerby.

**Transitional Oligocene—Miocene.**—The fine massive sandstones on Twobar Creek lying above the typical San Lorenzo (Oligocene) shales, but below the Vaqueros (lower Miocene) sandstone and conglomerate, contain a fauna allied to those of both the beds below and the beds above. The fauna, however, appears to be more closely related to that of the San Lorenzo. Among the species common to the latter and to the transitional beds are: Cardium cooperi Gabb, var. lorenzannum, new variety; Marcia oregonensis Conrad; Tellina lorenzonensis, new species; Pecten sanctacruczensis Arnold; Solen, species; Yoldia impressa Conrad; Sigaretus scopulosus Conrad, etc. Those common to the transitional beds and the Vaqueros (lower Miocene) are: Marcia oregonensis Conrad; Chione (cf.) mathewsonii Gabb; Pecten brennieri Arnold; Thracia trapezoides Conrad; Tritonium, species, etc.

**Miocene.**

**Vaqueros sandstone.**—The Vaqueros sandstone of lower Miocene age is one of the most important formations of the quadrangle. Its areal distribution is controlled largely by the northwest-southeast structural lines usual in the quadrangle, and the areas covered by it therefore consist for the most part of northwest-southeast bands.

The sandstone varies in texture from fine-grained beds to conglomerate, but are usually medium-grained and generally brown or buff in color, and vary from soft to extremely hard. The Vaqueros lies conformably above the San Lorenzo formation, and there is often a gradual change from one formation to the other, with no clear line of demarcation between them. But while the San Lorenzo formation is made up chiefly of shales and fine-grained, impure sandstones, the Vaqueros formation is composed principally of medium and coarse-grained sandstones, showing that the conditions of deposition were different during the two periods.

The relation of the Vaqueros sandstone to the overlying beds is not so clear as are its relations to the underlying strata. There is an unconformity west of a part of the Big Basin area between the diatomaceous shale (supposed to be Monterey) and the underlying San Lorenzo formation; the latter formation lies conformably below the Vaqueros sandstone. Elsewhere in the quadrangle there is com-
monly a marked difference in the dips of the Monterey strata and those of the Vaqueros sandstone, and an unconformity is therefore believed to exist generally between the two formations.

Few localities in the Vaqueros sandstone are fossiliferous, but such as are yield an abundant fauna of unmistakable lower Miocene age. As would be expected in a formation composed largely of conglomerates and coarse sandstones, the Vaqueros contains a shallow water or littoral fauna.

The following species have been found in the Vaqueros formation within the Santa Cruz quadrangle:

**BRACHIPODA.**

*Terebratalia (aff.) occidentalis* Dall.

**PELECYPODA.**

*Arca microlonta* Conrad.
*Callista*, species, v.
*Cardium vaquerosensis*, new species.
*Chione toulholcensis* Anderson.
*Dosinia conradi* Gabb.
*Dosinia mathewsonii* Gabb.
*Dositha cf. montana* Conrad.
*Dosinia ponderosa* Gray.
*Glycymeris brunnerti*, new species.
*Leda calillicusis*, new species.
*Ostrea titan* Conrad, new variety, v.
*Panopea genicosa* Gould.

*Pecten andersoni* Arnold.
*Pecten brunneri* Arnold.
*Pecten estrellaensis* Conrad.
*Pecten magnolus* Conrad.
*Phacoides richthofeni* Gabb.
*Phacoides acutilineatus* Conrad.
*Pinna alamedensis* Yates.
*Psammobia calentu* Gabb.
*Solen*, species, v.
*Tirela ineziuna* Conrad.
*Volitna submontoncensis*, new species.

**GASTEROPODA.**

*Acteon*, species, v.
*Agasoma kernianum* Cooper.
*Agasoma santacruzanum*, new species.
*Conus oweniana* Anderson.
*Crepidula princeps* Conrad.
*Conus biplicatus* Gabb.
*Galcrus inornatus* (?), Gabb.

*Nucrom*, species, v.
*Venerita callosa* Conrad.
*Olivella*, species, v.
*Plos*, new species, v.
*Sinorcaras scopulinos* Conrad.
*Turritella ineziuna* Conrad.
*Turritella ocyana* Conrad.

**PISCES.**

*Galvecordis productus* Agassiz.
*Lamina clarata* Agassiz.

*Monterey shale.*—As with the previously described Tertiary formations, the areal distribution of the Monterey is controlled largely by the northwest-southeast structural lines of the region.

The largest area of Monterey shale on the quadrangle is that flanking the west side of the Santa Cruz Range and extending from the city of Santa Cruz northwestward for 30 miles to a point slightly north of Pescadero Creek. At the base of the shale through most of this region is a body of sandstone, varying in thickness from 50 to 200 or 300 feet. The maximum thickness of the Monterey for the quadrangle is about 2,500 feet.
The formation consists chiefly of diatomaceous shale, with here and there intercalated sandstones. The diatomaceous material occurs in various grades of purity, from the very light shales composed almost entirely of diatom skeletons to those containing such large proportions of clay and fine sands as to almost or quite lose their diatomaceous character. In the region northwest of Santa Cruz and in many other places in the Coast ranges the Monterey shale is ordinarily spoken of as "chalk rock." The shale usually weatherers to white or buff color, but unweathered surfaces often present a dark gray, drab, or chocolate color.

The paucity of marine invertebrate fossils in the formation is one of its characteristics, although the rather widespread distribution of two of its species, \textit{Pecten peckhami} Gabb and \textit{Area obispoana} Conrad, is important.

The following species have been found in the Monterey at various points throughout the quadrangle:

\textit{List of Monterey, middle Miocene, fossils in the Santa Cruz quadrangle.}

**Echinodermata.**

\textit{Cidaris}, species, \textit{a}.

**Pelecypoda.**

\textit{Area obispoana} Conrad.
\textit{Chione mathewsoni} Gabb.
\textit{Corbula}, species, \textit{a}.
\textit{Diplodonta} (aff.) \textit{serricata} Reeve.
\textit{Mactra montereyana}, new species.
\textit{Marcia oregonensis} Conrad.
\textit{Pecten andersoni} Arnold.
\textit{Pecten peckhami} Gabb.
\textit{Semple}, species, \textit{a}.
\textit{Siliqua}, species, \textit{a}.
\textit{Tellina congesta} Conrad.
\textit{Venericardia montereyana}, new species.
\textit{Yoldia impressa} Conrad.

**Gasteropoda.**

\textit{Hamina petrosa} Conrad.

\textit{Santa Margarita formation.}—The region of Scott Valley north of Santa Cruz is occupied by a formation showing some very distinctive characteristics. The base of this formation, which in places rests unconformably on the Monterey, consists of about 200 feet of coarse, white, incoherent sand with bedded conglomerates near the bottom. Above the white sand is a thickness of about 100 feet of fine, thin-bedded, rather hard shale, which in the Scott Valley region lies nearly horizontal.

Few fossils have been found in either the sandstone or shale of this formation, but the lithologic similarity of the beds to those of the Santa Margarita formation of the Salinas Valley, together with the identity of those species of fossils which have been obtained from the Santa Margarita in the Santa Cruz region, has led to the correlation of the latter with the typical Santa Margarita farther south.
The following species have been found in the Santa Margarita formation within the quadrangle:

**List of Santa Margarita, upper Miocene, fossils from the Santa Cruz quadrangle.**

**ECHINOIDEA.**

*Astrodapsis antiscii* Conrad.

**OPHIUROIDEA.**

*Amphiura sanctaegeacris* Arnold.

**PELECYPODA.**

*Pecten crassicardlo Conrad.*

**TRANSITIONAL MIocene-PLIOcene.**

*Purisima formation.*—A large portion of the Santa Cruz quadrangle is occupied by an apparently continuous series of sediments composed of heavy conglomerates, sandstones, breccias, impure soft mud shales, and white diatomaceous shale like the Monterey shale. The formation as here defined attains a maximum thickness of between 5,000 and 8,000 feet, and includes a thick mass of sediments representing upper Miocene and much of Pliocene time. They appear to be conformable, and no area was found where they could be conveniently subdivided.

The Purisima beds lie unconformably upon the Vaqueros sandstone and are usually unconformable above the Monterey shale; upward they grade into beds having a fauna similar to that of the Merced formation. The upper limit of the Purisima may be defined as the base of the Merced, as exposed in the type section of Merced on Seven-mile Beach south of San Francisco and north of the Santa Cruz quadrangle.

Overlying the Miocene basalt in the region south and southwest of Stanford University are some fossiliferous beds which have been mapped with the Purisima but which are probably older than any of the Purisima in the type region.

The fauna yielded by these beds, which are believed to be the equivalent of what Merriam has called the "Contra Costa County Miocene," is as follows:

**List of fossils from the lower part of the Upper Miocene of the Santa Cruz quadrangle.**

**PELECYPODA.**

*Area (cf.) obispoana* Conrad.

*Area canalis* Conrad.

*Chione (cf.) lemborensis* Anderson.

*Chione mathewsonii* Gabb.

*Dosinia mathewsonii* Gabb.

*Dosinia ponderosa* Gray.

*Leda taphira* Dall.

*Panopea generousa* Gould.

*Phacolites acutilineatus* Conrad.

*Pecten andersoni* Arnold.

*Periploma sanctaegeacris*, new species.

*Sarcidionus (cf.) gibbosus* Gabb.

*Solen sicarius* Gould.

*Sphisula (cf.) californica* Conrad.

*Tapes (cf.) staleyi* Gabb.

*Yoldia supramontereyensis*, new species.
A second fossiliferous horizon, believed to be somewhat younger than the last, is represented by the fauna found in Pescadero Creek near the mouth of Jones Gulch and on the Halliday ranch near Portola. The fauna from the middle part of the formation is as follows:

List of fossils from the lower portion of the Purisima formation.

**PELECYPODA.**

Area canalis Conrad.
Area trilunata Conrad.
Cardium mecklaeum Gabb.
Chione (aff.) gaudia Broderip and Sowerby.
Clidioaphora punctata Conrad.
Cryptoma oralis Conrad.
Dosinia ponderosa Gray.
Mactoma nasuta Conrad.
Mactra alba Maria Conrad.
Nucula (Acilia) Castrensis Hinds.
Panopea geniculosa Gould.

**GASTEROPODA.**

Chlorostoma stantonii Dall, var. lahon-ducensis, new variety.
Chrysodoma imperialis Dall.
Chrysodoma (aff.) livia Martyn.
Chrysodoma stantonii, new species.
Cryptidula princeps Conrad.
Fusus portulacensis, new species.
Lanatia levisii Gould.
Nassa californiana Conrad.

**ASTRACOPODA.**

Natica clausa Broderip and Sowerby.
Natica lahon-ducensis, new variety.
Olivelia intorta Carpenter.
Olivelia pedrona Conrad.
Pleurotomaria, species, a.
Solarilla (aff.) pernubilis Carpenter.
Thais crispata Cremnitz.
Tornatina calcitella Gould.
Tritonium, species, a.

The upper part of the Purisima formation usually consists of fine soft sandstone with harder calcareous and often fossiliferous beds intercalated. These upper beds are typically exposed in the sea cliffs in the vicinity of Purisima and south to the mouth of Pescadero Creek, in the region immediately east of Point Ano Nuevo and in the region east of Santa Cruz.

The following fossils occur in the upper portion of the Purisima formation:

List of fossils from the upper portion of the Purisima formation, Santa Cruz quadrangle.

**ECHINOIDEA.**

Astrodapsis, new species, p.
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PELCYPODA.

Area canalis Conrad.
Area trilineata Conrad.
Cardium meekianum Gabb.
Cryptomya californica Conrad.
Leuca taphria Dall.
Macoma nasuta Conrad.
Maetra albaria Conrad.
Modiolus directus Dall.
Mocellus salmonca Carpenter.
Nucula (Acila) castreensis Hinds.
Panopea generosa, Gould.
Peclen hastatus Sowerby.
Peclen parishuuncescus Arnold.

GASTEROPODA.

Adunie gracilior Carpenter.
Astyris richthofeni Gabb.
Bathyella carpenteriana Gabb, var. fremandoa Arnold.
Bittium asperum Gabb.
Boreotrophon pacificus Dall.
Cameclavia, species, a.
Chrysodomus stantoni, new species.
Chrysodomus tabulatus Baird.
Crepidula princeps Conrad.
Crepidula mariceloides Nuttal.
Drillia (aff.) graciosa Arnold.
Galvea inornatus Gabb.

PLEISTOCENE.

Merced formation.—The Merced formation, so remarkably developed at Sevenmile Beach, south of Lake Merced, only a few miles north of the Santa Cruz quadrangle, is barely represented on the latter. Certain limited fossiliferous outcrops, however, yield a fauna similar to that of the typical Merced and have therefore been correlated with it. The most important of these localities are just south of the mouth of Año Nuevo Creek, near Felt Lake, and in the sea cliffs between Santa Cruz and Capitola. The following species of fossils have been found in the Merced outcrops above indicated:

List of Merced (upper Pliocene) fossils from the Santa Cruz quadrangle.

ECHINOIDEA.

Scutella interlineata Simpson.

PELCYPODA.

Area canalis Conrad.
Area trilineata Gabb.
Cardium meekianum Gabb.
Chione, species, A.
Cryptomya californica Conrad.
Macoma nasuta Conrad.
Maetra albaria Conrad.

Pecten mutteri Arnold.
Phacoidea annulatus Reeve.
Phacoidea nutallii Conrad.
Saxidomus gibbosus Gabb.
Schizothurus pajaroanus Conrad.
Siliqua (cf.) lucida Conrad.
Siliqua (cf.) patula Dixon.
Spinaula (cf.) siscoccensis Arnold.
Tapes staleyi Gabb.
Tapes tenuicirra Carpenter.
Tellina (aff.) congesta Conrad.
Thracia trapezoides Conrad.
Yoldia cooperi Gabb.
Yoldia (aff.) scissurata Dall.
Zirrhina gabbi Tryon.

PELCYPODA.

Leptothyra panaeostata Dall.
Lunatia levisii Gould.
Mioplocma oregonensis Dall.
Nassa californiana Conrad.
Nassa (aff.) perpugiaiis Hinds.
Natica clausa Broderip and Sowerby.
Nucula reducta Petit.
Olivelia intorta Carpenter.
Olivelia pedronna Conrad.
Princetica pacifica Dall.
Serriatella squamigera Carpenter.
Sigeretus debilis Gould.
Volva, new species, a.
Fresh-water Pliocene-Pleistocene.—During at least a portion of the time that the gravels, sands, and finer sediments of the Merced were being deposited in the ocean, somewhat similar sediments were being laid down in great fresh-water lakes on the opposite side of the Coast Range. These fresh-water deposits are now exposed in a narrow band which extends from the region of the Crystal Springs Lakes along the eastern side of a main ridge bordering the Santa Clara Valley on the west. Fresh-water fossils have been found within this formation at several points. Among these are the following:

List of Fresh-water Pliocene-Pleistocene fossils from the Santa Cruz quadrangle.

**GASTEROPODA.**

*List of Pleistocene fossils from the Santa Cruz Quadrangle.*

**QUATERNARY.**

The Quaternary in the Santa Cruz quadrangle was a period of intermittent uplift and depression. The record of the changes that have taken place during it are found in the wave-cut and stream terraces and the marine and fresh-water deposits which occur in different parts of the quadrangle. With the exception of some mammal bones found in the stream gravels on the Santa Clara side of the main range, the most important fossiliferous deposits are on the raised terraces along the coast. Two localities have yielded a considerable fauna, these being the raised terraces at Año Nuevo Point and near the light-house at Santa Cruz. The following fossils have been found in the Pleistocene deposits above mentioned:

List of Pleistocene fossils from the Santa Cruz Quadrangle.
DESIGNATIONS OF NEW SPECIES.

The following are the new species described:

Cretaceous species.

Pelecypoda.

\textit{Maotra stanzeni}, new species.

Gasteropoda.

\textit{Tarantula pescaduroensis}, new species.

Eocene species.

Echinoida.

\textit{Cidaris merriami}, new species.

Pelecypoda.

\textit{Semel gahi}, new species.

Gasteropoda.

\textit{Trioncium newsoni}, new species.

\textit{Hippopyx carpenteri}, new species.

\textit{Patella matevaensis}, new species.

\textit{Fissurella perini}, new species.

San Lorenzo (Oligocene) species.

Echinoida.

\textit{Cidaris brunneri}, new species.

Pelecypoda.

\textit{Vexula (Acilia) dahl}, new species.

\textit{Mathalia echalisisensis}, new species.


\textit{Tuellina lorenzozensis}, new species.

Gasteropoda.

\textit{Pleuratoma newsoni}, new species.

\textit{Pleuratoma perissolaxoides}, new species.

\textit{Pleuratoma sanctacruziensis}, new species.

\textit{Strepsidura californica}, new species.

\textit{Euxus hucori}, new species.

\textit{Euxus sanctacruziensis}, new species.

\textit{Lirfusus ashleyi}, new species.

\textit{Turinella sanctacruzan}, new species.

Architectonica lorenzozensis, new species.

Vaqueros (Lower Miocene) species.

Pelecypoda.

\textit{Leda cathilidensis}, new species.

\textit{Yoldia submontegeyensis}, new species.

\textit{Glycymeris brunneri}, new species.

\textit{Cardinii (Trachelorium) vaquecrinus}, new species.

Gasteropoda.

\textit{Agasoma sanctacruzan}, new species.

Monterey (Middle Miocene) species.

Pelecypoda.

\textit{Ventricardia montegeynana}, new species.

\textit{Maotra montegeynana}, new species.

Upper Miocene species.

Gasteropoda.

\textit{Eupomma sanctacruziensis}, new species.

\textit{Yoldia supramontegeyensis}, new species.

\textit{Periplouma sanctacruziensis}, new species.

Gasteropoda.

\textit{Fusus (Priscofusus?) stantoniensis}, new species.

\textit{Ipsoma stantoniensis}, new species.

Purisima and Merced (Upper Miocene and Pliocene) species.

Gasteropoda.

\textit{Fusus (Pricofusus?) portolanensis}, new species.

\textit{Chrysodorum stantoni}, new species.

\textit{Thais trancosana}, new species.

\textit{Chlorostoma stantoni} Dall, var. \textit{lauhondaeensis}, new variety.
PELECYPODA.

Genus MACTRA Linnaeus.

MACTRA STANTONI, new species.

Plate XXXI, fig. 3.

Description.—Shell averaging from 40 to 50 mm. in length, sub-trigonal in outline, altitude about five-sevenths of length, equi-valve, equilateral, the beaks located midway the shell, moderately thin, moderately convex. Anterior margin only very slightly depressed in front of beaks; quite evenly but somewhat acutely rounded in front; base evenly rounded; posterior margin sloping straight back from umboines; posterior extremity not quite as attenuate as anterior; a faint suggestion of an angle or carina extends from the beak to the posterior extremity. Surface sculptured by numerous small but sharply defined quite regular concentric ridges, separated by inter-spaces somewhat narrower than the latter, also by fine incremental lines which appear more prominent where the concentric ridges are obsolete. Hinge only moderately strong, umbonal pit small; lateral teeth high and thin, extending above the adjacent margins of the shell. Interior unknown.

Dimensions.—Length (restored), 50 mm.; latitude, 34 mm.; diameter (1 valve), 12 mm.; umbonal angle about 120°.

Notes.—This species is quite unlike any other found in the Cretaceous of the west coast. Distorted specimens, however, resemble Tapes conradiana Gabb, owing to the peculiar appearance of the concentric ribs. Numerous specimens of M. stantonii occur in the sandstone at locality No. 27, north of Pigeon Point, where most of the individuals are more or less distorted. The specimen figured is the best of those collected.

Named in honor of Dr. Timothy W. Stanton, chief paleontologist, United States Geological Survey.

Type.—Cat. No. 31001, U.S.N.M., 1 mile north of Pigeon Point, locality No. 27.

Horizon.—Chico formation, upper Cretaceous.

Locality.—Santa Cruz quadrangle, San Mateo County, locality No. 27. (Arnold.)
GASTEROPODA.

Genus TURRITELLA Lamarck

TURRITELLA PESCADEROENSIS, new species.

Plate XXXI. fig. 7.


Description.—Shell elongate, conical, large, often attaining a diameter of over 25 mm.; apex acute. Whorls at least 10, flat to convex above, convex below, excavated at base; there are 4 prominent, subequal, strong, squarish, often more or less nodose revolving ribs separated by concave-bottomed, channeled interspaces equal to or narrower than the ribs; the 2 lower ribs are usually slightly larger than the 2 upper; in addition to the 4 major ribs there are 2 sutural ribs, less prominent and more rounded than the others, one on each side of the suture and close to it, and sometimes an intercalated revolving raised line in one or more of the interspaces; fine incremental lines are visible in some specimens; base spirally striate; aperture subquadrate.

Dimensions.—Length (restored), about 110 mm.; latitude, 25 mm.; apical angle, 14°.

Notes.—A comparison of this robust species with some specimens of T. chicoensis Gabb from Pentz, Butte County, near the type-locality of the latter, reveals the following differences: T. pescaderoensis is larger, relatively broader (T. chicoensis has a deflection of 11° to 12°), has a much less pronounced basal excavation, has much stronger and more nearly equal and closer spaced revolving ribs, which are usually more rugose, and has more prominent sutural riblets. Specimens, which are believed to be a variety of T. chicoensis, from the Chico formation of the Santa Ana Mountains, Orange County, more closely resemble T. pescaderoensis than the typical form, being almost equal to the former in size and relative width, but showing the sculpture characteristics of the typical T. chicoensis. Named for the town of Pescadero, near which is the type-locality.

Type.—Imperfect specimen showing 3 large whorls. L. S. J. U., No. 999. (Locality No. 27 A.)

Horizon.—Chico formation, upper Cretaceous.

Localities.—Santa Cruz quadrangle, San Mateo County, locality No. 27 A, about 2½ miles north of Bolsa Point, in transition sandstone and conglomerate layers between the thin-bedded sandstones below and the heavy-bedded coarse conglomerate above. (G. H. Ashley, J. M. Hyde, J. F. Newsom, R. Arnold.)
ECOGENE SPECIES.
ECHINOIDEA.
Genus CIDARIS Leske.
CIDARIS MERRIAMI, new species.

Plate XXXII, fig. 8.

Description.—Spines subcircular in cross-section, as much as 4 mm. in diameter and probably over 10 mm. in length, tapering very slightly; surface sculptured by 13 or 14 prominent, narrow, nodose, ridge-like, longitudinal ribs separated by narrow, deeply incised grooves; the nodes are well defined, especially in the younger stages of growth, and are subelliptical in cross-section, their longer axis being parallel with the axis of the spine. Test unknown.

Dimensions.—The longest fragment obtained was over 20 mm. in longitude, the maximum diameter 4.5 mm.

Notes.—The test of this species is unknown, but the abundance and well marked characteristics of the fragments of the spines has been deemed of enough importance to justify a specific name. Seven specimens have been obtained at the type locality, each showing the characters described above.

Named in honor of Dr. John Charles Merriam, professor of paleontology at the University of California.

Dr. Hubert Lyman Clark, who kindly examined the type and other specimens of *Cidaris merriami* new species, *Cidaris branneri*, new species, from the Oligocene (see p. 363), and *Cidaris* species, *a*, from the middle Miocene (see p. 351), writes as follows concerning the relationships of the various forms:

The wax cast (*Cidaris* species, *a*) is a spine of a true *Cidaris* and very much like many spines of some individuals of the species of *Cidaris* common on the west coast of Lower California, Mexico, and Central America. *C. thomarsii*. I do not think it shows a single feature by which it can be distinguished from *thomarsii*. If it is not *thomarsii*, it is certainly from the ancestor of that species.

The other specimens (*Cidaris merriami, new species*) all appear to belong to one species, except possibly one fragment. That piece might possibly have come from quite a different species. I am very glad to see this material of *merriami*, for it satisfies me that the species must have been allied to, if not identical with, *Tretocidaris perplera* Clark (Cidaridae, 1907, p. 205, pl. vi, figs. 1-2; pl. vii, figs. 1-4), the only other living littoral *Cidarid* known from north of Panama (other, I mean, than *thomarsii*). So your material shows that the ancestors of both *thomarsii* and *perplera* lived in the Tertiary, in California. I think the other spine (*Cidaris branneri, new species*), * * * which I said was like *Guinocidaris*, is almost surely a third species.

Type.—Imperfect spine. Cat. No. 165438, U.S.N.M.

Horizon.—Martinez formation, lower Eocene.

Localities.—Santa Cruz quadrangle, San Mateo County, locality No. 25, ridge between headwaters of San Lorenzo River and Pescadero Creek. (H. S. Gay, R. Arnold.)
PELECYPODA.

Genus SEMELE Schumacher.

SEMELE GAYI, new species.

Plate XXXII, fig. 5.

Description.—Shell averaging about 14 mm. in latitude, subquadrate in outline, quite a little longer than wide, moderately inflated, rather thin, inequilateral, subequivalve. Beaks not prominent, turned slightly forward, situated about three-fifths length of shell from anterior end. Posterior margin slightly curved, sloping off rapidly toward anterior extremity, which is subangular and situated about one-third height of shell from the base; posterior fold very faint; anterior dorsal margin slightly depressed; anterior extremity more evenly and less sharply rounded than posterior; base evenly arcuate. Surface sculptured by numerous regular, fine, sharp concentric ridges, each with abrupt side toward the beak, the opposite side sloping, and each appearing to overlap its predecessor; in the larger specimens one or more well defined concentric grooves are sometimes found near the periphery. Interior showing well defined mantel impression parallel with margin and about one-sixth height of shell away from it; interior also coarsely radially grooved.

Dimensions.—Of imperfect right valve (type), restored; length, 17 mm.; latitude, 14 mm.; diameter of single valve, 2.8 mm.

Notes.—This species is apparently nearest related to S. rubropicta Dall (recent range, Washington to Mexico) of any of the living forms. It may be distinguished from the latter by its smaller size, finer and more regular concentric ribs, and lack of any external radiating sculpture. With the exception of S. rubropicta, S. gayi is more abruptly truncated posteriorly than any other member of the genus on the west coast.

Named in honor of Mr. Harold S. Gay, who first discovered the locality from which this species and its interesting associated fauna came.

Type.—Imperfect right valve. Cat. No. 165435. U.S.N.M.

Locality.—Santa Cruz quadrangle, San Mateo County, locality No. 25, between headwaters of San Lorenzo River and Pescadero Creek. (H. S. Gay, R. Arnold.)

GASTEROPODA.

Genus TRITONIUM Link.

TRITONIUM NEWSOMI, new species.

Plate XXXII, fig. 6.

Description.—Shell averaging about 18 mm. in altitude, subquadrate in outline; spire elevated, apex acute; whorls 5 or more, the the two upper minute; the others rounded and sculptured by 4 revolving and about 14 narrow, ridge-like axial costae, the intersections
of the two systems producing a slightly nodose-cancelate appearance; varices 2 to a volution, prominent, rounded, not reflected; suture appressed, slightly wavy.

**Dimensions.**—Of imperfect specimen, length, 17 mm.; latitude, 13 mm.; length of body whorl, 10 mm.; apical angle, 76°.

**Notes.**—Owing to the poor state of preservation of the type of this species, which happens to be the only one so far found, it is impossible to diagnose the characteristics of the aperture, lips, and details of sculpture. It belongs to the same general group as *T. californicum* Gabb* from* the Tejon formation, upper Eocene, but is relatively much wider and has much stronger but less numerous revolving and axial costae than the latter. The varices appear to be continuous on adjacent whorls in *T. newsoni* rather than more or less irregularly disposed, as in *T. californicum*.

Named in honor of Dr. John Flesher Newsom, professor of mining and metallurgy in Stanford University.

**Type.**—An imperfect specimen, lacking apex and canal. Cat. No. 165436, U.S.N.M.

**Locality.**—Santa Cruz quadrangle, San Mateo County, locality No. 25, ridge between headwaters of San Lorenzo River and Pescadero Creek. (R. Arnold.)

**Genus HIPPONYX** De France.

**HIPPONYX CARPENTERI** new species.

*Plate XXXII, figs. 3, 3a.*

**Description.**—Shell averaging only 11 mm. in longitude, tumid, with elongate oval base; apex distinct, small, curved slightly to right, situated almost directly above posterior extremity of base; profile from apex to anterior extremity of base is slightly but regularly bowed upward; profile from apex to posterior extremity of base is straight or bowed slightly inward. Surface sculptured by numerous regular, rounded, radiating ridges separated by narrow incised interspaces and by less prominent, wider, less regular, imbricating concentric lamellae; the radiating ridges are divaricate along a median line from anterior to posterior extremities; in some instances the incremental sculpture simply gives the radiating ridges a granulose appearance. Interior unknown.

**Dimensions.**—Length, 11 mm.; latitude (restored), 9 mm.; altitude, 4 mm.

**Notes.**—This beautiful little shell is quite closely allied to the living *Hipponyx tumens* Carpenter, but may be distinguished from the latter by its relatively narrower base, less prominent apex, and by its radiating ribs, which are equal instead of alternating large and small.

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*Pat. Cat., II, p. 154, pl. xxvi, fig. 33.*
Named in honor of the late Dr. P. P. Carpenter, widely known in relation to his work on West American conchology, who named two west coast species of this genus.

_Type._—Slightly imperfect specimen, Cat. No. 165433, U.S.N.M.

_Horizon._—Martinez (?) formation, lower Eocene.

_Localities._—Santa Cruz quadrangle, San Mateo County, locality No. 25, ridge between headwaters of San Lorenzo River and Pescadero Creek. (H. S. Gay, R. Arnold.)

**Genus PATELLA Linnaeus.**

**PATELLA MATEOENSIS**, new species.

_Plate XXXII, fig. 7._

_Description._—Shell averaging about 7.5 mm. in longitude, conical, with subelliptical base, very slightly narrowed in front; beak acute, slightly anterior; profile from beak to both extremities slightly convex upward; margin wavy to serrate. Surface sculptured by numerous fine, more or less irregular lines of growth and about 22 narrow, ridge-like radiating ribs separated by wide flat-bottomed interspaces in which are often intercalated one or more minor ribs.

_Dimensions._—Length, 7.5 mm.; latitude, 5.4 mm.; altitude, 2 mm.

_Notes._—This species is similar in general outline to _Patella_, new species, _b_, but a series of over twenty specimens of the two show no intermediate forms. _P. mateoensis_ is distinguished from _Patella_, new species, _b_, by its fewer, narrower ribs; which are simple instead of dichotomous, and between which are wider interspaces each usually containing one or two minor ribs. Named for San Mateo County, in which the type locality is situated.

_Type._—Cat. No. 165437, U.S.N.M.

_Horizon._—Martinez (?) formation, lower Eocene.

_Localities._—Santa Cruz quadrangle, San Mateo County, locality No. 25, ridge between San Lorenzo River and Pescadero Creek. (H. S. Gay, R. Arnold.)

**Genus FISSURELLA Bruguiere.**

**FISSURELLA PERRINI**, new species.

_Plate XXXII, fig. 4._

_Description._—Shell averaging about 16 mm. in longitude, conical, flaring slightly toward bottom; base oblong, narrowed in front; margin notched; apical hole oblong, with plane of margin tilted slightly forward, situated a little more than one-third the length of the shell from the anterior extremity. Surface sculptured by numerous (38 in type) quite regular, rounded, slightly elevated radiating ribs, separated by flat-bottomed interspaces usually slightly wider than the ribs, and also by numerous sharp, imbricating, wavy,
incremental lamellae, which are most prominent on the tops of the ribs. Interior and details of apical hole unknown.

**Dimensions**—Length, 16 mm.; latitude, 10.2 mm.; altitude, 2.6 mm.

**Notes.**—No intercalated riblets were noted on any of the specimens examined. This species appears to be closest to *F. volcanos-m* Reeve of the recent fauna, but differs from it in being smaller, relatively more depressed, and having the apical hole less central and the ribs fewer, farther apart, and more regular and more regularly disposed over the surface.

Named in honor of Dr. James Perrin Smith, professor of paleontology, Stanford University.

**Type.**—Nearly perfect specimen, Cat. No. 165434, U.S.N.M.

**Horizon.**—Martínez (?) formation, lower Eocene.

**Locality.**—Santa Cruz quadrangle, San Mateo County, on ridge between headwaters of San Lorenzo River and Pescadero Creek. (H. S. Gay, R. Arnold.)

**SAN LORENZO (OLIGOCENE) SPECIES.**

**ECHINOIDEA.**

*Genus CIDARIS* Leske.

**CIDARIS BRANNERI,** new species.

Plate XXXIII, fig. 5.

**Description.**—Test unknown. Spines, long, slender, circular in cross-section, attaining a length of at least 25 mm. and a diameter of over 2 mm. Surface of spine smooth for about one-fifth its length from the base; above this it is ornamented by 10 longitudinal rows of elongated nodes or granules which are barely connected near the smooth portion, but which partake more and more of the character of nodose ribs toward the distal end; the last one-fifth of the spine is ornamented by 5 prominent, slightly nodose ribs; the extreme end is blunt and rounded; collar at base only faintly developed.

**Dimensions.**—Length, 20 mm.; diameter, basal end, 2.2 mm.; distal end, 1.1 mm.

The spines of this species are easily distinguishable from those of *C. merriami,* new species, from the Eocene, by their smaller size, fewer but much more prominently nodose longitudinal ribs, and smooth basal portion. No complete spine of *C. merriami* was obtained, so that the smooth basal section may possibly be a characteristic of this latter species as well as of *C. branneri.* (See note under description of *C. merriami,* p. 359, for a discussion of the zoologic relations of this species.)

Named in honor of Dr. John Casper Branner, professor of geology, Stanford University.
Type.—External mold of almost perfect spine, L.S.J.U., No. 1056. (Locality, No. 109.)

Horizon.—San Lorenzo formation, Oligocene, upper portion transitional toward Vaqueros formation, lower Miocene.

Locality.—Santa Cruz quadrangle, Santa Cruz County, locality No. 109, on Bear Creek, 4 miles above its confluence with the San Lorenzo River. (J. F. Newsom.)

PELECYPODA.

Genus NUCULA Lamarck.

Subgenus ACILA H. and A. Adams.

NUCULA (ACILA) DALLI, new species.

Plate XXXIII. fig. 15.

Description.—Shell trigonal in outline, nearly as broad as long, large for a member of this genus, sometimes attaining a length of over 30 mm., rather compressed, strongly divaricately sculptured. Umbones prominent and turned backward, placed very near the posterior end, which is abruptly truncated and depressed, and forms a straight or slightly inwardly curved line from the umbones to the base, with which it makes a sharp angle of about 90°; base rounded, becoming more and more so toward the anterior extremity, which region exhibits the sharpest curvature of any on the anterior portion of the shell; anterior dorsal margin nearly straight for a considerable distance in front of the umbones; a faint carina extends from the umbo to the posterior ventral angle; surface sculptured by numerous rounded, raised, divaricating lines; margins crenulate. Hinge as in other members of this genus.

Dimensions.—Length, 33 mm.; latitude, 28 mm.; diameter of both valves together about 14 mm.

Notes.—This magnificent species is easily distinguishable from the other west coast forms by its great size, great breadth, and coarse, well defined sculpture. In size it approaches the gigantic Acila mirabilis Adams and Reeve, from the recent fauna of Japan.

Named in honor of Dr. William Healey Dall, of the United States Geological Survey.

Type.—Mold of exterior of left valve, Cat. No. 165452, U.S.N.M. (Locality No. 115.)

Horizon.—San Lorenzo formation, Oligocene, and possibly also the Monterey shale, middle Miocene.

Localities.—Santa Cruz quadrangle, Santa Cruz County, locality Nos. 100, 101, and 102, on San Lorenzo River, 3, 3½, and 5½ miles, respectively, above the town of Boulder Creek; locality No. 103, Kings Creek, three-eighths mile above its confluence with San Lorenzo River; locality No. 104, Boulder Creek, 5½ miles above its
confluence with San Lorenzo River; locality No. 107, in small ravine off Boulder Creek, 2½ miles north of Eagle Rock; localities Nos. 115, 116 and 117, the first two on the headwaters of the South Fork, the last on the headwaters of the North Fork, of Waddell Creek, in the Big Basin. (R. Arnold, W. R. Hamilton, H. L. Hamilton, etc.)

Genus MALLETIA Desmoulins.

MALLETIA CHEHALISENSIS, new species.

Plate XXXIII, figs. 9, 9a.

Description.—Shell attaining a length of 25 mm., oval, compressed, smooth; umbones rather inconspicuous, slightly anterior to middle, turned backward; anterior dorsal margin sloping straight from umbo; anterior extremity regularly rounded; posterior dorsal margin straight, depressed immediately in rear of umbones; posterior extremity above medial line, more attenuated than the anterior; posterior portion of base near extremity nearly straight, otherwise quite regularly curved. Surface smooth, except for faint concentric lines. Hinge consists of a row of sharp teeth flexed toward the umbo on each side of a prominent, projecting umbonal pit. Pallial sinus large and deep.

Dimensions.—Length, 7.4 mm.; latitude, 4.5 mm.; diameter of single valve, 1.5 mm.

Notes.—This species is very closely allied to M. gibbsii Dall, dredged at U. S. Bureau of Fisheries Station 2860 in 876 fathoms off Queen Charlotte Island, but may be distinguished from the latter by its prominent umbonal pit and straighter posterior dorsal margin. The type is a rather undersized specimen, chosen for its perfect state of preservation, the species usually attaining a larger size. The specimens from the Santa Cruz quadrangle reach a length of over 12 mm.

Named for Chehalis County, Washington, where the type was found.

Type.—Cat. No. 165447, U.S.N.M., Porter, Chehalis County, Washington.

Horizon.—San Lorenzo formation, Oligocene (Santa Cruz region; Oligocene (Porter, Washington); base of Oligocene-Miocene (Washington).

Localities.—Santa Cruz quadrangle, Santa Cruz County, locality No. 103, Kings Creek, three-eighths mile above its confluence with San Lorenzo River; locality No. 104, on Boulder Creek, 5 miles northwest of its confluence with the San Lorenzo River; locality No. 106, on Twobar Creek, 1 mile above its confluence with the San Lorenzo River; locality No. 107, small ravine off Boulder Creek, 2½ miles north of Eagle Rock (R. Arnold); also in basal portion of Oligocene-
Miocene series west of Gettysburg and west of Port Crescent, Clallam County, and in Kitsap County, opposite Seattle, Washington (R. Arnold); Oligocene, Porter, Washington (R. Arnold).

Genus CARDIUM (Linnaeus) Lamarck.

CARDIUM COOPERI Gabb, var. LORENZANUM, new variety.

Plate XXXIII, fig. 6.

Description.—Shell attaining a length of only about 14 mm.; somewhat longer than high; end view of both valves together has a cordate appearance; outline of a single valve subcircular; shell very convex, thin; umbo small, prominent, turned slightly forward, projecting beyond dorsal margin; dorsal margin straight for short distance under umbo, bends off slightly more angularly posteriorly than it does anteriorly; extremities broad and regularly rounded, as is also the base; surface sculptured by fine incremental lines and by numerous fine radiating lines, those over the posterior end being larger and more prominent than those on the remainder of the shell, and distinctly separated from the latter by a faint angle in the surface of the shell extending from umbo to posterior ventral margin. Margin minutely crenulate. Lunule faint or lacking.

Dimensions.—Length, 14 mm.; altitude, 12.5 mm.; diameter of single valve, 1.5 mm.

Notes.—Gabb, in the original description a of C. cooperi, writes that no carina or angle separates the two differently sculptured portions of the shell. Specimens of C. cooperi from the Eocene of Rose Canyon, north of San Diego, show a faint angle at this point. C. cooperi Gabb, var. lorenzatum, new variety, apparently differs from the typical Eocene form in size only, the latter often attaining a length of nearly 40 mm., although in the type of the new variety the lunule is lacking. Other specimens from the same horizon as the latter show a faint lunule. The small variety is apparently confined to the Oligocene, while the typical form is characteristic of the Eocene.

Type.—Slightly imperfect right valve, Cat. No. 165444, U.S.N.M. (Locality No. 4063, Porter, Washington.)

Horizon.—San Lorenzo formation, Oligocene.

Localities.—Santa Cruz quadrangle, Santa Cruz County, locality No. 101, on San Lorenzo River, 3 3/8 miles north of Boulder Creek; locality No. 103, on Kings Creek, one-half mile above confluence with San Lorenzo River; locality No. 106, on Twobar Creek, seven-eighths mile above its confluence with San Lorenzo River; locality No. 107, on small ravine off Boulder Creek, 2 1/4 miles north of Eagle Rock; locality No. 108, beside road on ridge between headwaters of South Fork of Waddell Creek, and Boulder Creek, 1 mile north of Eagle Rock.

a Pal. Cat., 1, p. 172.
Rock; locality No. 117, on east branch of North Fork of Waddell Creek, Big Basin (R. Arnold). Also at U. S. Geological Survey locality Nos. 4063 and 4064, Porter, Chehalis County, and locality No. 4071, Restoration Point, Kitsap County, opposite Seattle, Washington (R. Arnold).

Genus TELLINA Linnaeus.

TELLINA LORENZOENSIS, new species.

Plate XXXIII, fig. 1.

Description.—Shell attaining a length of 40 mm., width a little over five-eighths of length, oblong, compressed, slightly inequivalve, anterior end evenly rounded, posterior end biangular and narrower than anterior; umbo small, central, though sometimes, as in type, placed a little in front of middle; sides making an angle of 125° at the umbo; anterior dorsal margin very gently curved near umbo, becoming rapidly more curved near extremities; ventral dorsal margin very gently curved for whole length to upper posterior angle; a moderately sharp fold, on which the lines of growth are particularly prominent, extends from the umbo to the lower posterior angle; a faint indication of a reentrant angle often occurs in the margin at the end of the fold; base nearly straight, curving quite rapidly at ends. Surface sculptured by numerous slightly unequal concentric lines. Left valve similar to right except that instead of being very slightly flexed upward at the posterior extremity, it is flexed downward.

Dimensions.—Length, 40 mm.; latitude, 26 mm.; diameter single valve, 3 mm.

Notes.—This species is very closely allied to T. rubescens Hanley from the recent fauna of the west Mexican coast, but may be distinguished by its more anterior umbo, slightly sharper posterior fold, less sharply angular and usually less flexed posterior extremity, and considerably finer concentric sculpture. T. lorenzoensis also resembles T. cbrnica Hanley of the Panama fauna, but is smaller and has finer sculpture and other minor differences. It is unlike any of the other west coast Oligocene and Miocene forms in having a more central umbo. Named for the San Lorenzo formation, of which it is believed to be characteristic.

Type.—Mold of right valve, from which specimen figured is the cast; Cat. No. 165439, U.S.N.M. (Locality No. 115.)

Horizon.—San Lorenzo formation, Oligocene.

Localities.—Santa Cruz quadrangle, Santa Cruz County, locality No. 107, on small ravine off Boulder Creek, 2½ miles north of Eagle Rock (R. Arnold; I. Anderson); locality No. 115, on southeast branch of South Fork of Waddell Creek, Big Basin (R. Arnold, W. R. Hamilton).
GASTEROPODA.

Genus PLEUROTOMA Lamarck.

PLEUROTOMA NEWSOMI, new species.

Plate XXXIII, fig. 2.

Description.—Shell about 12 mm. in length, spindle-shaped and exceedingly slender; spire very long and apex acute. Whorls 6, convex, sharply angulated, the angle carrying a very prominent, rounded revolving rib; upper and lower surfaces of whorl concave and bordered by moderately pronounced sutural ridges; body whorl biangular, each angle carrying a revolving ridge similar to those on upper whorls, the lower ridge being slightly less prominent than the upper; below the lower rib is still a third much smaller one; between and below the revolving ridges on the body whorl are several minor raised revolving lines (3 between the major revolving lines on the type); faint indications of spiral lines are also visible on the concave surfaces of the upper whorls. Suture distinct. Aperture subovate. Canal long, narrow, nearly straight.

Dimensions.—Length, 12 mm.; latitude, 3.3 mm.; apical angle, 18°.

Notes.—This species is entirely unlike any previously described Pleurotoma from the west coast and is characterized by its exceeding slenderness and the prominence of the revolving cord-like ridges. The character of the spiral sculpture, especially of the body whorl, reminds one somewhat of Perissolax blakei Conrad from the Tejon (Eocene). Named in honor of Dr. John Flesher Newsom, of Stanford University.

Type.—Cat. No. 165410, U.S.N.M. (Locality No. 107.)

Horizon.—San Lorenzo formation, Oligocene.

Locality.—Santa Cruz quadrangle, Santa Cruz County, locality No. 107, in small ravine off Boulder Creek, 2\tfrac{1}{2} miles north of Eagle Rock. (R. Arnold, Isaac Anderson.)

PLEUROTOMA PERISSOLAXOIDES, new species.

Plate XXXIII, fig. 13.

Description.—Shell about 28 mm. in length, fusiform; spire well elevated; apex moderately acute; whorls at least 5, very angular with an exceedingly prominent revolving smooth keel on angle which is near base of whorl; upper portion of whorl flat or slightly concave; surface ornamented by microscopic revolving strie and numerous fine incremental lines which indicate a very deep narrow sulcus in the outer lip just above the keel of the whorl; body whorl carrying a second keel less prominent than and below the major keel and distant from it about one-sixth the length of the body whorl; suture dis-
distinct, appressed, and just overlapping the lower keel of the antecedent whorl; aperture subpyriform; canal moderately long, tapering quite rapidly forward.

**Dimensions.**—Of type, from which a portion of the spire is removed, length, 24 mm.; latitude, 13 mm.

**Notes.**—The type of this species is a fairly well preserved mold of the penultimate and body whorls (locality No. 107); the figure is of a wax cast from the mold; another specimen of the same species from locality No. 101 retains a portion of the original shell material and furnishes the detailed characters of the external sculpture. *P. perissolacoides* reminds one of the young of the living *P. circinata* Dall from Alaska, but differs from the latter in having a minor keel on the body whorl. Named for its general resemblance to *Perissolax blakei* Conrad from the Eocene of California.

**Type.**—Cat. No. 165451, U.S.N.M. (Locality No. 107.)

**Horizon.**—San Lorenzo formation, Oligocene.

**Localities.**—Santa Cruz quadrangle, Santa Cruz County, locality No. 101, on San Lorenzo River about 3 3/4 miles above Boulder Creek; locality 107, small ravine off Boulder Creek about 2 1/4 miles north of Eagle Rock. (R. Arnold.)

**PLEUROTOMA SANCTÆCRUCIS,** new species.

Plate XXXIII, fig. 7.

**Description.**—Shell about 18 or 20 mm. in length, broadly fusiform in shape; spire elevated cone-shaped, straight-sided; apex moderately acute; whorls 6 or more, biangular, tabulated above and below, near suture, which is canal-like and very deeply and prominently impressed; upper surface of whorl concave, side flat and sloping exactly with slope of spire, base flat and its plane practically perpendicular to the axis of the shell, surface sculptured by minute incremental lines and 1 or 2 obsolete revolving lines. Canal and aperture unknown; sinus as indicated by incremental lines corresponded in position to the upper angle of the whorl.

**Dimensions.**—Of spire from which canal is lacking, length, 8 mm.; latitude, 7 mm.

**Notes.**—This peculiar species of which only the type is known is easily distinguished by its deep canal-like suture and the shape of the whorl the side of which is sloping with the slope of the sides of the spire, while the top and bottom are in planes practically perpendicular to the axis of the whole spire. Named for the Santa Cruz quadrangle.

**Type.**—Cat. No. 165445, U.S.N.M. (Locality No. 108.)

**Horizon.**—San Lorenzo formation, Oligocene.

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Locality.—Santa Cruz quadrangle. Santa Cruz County, locality No. 108, on road between headwaters of Boulder Creek and South Fork of Waddell Creek, about a mile north of Eagle Rock. (R. Arnold.)

Genus STREPSIDURA Swainson.

STREPSIDURA CALIFORNICA, new species.

Plate XXXIII, fig. 12.

Description.—Adult shell attaining an altitude of at least 40 mm., broadly fusiform; spire elevated; apex acute. Whorls 5 or 6, upper whorls prominently angular, body whorl biangular with a very faint suggestion of a third angle below the other two; posterior margin of each whorl appressed against the middle of the antecedent whorl, covering the lower angle of the latter; upper portion of whorl flat or concave, middle of whorl between angles, exceedingly concave; angles ornamented by several (13 on body whorl of type) prominent sharp nodes which protrude straight out from the angle, flexing neither backward nor forward, and merge into faint or obsolete axial ribs on the body of the whorl; posterior portion of whorl showing a faint sutured carina; three uppermost whorls less prominently nodose but rather more cancellate than the lower ones; surface sculptured by numerous, sometimes alternating, sometimes subequal, raised revolving lines; these lines are usually much finer and closer set on the angles than on the body of the whorl; fine incremental lines are also plainly seen over much of the surface, especially the lower portion of the body whorl, and sometimes irregular lines of interrupted growth cross the whorls approximately parallel with the axis of the spire. Suture deeply appressed, slightly wavy. Pillar short, basal portion turned outwardly with a biangular fold at the base of the aperture. Aperture subpyriform.

Dimensions.—Altitude, 32 mm.; latitude, 23 mm.; altitude of body whorl, 22 mm.

Notes.—S. californica is allied to S. oregonensis Dall from the Eocene of Oregon, but is distinguished from the latter by its somewhat sharper spire, much more strongly angulated and nodose whorls, coarser revolving lines, and less well-defined third angle on the lower part of the body whorl.

Type.—Cat. No. 165450, U.S.N.M.

Horizon.—San Lorenzo formation, Oligocene.

Localities.—Santa Cruz quadrangle. Santa Cruz County, locality No. 103, near mouth of Kings Creek; locality No. 108, on road near divide between headwaters of South Fork of Waddell Creek and

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Boulder Creek, and locality No. 117, on the East Fork of the North Fork of Waddell Creek, in the Big Basin (R. Arnold); also found in the Oligocene at Porter, Washington (U. S. Geological Survey, locality No. 1063).

Genus FUSUS Lamarck.

FUSUS HECOXI, new species.

Plate XXXIII, fig. 8.

Description.—Shell about 50 mm. in length, slender, fusiform; apex acute. Whorls 6 or 7, moderately angulated, concave above angle, slightly convex below; an almost obsolete narrow revolving band marks the upper margin of the whorl; 10 regularly rounded slightly oblique nodes surmount the angle and become obsolete a short distance both above and below it; the obliquity of the nodes is in a direction sloping downward toward the left; whole surface sculptured by alternating major and minor narrow, raised, revolving lines and occasionally by obsolete microscopic revolving striae; suture appressed, distinct.

Dimensions.—Of imperfect type, length, 36 mm.; latitude, 18 mm.; apical angle, 49°.

Notes.—A large specimen believed to be of this species from locality No. 105, on Love Creek, shows 2 instead of 1 minor lines between some of the major revolving ones; this large specimen measures 25 mm. in width. F. hecoxi is closely related to F. sanctiverusis, but may be distinguished from the latter by its greater size, relatively broader spire, nodose rather than axially ribbed whorls, and by the alternating character of its spiral lines. Like F. sanctiverusis, F. hecoxi is allied to F. geniculatus Conrad from the Oligocene of Oregon, but may be distinguished from the last by the greater angularity of its whorls, by the concave outline of the upper portion of the whorl, by its nodose rather than axially ridged sculpture, and by the coarser character of its revolving lines. F. hecoxi also resembles Priscofusus medialis Conrad from Astoria, but is slenderer, has larger, broader nodes and much more prominent spiral sculpture.

Named in honor of Miss Laura J. F. Hecox. United States lighthouse keeper, Santa Cruz, whose collection of specimens and interest in natural history has been an inspiration to all who have had the pleasure of her acquaintance.

Type.—Cat. No. 165446, U.S.N.M. (Locality No. 100.)

Horizon.—Near base of San Lorenzo shale, Oligocene.

Localities.—Santa Cruz quadrangle, Santa Cruz County, locality No. 100. 3 miles above the town of Boulder Creek on the San Lorenzo River; locality No. 103, near mouth of Kings Creek; locality No. 104,
5½ miles above the town of Boulder Creek on Boulder Creek; locality No. 105, on Love Creek, 2 miles above its confluence with the San Lorenzo River. (Ralph Arnold.)

**Fusus SanctaeCrucis**, new species.

*Plate XXXIII, fig. 3.*

*Description.*—Shell about 45 mm. in length, slender, fusiform; apex acute. Whorls 6 or 7, convex below, flat to concave above; about 12 slightly oblique (sloping downward toward the left), narrow, wave-like ridges extend across each whorl from a short distance below the upper margin to the lower margin, becoming best developed on the angle of the whorl; a flat, narrow, roughened band forms the upper margin of the whorl; surface sculptured by numerous fine, equal, equidistant, raised spiral lines, most prominent between the longitudinal ridges; suture distinct, slightly wavy. Canal long, narrow, bowed slightly outward.

*Dimensions.*—Length (restored), 44 mm.; latitude, 12 mm.; length of body whorl, 30 mm.

*Notes.*—This species is characterized by its slender form, long slender canal, and the equality of its revolving lines. It resembles *F. geniculus* Conrad from the Oligocene of Astoria, Oregon, but is easily distinguished from the latter by its slenderer form and the regularity of its spiral sculpture. *F. sanctaeCrucis* is distinguishable from *F. hecoxi* by its slenderer form, narrower and relatively longer axial varices, and equality of the spiral lines; it comes from a considerably higher part of the formation than the latter. The plastotype, which is figured, shows the spiral sculpture over only a portion of the shell. Named for the Santa Cruz quadrangle.

*Type.*—L. S. J. U., No. 1037. (Locality No. 109.)

*Horizon.*—San Lorenzo formation, Oligocene, upper portion transitional into Miocene.

*Locality.*—Santa Cruz quadrangle, Santa Cruz County, locality No. 109, Bear Creek, 4 miles above its confluence with San Lorenzo River. (J. F. Newsom.)

**Genus LIROFUSUS** Conrad.

**LIROFUSUS ASHLEYI**, new species.

*Plate XXXIII, fig. 11.*

*Description.*—Shell about 23 mm. in altitude, broadly fusiform; spire elevated, apex moderately acute. Whorls about 6+, ventricose; upper whorls biangular; body whorl triangular; a prominent nodose-to undulating, squarish, narrow revolving ridge ornaments the lower angle, while a much less prominent ridge surmounts the upper; on
the body whorl a third revolving ridge equal in prominence to the major ridge marks the third angle, and below this are 8 or 9 minor revolving ridges, which become less and less prominent toward the anterior end of the shell; a faint carina revolves just below the suture; whole surface marked by fine incremental lines and numerous, microscopic revolving striae; on the last and penultimate whorls, are faint longitudinal undulations which rise to the prominence of faint nodes on the revolving ridges; suture appressed, distinct; canal quite short and rather narrow, curved slightly outward; aperture pyriform.

Dimensions.—Of type, from which canal is broken, length, 12 mm.; latitude, 12 mm.

Notes.—This species is quite unlike any other Fusus from the west coast, but is apparently allied to Lirofusus thoracicus Conrad from the Claiborne Eocene. It is less tabulated than the latter, however, and has a much shorter canal and less prominent axial sculpture.

Named in honor of Dr. George Hall Ashley, of the United States Geological Survey, one of the pioneer paleontologists to investigate the Santa Cruz region.

Type.—Cat. No. 165449, U.S.N.M. (Locality No. 100.)

Horizon.—San Lorenzo formation, Oligocene.

Localities.—Santa Cruz quadrangle, Santa Cruz County, locality No. 100, San Lorenzo River, 3 miles above the town of Boulder Creek; locality No. 107, small ravine 2½ miles north of Eagle Rock; locality No. 108, on road on divide between headwaters of South Fork of Waddell and Boulder creeks; locality No. 110, Two Bar Creek, 1½ miles up from mouth; locality No. 115, South Fork of Waddell Creek, 1½ miles southwest of Eagle Rock; locality No. 117, North Fork of Waddell Creek, 3½ miles west-northwest of Eagle Rock. (R. Arnold, W. R. Hamilton, and others.)

Genus TURCICULA Dall.

TURCICULA SANTACRUZANA, new species.

Plate XXXIII, fig. 4.

Description.—Shell turbinated, solid, averaging about 35 mm. in altitude; spire considerably elevated; apex only moderately acute; suture deeply impressed, distinct; whorls 5, quite convex, biangular, upper angle about middle of whorl, lower one-half way between upper one and base; surface above upper angle gently sloping, flat to slightly concave; surface between angles and between lower angle and suture decidedly concave; the upper angle is ornamented by about 18 low but distinct rounded nodes, while the lower angle and a slightly raised sutural ridge at the upper margin of the whorl each carry twice as many but slightly less prominent nodes; a faint ob-
liquely sloping ridge parallel with the incremental sculpture often connects the alternate nodes on the suture ridge with the nodes on the upper angle: between the lower angle and the umbilical region on the body whorl are 6 or 7 revolving ridges, the first and the most prominent, slightly tuberculated, the others diminishing in importance and nodosity and in distance apart as the umbilical region is approached: the surface of all the whors is crossed by numerous fine incremental lines which slope downward and backward from the upper margin, at an angle deflecting about 25° from the vertical; aperture subcircular; lip simple; character of shell material, nacreous, over which in the well-preserved fragments is a horny epidermis in which the nodes of the underlying layer are somewhat exaggerated.

Dimensions.—Of type (restored), altitude, 35 mm.; latitude, 35 mm.; apical angle between 85° and 90°.

Notes.—This magnificent species is apparently the precursor of T. bairdii Dall, now found living off the California coast; it differs from the latter in its more angular whorl and more tabulate upper portion of the whorl, in its less conspicuous nodes on the suture carina, in its stronger revolving basal ridges, and in minor points in the secondary sculpture. T. santacruzanana is much smaller and relatively shorter than T. columbiana Dall from the Eocene of Rock Creek, Columbia County, Oregon, and has an entirely different arrangement of the nodes and revolving ridges than the latter.

Named for the Santa Cruz quadrangle, in which it has so far only been found.

Type.—Slightly decolleté specimen, Cat. No. 165,442; U.S.N.M. (Locality No. 100.)

Horizon.—San Lorenzo formation, Oligocene.

Localities.—Santa Cruz quadrangle, Santa Cruz County, locality No. 100, on San Lorenzo River, 3 miles above the town of Boulder Creek, abundant; locality No. 102, San Lorenzo River, 5 1/2 miles north of Boulder Creek. (R. Arnold, R. Anderson.)

Genus ARCHITECTONICA Bolten.

ARCHITECTONICA LORENZOENSIS, new species.

Plate XXXIII, fig. 10.

Description.—Shell spiral, conical, depressed, attaining a diameter of 20 mm.; spire low, whors 5 or 6, quite evenly but moderately convex; suture deeply impressed. Upper whors ornamented by 3 raised spiral lines; body whorl biangular, the two angles being close together and each bearing a rounded revolving rib; upper surface of body whorl bearing an impressed groove near the suture and between this and the periphery 2 quite prominent raised lines and 1 or more subsidiary revolving striae; base very slightly convex, carrying a
crenulated revolving rib adjacent to umbilicus, 1 or 2 incised grooves outside of this and finally 2 or 3 revolving raised lines toward the periphery; whole surface of whorls ornamented by numerous sharp, subequal, incremental lines which slope obliquely downward and backward from the upper margin. Umbilicus wide, spiral, and margins crenulated by rib previously mentioned; aperture subquadrate; lip simple.

**Dimensions.**—Of type, imperfect specimen, approximate, altitude, 8 mm.; latitude, 19 mm.

**Notes.**—This beautiful species, of which a rather imperfect mold is the type, has so far been found only at locality No. 107. All of the specimens figured are wax casts from molds in the soft sandstone matrix. *V. lorenzoensis* is allied to *V. hornii* Gabb from the Tejon (Eocene), from which it differs by its larger size and spirally sculptured upper surfaces of the whorls, and also to *V. bland a* Dall from the Eocene of Fall Creek, Oregon, from which it differs by having raised spiral lines near the periphery, rather than an entire spiral sculpture of impressed grooves.

Named for the San Lorenzo formation, of which it is believed to be characteristic.

**Type.**—Imperfect mold, Cat. No. 165448, U.S.N.M.

**Horizon.**—San Lorenzo formation, Oligocene.

**Locality.**—Santa Cruz quadrangle, Santa Cruz County, locality No. 107, on small ravine off Boulder Creek, 2½ miles north of Eagle Rock. (R. Arnold, I. Anderson.)

**VAQUEROS (LOWER MIocene) SPECIES.**

**PELECYPODA.**

Genus LEDA Schumacher.

LEDA CAHILLEN SIS, new species.

Plate XXXIV, fig. 9.

**Description.**—Shell attaining a length of only 6 or 7 mm., width about seven-ninths of length, oval, rounded in front, attenuate behind; well inflated, margin smooth; umbo small, subcentral, turned backward; anterior dorsal margin nearly straight, sloping steeply from umbo; anterior extremity regularly rounded; posterior dorsal margin concave, prominently excavated behind umbo; posterior extremity very attenuate; surface sculptured by numerous, equal, rounded concentric ribs, separated by moderately wide impressed lines; a trace of a poorly developed carina extending from the umbo to the posterior extremity is discernible in the type.

**Dimensions.**—Length, 6.5 mm.; latitude, 4.8 mm.; diameter of single valve, 1.9 mm.
Notes.—This gibbous little Leda is easily distinguished from associated fossil forms by its small size, great convexity, broad outline, sharply attenuate posterior extremity, excavated margin posterior to umbo, and rather coarse sculpture. It resembles L. acuta Conrad (recent) in size but is relatively broader and more excavated behind. Distinguishable from the closely allied L. taphria Dall by much smaller size, more excavated dorsal posterior margin, and finer concentric sculpture.

Named for Cahill Ridge, west of Redwood City, on the flanks of which is the type-locality.

Type.—L. S. J. U., No. 1065. (Locality No. 57.)

Horizon.—Vaqueros formation, Lower Miocene.

Locality.—Santa Cruz quadrangle, San Mateo County, locality No. 57, on road to Kings Mountain House, 2 miles west of Woodside, in rather coarse, brownish-yellow sandstone. (W. A. Williams.)

Genus YOLDIA Moller.

YOLDIA SUBMONTEREYENSIS, new species.

Plate XXXIV, fig. 8.

Description.—Shell attaining a length of 32 mm., width about two-thirds of length, oblong, rounded in front, somewhat attenuated, angular, and slightly gaping behind, compressed; margin smooth; umbo central; anterior dorsal margin nearly straight, anterior extremity broad and evenly rounded; posterior dorsal margin concave, curving upward at posterior extremity, but not prominently excavated immediately in rear of umbo; basal margin curving up sharply behind and meeting dorsal margin in a right angle, although the extreme end is slightly posterior to the angle; a faint carina, separated from dorsal margin by impressed line or lunule, extends from umbo to posterior extremity; surface sculptured by numerous regular, narrow, incremental lamellae, which are abruptly truncated on the edge toward the umbo, slope off gently on the side toward the periphery, and become narrower posteriorly.

Dimensions.—Length, 32 mm.; latitude, 24 mm.; diameter of single valve, 2.5 mm.; umbo to anterior extremity, 17 mm. (53 per cent of longtitude).

Notes.—This species is characterized by its size, the central position of the umbones, rather broad, slightly rounded, gaping posterior extremity and regular concentric lamellae. It is closely allied to Leda whitmani Dall (possibly a Yoldia) from the Miocene of Oregon, but differs from it in being less attenuate posteriorly and broader in outline; the excavation behind the umbo in the latter is also more pronounced than in Y. submontereyensis. It is smaller and less attenuated posteriorly than Y. oregona Shumard; is much smaller and
much longer, but narrower posteriorly, than Y. cooperi Gabb from the Pliocene to Recent fauna; and is much larger, broader and more closely sculptured than Y. impressa Conrad from the Oligocene and Miocene. Distinguished from Y. supramontecryensis, new species, which occurs in the Miocene above the Monterey, by its shorter and broader posterior end.

Name derived from its stratigraphic position in the lower Miocene below the Monterey (middle Miocene) formation.

*Type.*—Cat. No. 165459, U.S.N.M. (Locality 35.)

*Horizon.*—Vaqueros formation, lower Miocene.

*Localities.*—Santa Cruz quadrangle, San Mateo County, localities Nos. 1 and 2, on hill and beside road, respectively, three-fourths mile northeast of north end of Searsville Lake (R. Arnold); locality No. 35, on San Francisquito Creek, just below dam, 1\(\frac{1}{4}\) miles south-west of Stanford University (R. Arnold; Fay).

**Genus GLYCYMERIS Da Costa.**

**GLYCYMERIS BRANNERI, new species.**

Plate XXXIV, fig. 1.

*Description.*—Shell averaging nearly 70 mm. in length, about as wide as long, suborbicular, equi valve, bilaterally unsymmetrical, considerably convex for one of this genus, thick and heavy; umbo somewhat anterior to center, protruding beyond hinge line and turned slightly toward the front; anterior dorsal margin straight, sloping steeply from umbo; anterior extremity quite sharply rounded, and located above center line of shell; posterior dorsal margin straight, sloping less steeply than anterior; posterior extremity protruding obliquely downward and backward, regularly rounded, located below center line of shell; posterior dorsal and ventral margins join in a faintly defined angle considerably above and in front of the extreme end of the shell. Surface sculptured by numerous flat to concave-topped, close-set, radiating ribs (about 55 discernible in the type), relatively much broader toward the middle of the shell and becoming narrower and less well defined toward either end; in the later stages of growth a raised beaded intercalary line occupies the interspace and (in the type) rises above the level of the ribs; prominent incremental lamellæ cross the ribs, bowing convexly upward toward the umbo; they are straight on the sides and across the top of the ribs, and become less prominent and more closely set toward the periphery in the adult shell. Hinge with 5 or 6 boomerang-shaped teeth, with angle toward the umbo, on either side of a centrally divergently striated broad ligamental area; the teeth in the young form a semicircle below and extending on either side beyond the ligamental area.
but in the later stages of growth the centrally situated teeth are obliterated by encroachment of the ligament. Interior unknown, but interior of margins appear to be smooth.

**Dimensions.**—Length, 62 mm.; latitude, 62 mm.; diameter of single valve, 23 mm.

**Notes.**—This magnificent species is apparently one of the largest of the west coast forms, equaling in size but not in convexity the Cretaceous *Glycymeris veatchii* Gabb and its Eocene variety *G. veatchii major* Stanton. It also lacks the prominent groove which separates the dorsal posterior angle from the rest of the shell in the earlier forms. It is distinguishable from *Glycymeris gabbi* Dall from Coos Bay, Oregon, the next largest Miocene species, by its unsymmetrical outline, its much greater size, relatively greater convexity, closer set ribs, and peculiar wavy incremental sculpture. The species is believed to be characteristic of the Vaqueros formation (lower Miocene).

Named in honor of Dr. John Casper Branner, professor of geology, Leland Stanford Junior University.

**Type.**—Left valve, Cat. No. 165455, U.S.N.M. (Locality No. 12.)

**Horizon.**—Vaqueros formation, lower Miocene.

**Localities.**—Santa Cruz quadrangle, San Mateo County, locality No. 12, Mindego Creek, 1 mile above its confluence with Alpine Creek. (R. Arnold, H. Holly, L. C. Mills.)

Genus *CARDIUM* (Linnaeus) Lamarck.

Subgenus *TRACHYCARDIUM* Morch.

*CARDIUM* (TRACHYCARDIUM) *VAQUEROSENSIS*, new species.

Plate XXXIV. fig. 3.

**Description.**—Shell attaining a length of over 100 mm., nearly as high as long, subcircular in outline, very convex, quite thick; umbo prominent, protruding above hinge-line, subcentral, turned slightly toward anterior extremity; anterior extremity regularly rounded, posterior one somewhat flattened, forming two faint angles, the lower one of which is connected with the umbo by quite a pronounced angle in the surface of the shell. Upper angle about two-fifths length of shell from the umbo. Sculpture consists of about 34 tall, squarish ribs separated by deep channeled interspaces about equal in width to the ribs; the ribs become less and less conspicuous toward the ends of the shell; incremental sculpture well developed, and making a convex bow upward toward the umbo on top of each rib. Hinge and interior probably similar to *C. quadrigenarum*.

**Dimensions.**—Length, 65 mm.; altitude, 60 mm.; diameter of single valve, 29 mm.

**Notes.**—This species is doubtless the precursor of *C. quadrigenarum* Conrad, from the Pleistocene and Recent fauna, but differs
from the latter in being bilaterally more symmetrical on account of being less produced in the ventro-posterior region, having only about three-fourths as many ribs (34 instead of about 45), having narrower, steeper sided ribs and a more prominent angle extending from umbo to posterior extremity. It differs from C. quadrirriganum Conrad, var. fernandocensis Arnold, from the lower Pliocene, by being much larger, more convex, having more prominent umbones, and having fewer, wider, deeper, steeper-sided interspaces. Named for the Vaqueros formation, of which it is believed to be characteristic.

_Type._—Imperfect right valve, Cat. No. 165457, U.S.N.M. (Locality No. 12.)

_Horizon._—Vaqueros formation, lower Miocene.

_Localities._—Santa Cruz quadrangle, San Mateo County, locality No. 12, Mindego Creek, 1 mile above its confluence with Alpine Creek. (R. Arnold, H. H. Holly, L. C. Mills.)

**GASTEROPODA.**

**Genus AGASOMA Gabb.**

**AGASOMA SANTACRUZANA, new species.**

Plate XXXIV, fig. 7.

_Description._—Shell attaining a length of at least 40 mm., pyriform; spire short and small compared with body whorl, consisting of 4 to 5 whorls; upper whorls convex, minutely cancelled by about 4 spiral and numerous less prominent axial, sharp, raised lines; body whorl surmounted by a prominent outwardly expanding carina carrying 14 or 15 unequal, irregularly placed, rounded, raised tubercles; between the carina and the suture there is an irregular cord-like sutural ridge the plications of which are smooth except for microscopic incremental lines; whole surface of body whorl sculptured by numerous fine raised lines which usually alternate in size and increase in prominence toward the base; occasional lines of interrupted growth and numerous very fine incremental lines also cross the body whorl. Aperture pyriform; canal narrow; lip simple.

_Dimensions._—Of type from which portion of canal is missing, length, 26 mm.; latitude, 17.5 mm.

_Notes._—This species is allied to Agasoma barkeriawm Cooper, Agasoma gracida (Gabb), and Agasoma sinuata (Gabb), the first two from the Vaqueros (lower Miocene), the last from the upper Miocene of Walnut Creek, Contra Costa County. It differs from the first in having a lower spire, a broader but less sharply nodose carina on body whorl, and in lacking the prominent nodose angles on the middle of the body whorl; it differs from the second in having a

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*Bull. California State Min. Bur., No. 4, p. 53, pl. v, fig. 63, 1894.*
lower spire and in having a carinated body whorl, but no angles on body whorl; it differs from the last in being much broader and in having less prominently sculptured upper whorls, although it resembles the last in the prominence, width, and general character of its carina. Poorly preserved specimens from locality 12, which have been assigned to \( A. \) santacruziana, show faint indications of two or three rather prominent raised lines on the body whorl, somewhat similar to but very much less prominent than the nodose revolving ridges on the middle of the body whorl in \( A. \) barkeronium Cooper. With the exception of \( A. \) sinuata Gabb and \( A. \) stanfordensis, new species, which occur in the upper Miocene, all of the members of this genus on the west coast are believed to be confined to the lower Miocene or "Agasoma zone" of Merriam.a

Named for the Santa Cruz quadrangle.

Type.—Slightly imperfect young specimen, L. S. J. U., No. 1072. (Locality No. 1.)

Horizon.—Vaqueros formation, lower Miocene.

Localities.—Santa Cruz quadrangle. San Mateo County, locality No. 1, on hill north of road, one-half mile north-northeast of the north end of Searsville Lake; locality No. 12, Mindegco Creek, 1 mile above its confluence with Alpine Creek (R. Arnold); also found at U. S. Geological Survey locality No. 4631, 10 miles north of Coalinga, Fresno County. (R. Arnold, Jas. H. Pierce.)

MONTEREY (MIDDLE MIocene) SPECIES.

PELECYPODA.

Genus VENERICARDIA Lamarck.

VENERICARDIA MONTEREYANA, new species.

Plate XXXV, fig. 4.

Description.—Adult shell attaining a length of at least 10 mm., width about three-fourths of length, suboval in outline, compressed; umbones near anterior extremity, small, turned toward the front; anterior extremity short, regularly rounded; posterior extremity long, obliquely projected below, quite sharply rounded; surface sculptured by about 22 moderately broad radiating ribs and numerous subequally spaced concentric lines, radiating and concentric systems together giving a cancellate appearance.

Dimensions.—Length, 10 mm.; altitude, 7 mm.; diameter, 1 valve, 1± mm.

Notes.—This species is probably allied to \( V. \) barbarensis Stearns and \( V. \) ventricosa Gould. It has more anterior umbones and has more numerous ribs (22 instead of 18) than the former, and is much flatter.

a Bull. Dept. Geol., Univ. of California, 111, 1904, p. 377 et seq.
than the latter; its concentric sculpture is also more prominent than that in either of the recent species. Owing to the distortion of all the specimens of *M. montereyana* it is impossible to say with certainty just what its original outline was, but it is believed to have been about as shown in the figured type.

*Type.*—Cat. No. 165464, U.S.N.M.

*Horizon.*—Monterey shale, middle Miocene.

*Locality.*—Santa Cruz quadrangle, Santa Cruz County, locality No. 121, on Newell Creek, 1½ miles north of its confluence with San Lorenzo River. (J. F. Newsom, R. Arnold.)

Genus *MACTRA* Linneæus.

*MACTRA MONTEREYANA*, new species.

Plate XXXV, fig. 2.

*Description.*—Shell attaining a length of at least 30 mm., width a little more than one-half length, subtrigonal, compressed, subequivalve, inequilateral; umbones a little behind middle, small, turned slightly forward; anterior margin considerably longer than posterior; very gently convex; anterior extremity quite sharply angulated below; a faintly developed carina or angle, most prominent near umbo, extends from the latter to the anterior extremity; base only very gently rounded; posterior dorsal margin nearly straight, sloping only moderately steeply, posterior extremity regularly rounded and situated nearly midway between base and umbo; surface sculptured by numerous fine incremental lines and numerous obsolete short undulations.

*Dimensions.*—Length, 31 mm.; latitude, 18 mm.; diameter single valve, 2+ mm.; angle between dorsal margins, 130°.

*Notes.*—This species may be distinguished from all others of the same genus from the west coast by its great relative length and long, attenuated anterior extremity. It is very closely allied to *M. dolabriformis* Conrad of the recent Lower California fauna, but may be distinguished from the latter by its relatively greater length, less steeply sloping posterior dorsal margin, more central posterior extremity, and more attenuated anterior end. Considering the fact that all of the specimens of *M. montereyana* so far examined have been subjected to at least slight deformation by stresses within the containing shales, the separation of *M. montereyana* from *M. dolabriformis* is attended with some uncertainty.

*Type.*—Cat. No. 165463, U.S.N.M.

*Horizon.*—Monterey shale, middle Miocene.

*Locality.*—Santa Cruz quadrangle, Santa Cruz County, locality No. 122, on Love Creek, 1 mile above its confluence with San Lorenzo River. (J. F. Newsom, R. Arnold.)
UPPER MIocene SPECIES.

PELECYPoda.

Genus Yoldia, Moller.

Yoldia supramontereyensis, new species.

Plate XXXV, fig. 9.

Description.—Shell attaining a length of 32 mm., width about two-thirds length, oblong, rounded in front, somewhat attenuated, angular and slightly gaping behind, compressed; margin smooth; umbon not prominent, curving backward, anterior, being about 48 per cent of the length of the shell from the exterior extremity; anterior dorsal margin slightly convex, anterior extremity quite evenly rounded; posterior dorsal margin slightly concave and turned up at the extremity, meeting the ventral margin in a right angle slightly above and anterior to the curved extremity; a very faint carina, separated from the dorsal margin by a faint groove, extends from the umbo to the posterior extremity. Surface sculptured bynumerous, regular, narrow, incremental lamellae, as in Y. submontereyensis, new species. Hinge and teeth similar in a general way to Y. cooperi. (See note following description of Y. submontereyensis, p. 376.)

Dimensions.—Length, 37 mm.; latitude, 20.2 mm.; umbo to anterior extremity, 18 mm. (48 per cent of length).

Notes.—This species is characterized by its long posterior extremity, which has a relatively greater length than that of any of the other west coast species. Y. supramontereyensis is closely allied to Y. submontereyensis, new species from the lower Miocene, but is easily distinguishable by its long posterior extremity.

Name derived from its stratigraphic position in the upper Miocene above the Monterey (middle Miocene) formation. This species occurs in the bed overlying the basalt flow near Stanford University.

Type.—L.S.J.U., No. 1067. (Locality No. 4.)

Horizon.—Upper Miocene.

Localities.—Santa Cruz quadrangle, Santa Clara County, locality No. 4, in “Tusk Gully” near road, 2½ miles south of Mayfield; locality No. 42, on west face of hill facing road, one-half mile west of locality No. 1. (R. Arnold.)

Genus PeriploMa Schumacher.

PeriploMa sanctœcrucis, new species.

Plate XXXV, fig. 8.

Description.—Shell attaining a length of 40 mm., width nearly five-eighths of length, oblong, inequivalve, inequilateral, anterior end rounded, posterior shorter and more contracted; right valve gibbous,
left only slightly convex; shell material somewhat nacreous, this character persisting in the type of the species; beaks small, bent only slightly toward the posterior extremity; anterior dorsal margin nearly parallel with base, rounds off gradually into anterior extremity; posterior dorsal margin straight, forming an angle of about 140° with the anterior margin; posterior extremity somewhat angularly truncated. An internal rib extends from umbo to posterior ventral angle, this rib being reflected as a groove in that portion of the type specimen which is preserved as a cast. A peculiar substratum of the shell is rather minutely radially striated, and this radiation is exaggerated by erosion on the type. Surface sculptured by numerous unequal but faint concentric undulations and fine incremental lines. Hinge similar to *P. argentaria* Conrad.

**Dimensions.**—Length, 40 mm.; anterior extremity to beak, 25 mm.; latitude, 24 mm.; diameter, right valve, 7 mm.; left valve, 5 mm.

**Notes.**—This species is closely allied to *P. argentaria* Conrad, from the recent fauna of California, and is probably the latter’s precursor. It is narrower and much more produced posteriorly, has the umbo less prominently bent toward the rear, and apparently has the radial striations in the substratum of the shell better developed than does *P. argentaria*.

Named for the Santa Cruz quadrangle.

**Type.**—L. S. J. U., No. 1074.

**Horizon.**—Probable equivalent of Merriam’s “Contra Costa Miocene,” basal upper Miocene.

**Localities.**—Santa Cruz quadrangle, Santa Clara County, locality No. 42, in soft sandstone on hill on the east side of Madera Creek, 2½ miles southwest of Mayfield. (R. Arnold, J. C. Branner.)

**GASTEROPODA.**

**Genus FUSUS** Lamarck.

**Subgenus PRISCOFUSUS** Conrad.

**FUSUS** (PRISCOFUSUS?) **STANFORDENSIS**, new species.

Plate XXXV, fig. 7.

**Description.**—Shell attaining a length of 45 mm., rather broadly fusiform; apex acute; whorls 5 or more, regularly and prominently convex; upper whorls obsoletely spirally striate; sutureal riblet at the upper margin of the whorl well developed; body whorl plump, faintly angulated in middle, spirally sculptured by numerous (8 or 9 above angle) revolving major ribs, between each pair of which is a lesser rib; about 16 or 18 very faint varices cross the whorl and rise to faint nodes on the angle; surface sculptured also by fine incre-
mental lines; suture distinct, wavy. Aperture broadly ovate; canal moderately narrow, rather short, straight.

Dimensions.—Length, 40 mm.; latitude, 25 mm.; apical angle about 63°.

Notes.—This species is distinguished from other members of the genus in associated formations by its broad form. In general outline it resembles Priscofusus corpulentus Conrad from the Oligocene-Miocene of Astoria, Oregon, but has more regularly rounded, less angulated whorls and apparently more prominent spiral sculpture.

Type.—A well-preserved cast in soft sandstone, L. S. J. U., No. 1081.

Horizon.—Upper Miocene, above basalt flow.

Locality.—Santa Cruz quadrangle, Santa Clara County, locality No. 42, near Frenchman's Tower, on hill between Tusk Gully and Madera Creek, 2½ miles south-southwest of Mayfield. (J. C. Branner, R. Arnold.)

Genus AGASOMA Gabb.

AGASOMA STANFORDENSIS, new species.

Plate XXXV, fig. 5.

Description.—Shell attaining a length of at least 60 mm., broadly pear-shaped, body whorl large as compared with the spire, which is depressed-conical; whorls 4, convex, the three upper ones almost enveloped; exposed portion of the upper whorls spirally sculptured; body whorl large, plump, biangular; surface between angle and upper suture convex, sloping at angle of about 30°; sides nearly flat; upper angle ornamented by about 10 unequally spaced unequal axially elongated nodes; lower angle similarly sculptured except that the nodes are weaker but considerably longer and become obsolete only a short distance below the middle of the space between the two angles; spiral sculpture consists of about 11 or 12 quite prominent, widely and almost equally spaced wide raised lines, in the spaces between which are several alternating raised lines of less importance; suture appressed, distinct. Aperture subovate; lips simple; canal moderately long and recurved.

Dimensions.—Of type from which the canal has been broken, length, 55 mm.; latitude, 50 mm.; apical angle about 106°; spire, 5+ mm.

Notes.—This species is closely allied to and probably the direct descendant of A. kernianum Cooper from the Vaqueros or lower Miocene formation. It may be distinguished from the latter by its usually much larger size, wider and more sloping space between suture and upper angle, and less prominent but longer nodes on the lower angle. The details of spiral sculpture are quite similar on the
two species, but coarser in A. stanfordensis. Both the type and the fossil from San Diego, which may be the same species, the only two specimens extant, are casts; details of the sculpture are therefore unobtainable at present.

Type.—Internal cast, lacking canal; L. S. J. U., No. 1087, locality No. 4.

Horizon.—Miocene above and later than the basalt flow; this horizon believed to be the equivalent of the "Contra Costa County Miocene" of Merriam, which is above the Monterey (middle Miocene).

Localities.—Santa Cruz quadrangle, Santa Clara County, locality No. 4, in ravine beside county road, 2½ miles south of Mayfield (R. Arnold); also found in the San Diego formation, lower Pliocene, on mission grade midway between the head of Sixth street and the old County Hospital at San Diego (Mrs. Kate Stephens).

PURISIMA AND MERCED (UPPER MIocene AND PLIOCENE) SPECIES.

GASTEROPODA.

Genus FUSUS Lamarck.

Subgenus BUCCINOFUSUS Conrad.

FUSUS (BUCCINOFUSUS) PORTOLAENSIS, new species.

Plate XXXVII, fig. 8.

Description.—Shell attaining a length of at least 60 mm., fusiform, moderately slender; apex acute, whorls 7 or more, very convex, slightly compressed above near suture; nuclear whorls unknown; the next four crossed by 9 very broad, prominent, rounded varices extending from lower suture to upper revolving sutural ridge; interspace between varices deep and V-shaped; about 8 sharply defined, rounded, revolving ribs (between each pair of which on the lower whorls is often a small intercalary) occur on each whorl in addition to the sutural rib which is more prominent than the others; whole surface crossed by numerous small incremental lines; body whorl quite regularly convex, projected into a long, slightly outward-curving pillar; varices obsolete, or nearly so, on the body whorl, and also on the penultimate whorl on the larger specimens, as in F. barbarensis Trask; suture distinct, wavy. Aperture elongate-elliptical; outer lip internally striate; inner lip smooth gently concave; canal rather long, narrow, curved outward toward anterior extremity.

Dimensions.—Length, 62 mm.; latitude, 31 mm.; longitude of body whorl, 44 mm.; longitude aperture and canal, 34 mm.; apical angle about 49°.

Notes.—This species, which is very abundant at the Portola locality, is quite closely related to F. (Buccinofusus) coosensis Dall, from Proc. N. M. vol. xxxiv—08—25
the Empire beds (upper Miocene) of Coos Bay, Oregon, but may be distinguished from the latter by its smaller size, less prominently posteriorly angulated whorls, much broader axial varices, more regular spiral sculpture, which consists of 9 major ribs covering the whole whorl instead of 9 more or less irregular ribs which extend only to the angle and are then replaced by obsolete spiral striae on the upper part of the whorl; sutural riblet also better defined in *F. portolacensis*. *F. portolacensis* differs from *F. arnoldi* Cossmann, 1903, (+ *rugosus* Trask, 1855, not of Lamarck). *F. robustus* Trask, *F. kobelti* Dall, and other late Tertiary or Quaternary species from the west coast by its much broader, rounded spiral lines and less rugose incremental sculpture.

Named for the village of Portola, near which the species is found abundantly.

**Type.**—Cat. No. 165473, U.S.N.M. (U.S.G.S. locality No. 4665.)

**Horizon.**—Purisima formation (upper Miocene portion).

**Localities.**—Santa Cruz quadrangle, San Mateo County, locality No. 6, on Sausal Creek, one-half mile southwest of Portola (J. P. Smith, R. Arnold, and others); also occurs at about the same horizon at several localities in eastern Monterey County and western Fresno County (Homer Hamlin, R. Arnold); type-locality, U. S. Geological Survey No. 4635, Etchegoin (upper Miocene or lower Pliocene) formation, White Creek, 19 miles northwest of Coalinga, Fresno County.

**Genus CHRYSDOMUS Swainson.**

**CHRYSDOMUS STANTONI**, new species.

Plate XXXVII, fig. 4.

**Description.**—Shell often attaining a length of 100 mm., broadly fusiform, moderately thin; spire well elevated; apex acute. Whorls 5 or 6; nuclear whorls unknown; others tabulate and sharply angulated about one-third the width of the whorl from the posterior margin; surface of whorls below angle, slightly convex, nearly vertical, ornamented by several wide spaced obsolete revolving ribs which are closer set and slightly better developed toward the base of the body whorl; revolving table convex, sloping at about 30° from the horizontal, bounded by two raised lines or narrow ridges, the one nearest the suture being the more prominent and separated from the latter by a deep channeled sutural groove; whole surface ornamented by faint superficial revolving lines and by numerous fine incremental lines which extend posteriorly from the suture across the revolving table and then descend vertically to the suture below. Aperture broadly ovate, narrowing in front to a moderately broad, short canal which is equal in length to about one-fourth the length of the aperture, is almost as wide as long, and has a concave extremity which is
slightly reflexed; outer lip simple; inner lip smooth; pillar narrow, slightly twisted, very feebly plaited externally, and sculptured by broadly waved incremental lines.

Dimensions.—Length (of slightly decolleté type), 90 mm.; latitude, 45 mm.; length body whorl, 62 mm.; length aperture, 44 mm.; length canal, 11 mm.; latitude canal, 8.5 mm.

Notes.—This beautiful species is characterized by its peculiarly tabulated whorls, deep channeled sutural groove, and obsolete spiral sculpture. It bears a striking resemblance to Ancistrolepis magnus Dall, from the recent fauna of the north Pacific, but may be distinguished from the latter by its much longer, narrower canal.

C. stantoni is quite different from C. postplanatus Dall from the upper Miocene of the Bogachiel River, Clallam County, Washington, being distinguishable by its sutural canal, more sloping table, and obsolete instead of well defined spiral sculpture.

It is apparently characteristic of the upper part of the Purisima and lower portion of the Merced formations, where it is usually not rare.

The species is named in honor of Dr. Timothy W. Stanton, chief paleontologist, United States Geological Survey, whose work on the Mesozoic faunas is well known.

Type.—Cat. No. 165475, U.S.N.M. (Locality No. 139.)
Paratype.—L. S. J. U., No. 1088. (Locality No. 139.)

Horizon.—Upper Purisima and lower Merced formations, Pliocene.

Localities.

Purisima formation (lower Pliocene portion).—Santa Cruz quadrangle, San Mateo County, locality No. 139, Purisima Rock, seven-eighths mile east of Año Nuevo Point (R. Arnold, W. R. Hamilton); locality No. 141, sea cliffs between the mouths of Tunitas and Pescadero creeks. (J. P. Smith, G. H. Ashley, R. Arnold, J. F. Newsom, and others.)

Merced formation, upper Pliocene.—Santa Cruz quadrangle, San Mateo County, locality No. 140, sea cliffs, immediately east of mouth of Año Nuevo Creek, 2 miles east of Ano Nuevo Point (R. Arnold); also at locality A 11, in sea cliff, west of Capitola, Santa Cruz County, immediately east of the Santa Cruz quadrangle (G. H. Ashley, R. Arnold).
Genus THAIS Link.

THAIS TRANCOSANA, new species.

Plate XXXVI, fig. 3.

Description.—Shell attaining a length of 26 mm., subovate, a little longer than wide, very thick, heavy; spire elevated; apex acute; whorls 4 or more, very slightly convex, increasing rapidly in size from apex downward; surface smooth except for an obsolete sculpture of 3 or 4 revolving lines; body whorl much larger and more convex than others, regularly rounded, its surface ornamented by about 13 obsolete revolving ridges. Aperture elongate-elliptical; outer lip thickened and dentate internally, four teeth visible in the type; back of each tooth an internal revolving line; inner lip broad and smooth; canal short, narrow and oblique.

Dimensions.—Of decolleté type, length (restored), 27 mm.; latitude, 19 mm.; length body whorl, 21 mm.; length aperture and canal, 16 mm.; latitude aperture, 5 mm.

Notes.—The type exhibits a broad sinus or groove in the inner lip beginning at the middle and extending to the posterior extremity of the aperture. Doctor Dall suggests that the groove may have been worn in the lip by a hermit crab, as often happens in the case of recent shells, and from the appearance of the groove such an explanation seems well founded. The species is quite different from any of the known west coast recent or fossil forms of this genus, being characterized by its exceedingly heavy shell, straight-sided conical spire, and obsolete revolving ridges.

Named after Los Trancos Creek, near which the type was found.

Type.—A decolleté specimen, L. S. J. U., No. 1082.

Horizon.—Merced formation, upper Pliocene.

Locality.—Santa Cruz quadrangle, Santa Clara County, locality No. 21, ditch between Feld Lake and Los Trancos Creek, 2½ miles south-southwest of Stanford University. (T. J. Hoover, R. Arnold.)

Genus CHLOROSTOMA Swainson.

CHLOROSTOMA STANTONI Dall, var. LAHONDAENSIS, new variety.

Plate XXXVI, fig. 2.

Description.—Shell attaining an altitude of 25 mm.; conoidal, much broader than high, umbilicated; whorls 5, angulate near base, upper surface sloping steeply, very gently concave both above and below a slightly raised line which revolves about two-fifths the distance from the suture to the angle; a second similar line revolves close to and just below the suture, and a much more prominent one adorns the angle of the whorl; body whorl biangular, the surface between
the angles concave, almost vertical, and being about equal in width to the distance between the sutural revolving line and the next line below; the upper angle is compressed into a raised line, while the lower angle is simply the junction between the convexly curved base and the concave, nearly perpendicular surface of the interangular space; obsolete spiral lines are sometimes present on the upper surface of the whorls, especially near the suture; base minutely spirally striate; whole surface of whorls marked by numerous fine, posteriorly, downward-sloping, incremental lines; suture appressed, inconspicuous; umbilicus lacking, body whorl not angulate adjacent to it; aperture subcircular, the upper margin extending far in advance of the lower part.

Dimensions.—Altitude, 23 mm.; latitude, 30 mm.; apical angle about 80°.

Notes.—This variety differs from the typical form, which is from the Empire beds (upper Miocene) of Coos Bay, Oregon, by being relatively broader, less prominently spirally sculptured, and in having the revolving line on the upper surface much less prominently raised and situated above, rather than below the middle of the upper surface; in C. stantoni the upper surface is prominently angulated in the middle of the upper surface. The new variety also possesses a revolving rib just below the suture which the typical form lacks.

Named for La Honda, near the type locality.

Type.—Decolleté specimen, L. S. J. U., No. 1079.

Horizon.—Lower Purisima (upper Miocene portion).

Locality.—Santa Cruz quadrangle, San Mateo County, locality No. 150, Pescadero Creek, just above mouth of Jones Gulch, 3 miles due south of La Honda. (J. F. Newsom, R. Arnold.)
EXPLANATION OF PLATE XXXI.

KNOXVILLE AND CHICO (CRETACEOUS) FOSSILS.

Fig. 1. *Aucella crassicollis* Keyserling, L.S.J.U., No. 1014. View of left valve; latitude, 35 mm. X 1. Locality No. 170, Knoxville formation, lower Cretaceous, Pulgas Creek, 1½ miles west-northwest of Redwood City. A characteristic species of the Knoxville.

2. *Amberlega dilleri* Stanton, L.S.J.U., No. 1011. Back view; altitude, 16 mm. X 2. Locality No. 170, same as fig. 1. Also characteristic of the Knoxville.


6. *Area carneocrenosis* Meek, Cat. No. 31003, U.S.N.M. Left valve; longitude, 31 mm. X 1½. Locality No. 26, same as fig. 5. An abundant Chico fossil.

Knoxville and Ohio (Cretaceous) Fossils.
For explanation of plate see page 390.
EXPLANATION OF PLATE XXXII.

Eocene Fossils.

Fig. 1. *Pecten proavus* Arnold, Cat. No. 164930, U.S.N.M., type. Mold of interior of left valve, showing portion of external surface sculpture; altitude, 38 mm. × 1. Locality No. 25; Eocene between headwaters of San Lorenzo River and Pescadero Creek.

2. *Teocratulina tejonesis* Stanton, Cat. No. 165432, U.S.N.M. Ventral valve; altitude, 15 mm. × 2. Locality No. 25, same as fig. 1. Found also in the Martinez formation at Lower Lake, Lake County.

2a. Same species as fig. 2, L.S.J.U., No. 1023. Dorsal valve; altitude, 11 mm. × 2. Locality 25, same as last.

3. *Hipponyx carpenteri*, new species, type, Cat. No. 165433, U.S.N.M. Top view of nearly perfect specimen; length, 11 mm. × 3. Locality No. 25, same as fig. 1, p. 361.

3a. Same species and specimen as fig. 3; side view × 3.

4. *Fissurella perrini*, new species, type, Cat. No. 165434, U.S.N.M. Top view of slightly imperfect specimen; length, 16 mm. × 2. Locality No. 25, same as last, p. 362.

5. *Scucele gayi*, new species, type, Cat. No. 165435, U.S.N.M. Right valve; latitude, 14 mm. × 2. Locality No. 25, same as fig 1, p. 300.

6. *Tritonium newsomi*, new species, type, Cat. No. 165436, U.S.N.M. Back view; altitude, 16 mm. × 2. Locality No. 25, same as fig. 1, p. 360.

7. *Patella mactoensis*, new species, type, Cat. No. 165437, U.S.N.M. Top view; length, 7 mm. × 3. Locality No. 25, same as fig. 1, p. 362.

8. *Cidaris merriami*, new species, type, Cat. No. 165438, U.S.N.M. Fragment of spine; length, 21 mm. × 2. Locality No. 25, same as fig. 1, p. 358.
Eocene Fossils.

For explanation of plate see page 392.
EXPLANATION OF PLATE XXXIII.

SAN LORENZO (OLIGOCENE) FOSSILS.

Fig. 1. **Tellina lorenczouisa**, new species, plastotype, Cat. No. 165439, U.S.N.M., Right valve; length, 40 mm. × 1. Locality No. 115, branch of south fork of Waddell Creek, 1½ miles northwest of Eagle Rock, p. 367.

2. **Pleurotoma newsoni**, new species, plastotype, Cat. No. 165440, U.S.N.M., Back view of wax cast; altitude, 19 mm. × 2. Locality No. 108, on road on divide between headwaters of Waddell Creek and Boulder Creek, 1 mile north of Eagle Rock, p. 368.

3. **Fusus sanctacruzensis**, new species, plastotype, L.S.J.U., No. 1037. Aperture view of cast of imperfect and decorticated specimen; altitude, 43 mm. × 1, Locality No. 109, on Bear Creek, 4 miles above its confluence with the San Lorenzo River, p. 372.

4. **Turricula santacruzenensis**, new species, type, Cat. No. 165442, U.S.N.M., Front of imperfect specimen; altitude, 33 mm. × 1. Locality No. 100, on San Lorenzo River, 3 miles above Boulder Creek, p. 373.

5. **Cidaris branneri**, new species, plastotype, L.S.J.U., No. 1056. Lateral view of wax cast of nearly perfect specimen; length, 20 mm. × 2. Locality No. 109, same as fig. 3, p. 363.


7. **Pleurotoma sanctacruzensis**, new species, plastotype, Cat. No. 165445, U.S.N.M., Cast from imperfect mold; altitude, 8.5 mm. × 2. Locality No. 108, same as fig. 2, p. 369.

8. **Fusus heweri**, new species, type, Cat. No. 165446, U.S.N.M., Back view of imperfect specimen; altitude, 35 mm. × 1. Locality No. 100, same as fig. 4, p. 371.


9a. Same species and specimen as fig. 9; view of interior.

10. **Architectonica lorenczouizens**, new species, plastotype, Cat. No. 165448, U.S.N.M., Top view of wax cast of nearly perfect specimen; maximum diameter, 11 mm. × 2. Locality No. 107, on small ravine off Boulder Creek, 2½ miles north of Eagle Rock, p. 374.

11. **Lirofusus ashleyi**, new species, type, Cat. No. 165449, U.S.N.M. Back view of nearly perfect specimen; altitude, 12.5 mm. × 2. Locality No. 100, same as fig. 4, p. 372.

12. **Strepsidura californica**, new species, type, Cat. No. 165450, U.S.N.M., Back view of nearly perfect specimen; altitude, 33 mm. × 1. Locality No. 103, on Kings Creek, one-half mile above its confluence with the San Lorenzo River, p. 370.

13. **Pleurotoma perseoloxoides**, new species, plastotype, Cat. No. 165451, U.S.N.M., Back view of wax cast of nearly perfect specimen; altitude, 12.5 mm. × 2. Locality No. 107, same as fig. 10, p. 368.

14. **Aturia ziczac** Sowerby, L.S.J.U. No. 1089. Fragment of specimen showing suture lines; altitude of fragment, 27 mm. × 1. This species resembles a small pearly Nautilus. Locality No. 91, on Bear Creek, one-half mile north of its confluence with Bear Creek.

15. **Nautilus (Acila) dalli**, new species, plastotype, Cat. No. 165452, U.S.N.M., Wax cast of left valve; length 35 mm. × 1. Locality No. 115, same as fig. 1, p. 364.

16. **Dentalium subtrutatum** Conrad, Cat. No. 165453, U.S.N.M., Lateral view of fragment; altitude, 12 mm. × 2. Locality No. 100, same as fig. 4.

17. **Haminea petrosa** Conrad, Cat. No. 165454, U.S.N.M., Back view of wax cast of slightly imperfect specimen; length, 7 mm. × 3. Locality No. 107, same as fig. 10.
San Lorenzo (Oligocene) Fossils.

For explanation of plate see page 394.
EXPLANATION OF PLATE XXXIV.

VAQUEROS (LOWER MIocene) FOSSILS.

Fig. 1. Glycymeris branneri, new species, type, Cat. No. 165455, U.S.N.M. Left valve; altitude, 64 mm. X 1. Locality No. 12, Mindego Creek 1 mile above its confluence with Alpine Creek, p. 377.


3. Cardium (Trachycardium) vaquerosensis, new species, type, Cat. No. 165457, U.S.N.M. Imperfect right valve considerably decorticated; length, 65 mm. X 1. Locality No. 12, same as fig. 1, p. 378.

4. Terebatalia (aff.) occidentalis Dall. L.S.J.U., No. 1091. Internal cast of dorsal valve; length, 31 mm. X 1. Locality No. 9, Tuff Hill, 2 miles due south of Mayfield.

5. Tivela inziana Conrad, Cat. No. 165458, U.S.N.M. Slightly broken right valve; length, 61 mm. X 1. Locality No. 14, on divide between headwaters of Corte de Madera and Stevens creeks.

6. Turritella inziana Conrad, Cat. No. 165459, U.S.N.M. Back view of imperfect but characteristic specimen; altitude, 73 mm. X 1. Locality No. 14, same as fig. 5.


8. Yoldia submontecyrensis, new species, plastotype, Cat. No. 165459, U.S.N.M. Wax cast of slightly imperfect right valve; length, 32 mm. X 1. Locality No. 35, on San Francisquito Creek, one-fourth mile below its confluence with Los Trancos Creek, p. 376.

9. Leada cahillensis, new species, type, L.S.J.U., No. 1065. Left valve; length, 7 mm. X 3. Locality No. 57, on road to Kings Mountain House, 2 miles west of Woodside, p. 375.
Vaqueros (Lower Miocene) Fossils.

For explanation of plate see page 396.
EXPLANATION OF PLATE XXXV.

MONTEREY (MIDDLE MIocene) AND UPPER MIocene FOSSILS.

Fig. 1. *Aere ohiopolna* Conrad, Cat. No. 105462, U.S.N.M. Casts of right and left valves; length of more nearly perfect specimen, 42 mm. × 1. Monterey formation, middle Miocene, locality No. 125, at confluence of Zayante and Bean creeks. Usually quite abundant in the Monterey formation.

2. *Mactra monteryana*, new species, type, Cat. No. 105463, U.S.N.M. Exterior of both valves; altitude of each, 31 mm. × 1. Monterey formation, middle Miocene, locality No. 122, Love Creek, 1 mile above its confluence with the San Lorenzo River, p. 381.

3. *Yoldia impressa* Conrad, Cat. No. 105465, U.S.N.M. Cast of distorted (longitudinally elongated) right valve showing teeth of left valve; length, 26 mm. × 1. Monterey formation, middle Miocene, locality No. 121, Newell Creek, 1½ miles above its confluence with the San Lorenzo River. Abundant in the Monterey; also found in the Oligocene.

4. *Yenencardia monteryana*, new species, type, Cat. No. 105464, U.S.N.M. Left valve of slightly distorted specimen; length, 10 mm. × 2. Monterey formation, middle Miocene, locality No. 121, same as fig. 3, p. 380.


6. *Leda taphria* Dall, L.S.J.U., No. 1069. Right valve; length, 18 mm. × 2. Upper Miocene, locality No. 42, west face of hill on east side of Madera Creek. 2½ miles south-southwest of Mayfield. Also found in the Pliocene and Quaternary faunas.


8. *Periploma sanctaccensis*, new species, type, L.S.J.U., No. 1074. Partially decorticated right valve; length, 43 mm. × 1. Upper Miocene, locality No. 42, same as fig. 6, p. 382.

9. *Yoldia supermonteryensis*, new species, type, L.S.J.U., No. 1067. Imperfect left valve; length, 40 mm. × 1. Upper Miocene, locality No. 4, same as fig. 5, p. 382.

Monterey (Middle Miocene) and Upper Miocene Fossils.

For explanation of plate see page 398.
EXPLANATION OF PLATE XXXVI.

Purisima and Merced (Upper Miocene and Pliocene) Fossils.

Fig. 1. Cardium meekianum Gabb, L.S.J.U., No. 1058. Decorticated left valve; altitude, 73 mm. X 1. Merced formation, upper Pliocene, locality A 11, 1 mile southwest of Capitola, Santa Cruz County. A common species in the upper Miocene and Pliocene.

2. Chlorostoma santonii Dall, var. lahondacensis, new variety, type, L.S.J.U., No. 1079. Back view of a slightly imperfect specimen; altitude, 21 mm. X 1. Purisima formation, locality No. 150, Pescadero Creek just above Jones Gulch, p. 388.


7. Thais ostrina Gould, L.S.J.U., No. 1096. Aperture view of imperfect specimen; altitude, 23 mm. X 1. Merced formation, upper Pliocene, locality No. 21, same as fig. 3. Also found recent.


PURISIMA AND MERCED (UPPER MIocene AND PLIOCENE) FOSSILS.

For explanation of plate see page 400.
EXPLANATION OF PLATE XXXVII.

PURISIMA AND MERCED (UPPER MIocene AND PLIOcene) FOSSILS.

Fig. 1. Schizothorus pajaroanus Conrad, Cat. No. 165467, U.S.N.M. Left valve; length 72 mm. × 1. Merced formation, upper Pliocene, locality No. 140, sea cliff immediately south of the mouth of Año Nuevo Creek. A common form in the upper Miocene and Pliocene, originally described as Venus pajaroana Conrad.

2. Miopleiona oregonensis Dall, Cat. No. 165469, U.S.N.M. Aperture view of a specimen from which the canal has been broken; altitude, 78 mm. × 1. Purisima formation, lower Pliocene, locality No. 139, Purisima Rock, 1 mile east of Año Nuevo Point. Found in the upper Miocene and lower Pliocene.

3. Phacoides annulatus Reeve, Cat. No. 165470, U.S.N.M. Right valve; length, 50 mm. × 1. Purisima formation, lower Pliocene, locality No. 139, same as fig. 2.

4. Chrysodoma stantoni, new species, paratype, L.S.J.U., No. 1088. Specimen from which canal has been broken; altitude, 79 mm. × 1. Purisima formation, lower Pliocene, locality No. 139, same as fig. 2. Supposed to be characteristic of the Pliocene, p. 386.

5. Nucula (Acila) castrensis Hinds, Cat. No. 165471, U.S.N.M. Left valve; length, 15 mm. × 2. Purisima formation, lower Pliocene, locality No. 139, same as fig. 2. Also found recent.

6. Bittium aspernum Gabb, Cat. No. 165472, U.S.N.M. Aperture view of slightly imperfect specimen; altitude, 26 mm. × 3. Purisima formation, lower Pliocene, locality No. 139, same as fig. 2. Also abundant in the upper Pliocene fauna.

7. Littorina petricola Dall, L.S.J.U., No. 1099. Aperture view of imperfect specimen; altitude, 10 mm. × 1. Merced formation, upper Pliocene, locality No. 21, between Feld Lake and Los Trancos Creek, 2½ miles south-southwest of Stanford University. Originally described from Oregon.

Purisima and Merced Upper Miocene and Pliocene Fossils.
For explanation of plate see page 402.
DESCRIPTION OF A NEW ISOPOD GENUS OF THE FAMILY DAJIDÆ.

By Harriet Richardson.

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During the summer of 1884, the U. S. Bureau of Fisheries steamer Albatross collected a curious isopod off the south coast of Long Island at a depth of 707 fathoms. The specimen has been in the Peabody Museum, Yale University, until recently, when it was transferred to the collections of the U. S. National Museum. This form represents a new species and genus of Dajidae.

COLOPHRYXUS, new genus.

Body of adult female, somewhat depressed, with the cephalic part projecting in front, and the lateral parts swollen, but not expanded anteriorly and not projecting in front of the head.

Middle part of dorsal surface distinctly segmented into five segments.

Abdomen without any trace of segmentation and triangularly produced posteriorly in an obtuse point.

The abdomen is without appendages, both uropoda and pleopoda being entirely absent.

There are five pairs of legs, closely crowded around the oral area.

Oral area small, rounded, and contracted behind. It is bounded laterally by the four pairs of coxal plates.

The male has the head and first segment of the thorax fused. The following six segments of the thorax are distinct and subequal. The abdomen is indistinctly segmented into about six segments. There are no uropoda or pleopoda.

The type of the genus is Colophryxus novanglies, the description of which follows:

COLOPHRYXUS NOVANGLIÆ, new species.

Description of adult female.—Body of adult female somewhat oval in outline, contracted anteriorly in the cephalic region and broadening posteriorly.
The cephalic part is large and projects far in front, being produced anteriorly in a wide marginal border.

The middle portion of the thoracic region is segmented into five distinct segments, the first of which is much shorter than any of those following. The lateral parts are tumid, but not greatly swollen, and do not project anteriorly beyond the limits of the thorax, nor posteriorly quite to the extremity of the abdomen.

The abdomen is entirely unsegmented, without any traces of segmentation and is devoid of appendages. It is large and triangularly produced posteriorly with the apex obtuse. (See fig. 1.)

On the ventral side the oral area is small, rounded, and contracted behind. The five pairs of legs are small, and closely crowded together. They are bounded laterally by the four pairs of coxal plates. (See fig. 2.)

Description of male.—The male has the head and first thoracic segment fused. The following six segments are subequal. The abdomen is indistinctly segmented into five or six segments. There are apparently no pleopoda or uropoda. (See fig. 3.)

Owing to the scarcity of material, a more detailed description can not be given.

Only one female and one male were collected by the U. S. Bureau of Fisheries steamer Albatross off the South coast of Long Island at Station 2235 at a depth of 707 fathoms. They were found in the trawl wings. The host is unknown.

The type is in the U. S. National Museum and is Cat. No. 38958.

In the indistinct segmentation of the abdomen of the male this genus is more closely related to Aspidophryxus Sars, a Prodajus Bonnier, and Arthrophryxus Richardson b than to the other genera of Dajidae. The absence of pleopoda brings it closer to Arthrophryxus. The female, however, differs from the female of Arthrophryxus in the unsegmented abdomen.

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a Crust. of Norway, II. 1899, pp. 227-228.
REMARKS ON THE HORDS AND ON THE SYSTEMATIC 
POSITION OF THE AMERICAN ANTELOPE.

By MARCUS WARD LYON, JR.
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INTRODUCTION.
The writing of these notes was prompted originally by the inquiries of correspondents regarding the deciduous character of the horns of the American Antelope, and later by the finding of a very curious Antelope horn in the collection in the U. S. National Museum (Plate XXXIX). In addition to giving a brief description of the horns of this animal, and the manner in which they are annually shed and renewed, I have taken this opportunity to make a few remarks upon the abnormal horn just mentioned and a somewhat similar case observed on a living specimen in London a few years ago, as well as to discuss briefly the systematic position of the American Antelope. These notes contain no new data as to the shedding of the horns of the Antelope. I have drawn freely from the literature on that point. The sources are clearly indicated in the footnotes and in the bibliography at the end of the article.

HISTORICAL.
Curiously enough the first printed statement regarding the shedding of the horns of the American Antelope was a denial by Audubon and Bachman that such an occurrence could take place. It was reported to them by hunters at Fort Union, that the Antelope dropped its horns and renewed them every year, somewhat after the manner of deer. Such a phenomenon was so unusual in the group of animals to which the American Antelope evidently belonged that the naturalists, regarding the belief as erroneous, took special pains to deny it.

Two other American naturalists of note also denied the possibility of the Antelope shedding its horns, and that at a time subse-

\(^a\) Viviparous Quadrupeds of North America, II, 1851, p. 189.
\(^b\) Now Fort Buford, North Dakota.
quent to the appearance of reliable printed statements concerning the true facts of the case.

The second mention of this peculiarity of the American Antelope was made in 1858, in Cassin’s Report of the United States Exploring Expedition. Little attention seems to have been paid, however, to the brief observations published there.

The first accurate observations on the annual shedding of the horns of the American Antelope were published in 1865. They were made on a specimen living in the gardens of the London Zoological Society. Several years before, however, in 1858, Dr. C. A. Canfield, of Monterey, California, had made very careful observations on the deciduous character of the horns, as shown in wild and semidomesticated animals. His notes were set forth at considerable length in a letter addressed to Prof. S. F. Baird, Secretary of the Smithsonian Institution. That any Antelope annually shed and renewed its horns appeared so improbable that the truth of the contents of Doctor Canfield’s letter was evidently doubted, for it was not published until after the appearance of the observations made on the living specimen in London. In the following year, 1863, this letter was published in the proceedings of the London Zoological Society.

Since then many articles on the subject have appeared in various publications. (See Bibliography.)

**DESCRIPTION OF THE GROWTH AND SHEDDING OF THE HORNS.**

The growth and shedding of the horns in males may be briefly outlined as follows: The kids are born during the spring and are of course at that time hornless. By the middle of summer the first horns begin to appear, being small and conical and concealed in the hair of the forehead. They reach a length of nearly an inch by autumn. Early in the winter they drop off, leaving small knobs projecting from the frontal region about a half inch long and covered with hairs. Inside of a week these knobs are again covered with a small cap of horn. This horn increases in size from the base, for a year, attaining a length of nearly six inches. The characteristic prong is not present at this age. In the early winter these horns drop off, leaving horn-cores about an inch and a half in length, covered, as in the first year, with a hairy skin. Horns immediately form on their tips, and in addition, at the base and in front of the horn-core, another point of horn forms, which becomes the prong. By a gradual conversion of the epidermis of the skin covering the horn-core into

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horn, the horny tip at the apex of the core and the horny tip of the prong are consolidated into one solid horn. This process is repeated annually, the successive horns gradually becoming larger, until the maximum size is reached, which takes about five years. The fully mature horn has a strongly recurved and somewhat incurved tip and bears a well-developed prong in front. A fully developed horn is shown on Plate XXXVIII, fig. 5. In that specimen the tendency of the tip to twist backward and inward has been carried to such an extent that the apex has almost made a complete circle and is there directed forward, the horn being abnormal in this respect. There is no process of the bony horn-core for support of the prong in front nor under the extremity of the horn, both the prong and the curving apex being solid material. The core, however, is distinctly widened or marked by a very obtuse angle, corresponding to the position of the prong over it. The new horn, immediately after the old one has been cast, is very small and rests as a cap upon the tip of the blade-like bony horn-core. (Plate XXXVIII, fig. 3.) The remainder of the horn-core is covered with skin bearing long coarse hairs. The epidermis gradually develops into horn from above downward. The prong begins to form before the epidermis between the tip of the horn and the prong has been converted into horn. (See Plate XXXVIII, fig. 4, where some epidermis which is being converted into horn and some long hairs may be seen between the prong and the tip of the horn above.)

The time of year in which the horns are shed is the autumn or early winter. Old bucks drop theirs earlier than do younger animals, that is, the oldest individuals cast their horns in the month of October, while younger individuals cast theirs in December or the early part of January.

The mechanical factor in the dropping off of the horns appears to be the rapid development of a new horn on the top of the horn-core and beneath the old horn which is about to be shed. This newly growing horn pushes the old one upward, loosening it from the horn-core to which it has been attached by the continuity of its substance with that of the horny layer of the skin covering the core. It is also apparently held in position by numerous long hairs which have their roots in the skin covering the core, while many of their apices penetrate into the substance of the horn. All observers say that when the horn is cast off its interior is lined with many long hairs, which were evidently pulled out from the skin covering the horn-core. On the other hand, the skin covering the core still possesses many long hairs whose apices once penetrated into the substance of the horn which has been pulled away from them. In the autumn of the year

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*a* Caton, The Antelope and Deer of America, 1877, p. 32, figs. 1 and 2.
the horns of the Antelope are always loosely attached to the bony core, and can be pulled off with little effort. The line of demarcation between the base of the horn and the surrounding skin at that time is well marked. In the earlier part of the year the horny substance at the base of the horn insensibly passes into the structure of the adjoining skin.

Direct observations as to the growth and replacement of the horns of the female Antelope are lacking, but the process is probably not essentially different from that observed in the males. A horn and horn core of a female are shown in Plate XXXVIII, figs. 1 and 2.

Common as is the American Antelope and as well developed the art of photography, I have been unable to find any published photographs of an Antelope showing clearly the fully adult horn, the horn immediately after shedding, and its gradual development. Reproductions from pen-and-ink drawings of animals just after the shedding of the horn and its appearance a few weeks later have been published.¹

**ABNORMAL HORN S.**

Plate XXXIX shows the skull of an American Antelope with a "shed" horn that has not been cast off. It is loose on the new but well-developed horn beneath it, but firmly attached, so that it can not be removed without injury to the specimen. Both the new and the old horns have well-developed prongs. On the right side the old horn had been cast off. The horns in this specimen are abnormal in that both are bent decidedly forward. Examination of the skull shows no apparent cause for this malformation, nor is it evident why the old horn should not have been cast off.

A most interesting instance of the retention of each year's growth of horn has recently been published and illustrated by Mr. R. I. Pocock.² In this case the horn curved forward, downward, and backward, making almost a complete circle when seen from the side. Six successive annual growths of horn were quite firmly united with one another. None of them showed a prong. This animal had been castrated when young, and to this fact Mr. Pocock attributed the anomaly. Mr. W. M. Hinman,³ who had a young castrated Antelope in captivity for a short time, makes no mention of any peculiarity of its horns. His specimen, however, met with an untimely death, perhaps before the anomalous horns had had time to manifest themselves.

SYSTEMATIC POSITION OF THE AMERICAN ANTELOPE.

Nearly all systematists have united in placing the American Antelope, *Antilocapra americana* (Ord), in a separate monotypic family, Antilocapridae, distinct from the other Ruminants, on the ground that it combines in a measure the characters of deer (Cervidae) and of oxen, sheep, goats, and true antelopes (Bovidae). In support of this, it is pointed out that its horns are branched and shed annually, both characters of deer, but that it is also a hollow-horned ruminant like cattle, etc. To one who gives the matter consideration, it becomes clear that there is no resemblance between the horns of the Antelope and the so-called horns, or antlers, of the deer, and there is every resemblance structurally and physiologically between the Antelope's horns and those of the Bovidae.

The antlers of the deer are branched processes of the frontal bone, shed and renewed annually. Each antler is supported on a distinct and permanent outgrowth of the frontal bone known as the pedicle. The base of the antler where it is attached to the pedicle is marked by an outgrowth or ring of bone known as the burl. When the antler is about to be shed, the bone at the junction of the antler with the pedicle is absorbed and the antler falls off. The skin which permanently covers the pedicle immediately grows up over the upper surface of it. From the top of the pedicle the new antler grows out, being always covered with the growing skin from the pedicle. This skin is very vascular and covered with velvety hair. The growing antler itself is very vascular in its interior so that the bone of which the antler is composed is rapidly formed. When the antler reaches maturity, the blood supply to the skin covering it is gradually diminished so that it dries up and eventually peels off, leaving the naked bone of the mature antler exposed. The development of the burl at the base of the antler probably assists in cutting off the supply of blood to the velvet of the antler. The blood supply to the antler itself in the interior is gradually diminished, so that by the time the antler is to be shed it has become practically so much dead bone.

In the Bovidae, and in the American Antelope as well, the horn is an epidermal outgrowth of definite material known as horn supported by a well-developed process of the frontal bone beneath it known as the horn-core. This latter is permanent, never cast off, and is simple and unbranched, but conforming more or less to the shape of the horn which it supports. The horn proper, the epidermal outgrowth, is added to annually. In the typical Bovidae the annual increment is not cast off and can be seen at the base of the horn in the form of the well-known annual rings. In the Antelope the annual increment is cast off each succeeding year and no
annual rings of growth are seen at the base of the horn, so that, as Doctor Canfield a intimated it might have been suspected that the American Antelope did shed its horns merely by an examination of those structures. The horn of the Antelope can not be said to branch in the sense of the branching of the antlers of the deer. The prong in front is merely a modification of the shape of the horn substance proper and can not be considered as morphologically different from the various ridges and twists that occur on the horns of many of the typical Bovidae.

That each year's successive growth of horn may not be shed in the Antelope as an abnormal process is beautifully shown in Mr. Pocock's specimen, mentioned above, and to a less extent by the specimen illustrated on Plate XXXIX. If the branching and shedding of the horns are regarded as the main family characters, then the castrated buck in the possession of the London Zoological Society possessed none of them. That the typical Bovidae may as an abnormal event cast a horn in a manner entirely similar to that of the Antelope is shown in the case described by Grill b of a cow casting its horn, without traumatism.

The placing of the genus Antilocapra as the sole representative of a family, Antilocaprini, on an equality with the Cervidae and the Bovidae is unnatural, as was pointed out by Cope c long ago. The visceral anatomy, the osteology, and the dentition, as shown by Dr. James Murie, d associate Antilocapra with the Bovidae. The only essential difference between Antilocapra and the other Bovidae is the casting off of the annual increment of its horn. I see no reason on this account for its separation as a distinct family of the Artiodactyla. Its true position is clearly no more than an aberrant subfamily, Antilocaprinae, of the Bovidae as the latter are at present understood, the essential characters of the subfamily being horns deciduous, with a characteristic branch or prong in front, and absence of annual rings of growth at base of horn. In addition to these plainly seen characteristics may be mentioned the large number of cutaneous glands possessed by the American Antelope, e 1 postmandibular, 1 ischial, 2 interdigital, 1 hock, present as pairs, and a median gland on the lower back, above the white patch of the rump. Neither cerumen or lachrymal gland, nor inguinal glands are present, though often found in other Bovidae. The ischial glands and the one on the lower back are not found on any of the other Bovidae, so far as I am aware. Doctor Murie has shown that the hair of the American

b Der zoologische Garten, IV, 1863, pp. 254 and 255.
c American Naturalist, XXII, 1888, p. 1081.
Antelope as compared with the hair of the other ruminants is peculiar in possessing markedly denticulate cells in the medulla. When the osteology of the Bovidae is better known, it is probable that the American Antelope will be found to possess certain peculiarities of structure not found elsewhere in the family, but, so far as our present knowledge goes, it has no peculiarities that are not found to a greater or less extent in other members of the family.

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The following list contains the references to the original articles on the subject of the annual shedding of the horns of the American Antelope that have come to my notice:

1851. Audubon, J. J. and Bachman, J.—[Remarks on the supposed shedding of the horns of the Antelopes.]
   Viviparous Quadrupeds of North America, II, p. 189.
   The authors deny the possibility of the horns being shed.

1858. Cassin, John.—[Doctor Marsh's observation on the horns of the Antelope.]
   United States Exploring Expedition, Mammalogy and Ornithology, p. 63.
   Cassin gives this quotation from the notes of Dr. Charles Pickering: "Doctor Marsh assures me that the horns of this animal are shed annually like those of the deer."

1863. Weinland, D. F.—[Editorial note.]
   Der zoologische Garten, IV, p. 225.
   On the casting of a cow's horn by natural causes mentions a like case observed in the American Antelope.

   Der zoologische Garten, V, 1864, pp. 254-256.
   Describes the structure of the growing horn, but evidently not aware of its annual shedding.

1865. Bartlett, A. D.—Remarks upon the affinities of the Prongbuck (Antilocapra americana).
   Describes the actual shedding of the horns of a living specimen in the possession of the London Zoological Society.

1866. Canfield, Colbert A.—On the habits of the Prongbuck (Antilocapra americana) and the periodical shedding of its horns. Publication of a letter written at Monterey, California, September 10, 1858, addressed to S. F. Baird, Secretary, Smithsonian Institution.
   A very complete and careful account of the growth and annual shedding of the horns of the American Antelope.

   American Naturalist, II, pp. 131-133, four figures on page 132, and figs. 1 and 2 on Plate 3.
   A careful account based on four years' observations of a living specimen, with illustrations of mature and newly formed horns.


American Naturalist, II, p. 537.

A brief note stating with reasons "There seems to be some foundation for the belief that the horns of these Antelopes are deciduous."

1869. Hinman, W. M.—Shedding of the horns of the American Antelope (Antilocapra americana).


"Communicated in a letter received by the Smithsonian Institution, Washington, D. C." A careful account of the annual shedding and the growth of the horns.

1876. Caton, John Dean.—The American Antelope or Prong Buck.


A careful and detailed account of the shedding and growth of the horns.

1877. Caton, John Dean.—[On the growth and shedding of the horns of the Antelope.]

The Antelope and Deer of America, pp. 25-35, figs. 1 and 2.

A very comprehensive account of the growth and shedding of the horns, including the histologic structure, which is illustrated.

1877. Williston, S. W.—The American Antelope.


Remarks that the weight of evidence is strongly in favor of the annual shedding of the horns, but he is not ready to affirm it.

1878. Endlich, F. M.—" General Notes."

American Naturalist, XII, p. 557.

Thinks that Antelopes do shed their horns, but only at irregular intervals.

1880. Forbes, W. A.—Exhibition of drawings of the horns of the Prongbuck, and remarks upon the shedding of the horns of this animal.


Describes a horn shed October 19, and gives figures of the new horn just after the shedding and four weeks later.

1882. Forbes, W. A.—Exhibition of the horns of a Prongbuck, and remarks upon the shedding of them.


Exhibition to the Society of the horns shed by a living specimen, one November 15 and the other November 24, 1881.


Gives a summary of the literature and adds observations of his own to demonstrate the shedding.


Description and illustration of a remarkable specimen in which the successive horns had not been shed for at least six years. This effect was probably due to the castration of the animal.


Discusses the horns on page 36, and quotes observations of Mr. W. R. McFadden showing that the horns are cast in the fall.
A very good and careful account of the shedding of Antelope horns as observed by Doctor Mearns on living and freshly killed wild individuals.

Plate XXV in Baird's Mammals of North America, 1857, gives many illustrations of the various shapes of the horns of the Antelope, at maturity and during the process of growth. Professor Baird was evidently not aware of the annual shedding of the horns. The interpretation of the ages and stages of growth of the horns illustrated on the plate are given in Doctor Canfield's letter published in 1866.

EXPLANATION OF PLATES.

PLATE XXXVIII.
All figures about \( \frac{1}{2} \) natural size.

Fig. 1. Right horn-core of adult female, Cat. No. 1078, from Presidio del Norte, Mexico.
2. Right horn of adult female, Cat. No. 144983, from Montana.
3. Newly formed left horn of a young adult male, Cat. No. 111702, from Medicine Hat, Alberta. Most of the horn-core is uncovered with horn. The blunt angle over which the prong was to grow is seen at the base of the horn-core.
4. Half-grown left horn of an adult male, Cat. No. 111708, from Medicine Hat, Alberta. Horn has formed for the apex of the horn and for the prong. The rest of the horn-core was presumably covered with skin. Some of this skin in the process of cornifying, together with long hairs, is seen on the horn-core above the prong.
5. Fully matured left horn of an adult male, Cat. No. 86395, from Wyoming. This horn is not typical in that the apex is twisted forward instead of backward, as is usually the case.

PLATE XXXIX.
About \( \frac{1}{2} \) natural size.

Adult male, Cat. No. 20776, from Wyoming. The horns of this specimen are decidedly abnormal in their marked forward inclination. The horn-core as well as the horn itself is bent forward. The specimen is still further abnormal in that the old shedding horn on the left side has not been cast off but is still firmly attached to new-formed but well-developed horn beneath it.
Abnormal Horns of American Antelope.
For explanation of plate see page 415.
DESCRIPTION OF A NEW BRITTLE STAR FROM THE UPPER MIocene OF THE SANTA CRUZ MOUNTAINS, CALIFORNIA.

By Ralph Arnold.


INTRODUCTION.

While engaged in field work on the Santa Cruz quadrangle during the summer of 1901 two beautifully preserved though somewhat imperfect molds of a brittle star were found by Mr. W. J. Miller in the soft arenaceous shale immediately overlying the Santa Margarita sandstone south of Scott Valley, Santa Cruz County, California. The casts made from these molds exhibit so many diagnostic characters that it has been deemed expedient to prepare the following description. No other fossils were found with the stars but from such forms as

*Astrodopsis antiselli* Conrad and

*Pecten crassicardo* Conrad

which have been found in the clear white sandstone immediately underlying the shale, the age of the stars is known to be upper Miocene (upper Santa Margarita formation).

The form of description used by Lyman in his monograph on the *Ophiuroidea* has been followed as closely as the state of preservation of the specimens would permit.

The writer wishes to acknowledge his indebtedness to Mr. Austin Hobart Clark, of the U. S. Bureau of Fisheries, for assistance rendered during the preparation of this paper.

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Genus AMPHIURA Forbes.

AMPHIURA SANCTÆCRUCIS, new species.

Plate XL.

Description.—Disk attaining a diameter of 13 mm., delicate, covered with small naked, overlapping scales. Arms five, long, slender, even or tapering very slightly and more or less flattened. Arm spines moderately short and sharp pointed, approximately equal in length to the width of the dorsal median plates. Upper arm plates simple, breadth about 1½ length; lower arm plates deeply grooved in the median line.

Disk pentagonal in outline, the arms passing out from the sides rather than from the angles, this being due to the spreading of the disk upon compression by the containing fine clayey sediments; whole dorsal surface of disk covered with overlapping scales, which, in the cast serving as the type, are minutely shallowly punctuate corresponding to numerous microscopic protuberances in the original animal. Radial shields moderately large, of a short, pear-seed shape, pointed within, outer edge sharply rounded, inner edges nearly straight and separated by 5 prominently overlapping scales (the continuation of the upper arm scales, but shorter than the latter), which narrow rapidly toward the points of the shields. Between the radial shields of adjacent arms are about 7 rows of small overlapping plates, the middle row apparently much larger than the others. The specimen exhibiting the ventral side is so much crushed that its characteristics are unrecognizable. Upper arm plates simple, small, breadth about 1½ length, slightly narrowed within, broader without, straight front, back and sides. Side plates small, triangular, with sharp cornered, beveled edges. Under arm plates quite similar to upper, except deeply medially longitudinally grooved. Spines at least 4 to a segment; about 1½ times length of upper arm plates, rounded, sharp.

Dimensions.—Specimen exhibiting dorsal surface: diameter of disk 13 mm.; arms at least 25 mm. long, and probably several times this amount; width near disk 2 mm., upper arm plates 0.7 to 0.8 mm. long.

Specimen exhibiting ventral surface: diameter of disk 6.5 mm.; arm at least 20 mm. long and probably at least twice this length judging by taper.

Notes.—The two specimens upon which this species is founded are beautifully preserved molds, the larger one, which is taken as the type, showing the dorsal surface, the smaller one the ventral. As would be expected, the surfaces of the disks are considerably crushed and distorted, but enough characteristics are visible to admit
of the above specific description. The specimens have been compared with the recent alcoholics in the collection of the U. S. National Museum, but no forms agreeing even remotely with the fossils were found. Both A. H. Clarke and the writer are of the opinion that the fossils belong to the genus Amphiuma, although, as might be expected in molds, some of the diagnostic characters are lacking. The species is named in honor of the Santa Cruz quadrangle near which the types were obtained.

Type.—Leland Stanford Junior University, Geological collection, No. 1078.

Paratype.—Cat. No. 165431, U. S. N. M.

Horizon.—Santa Margarita formation, upper Miocene.

Locality.—Santa Cruz County, hills immediately southeast of Scott Valley, 6 miles north-northeast of Santa Cruz. (W. J. Miller.)

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PLATE XL

Amphiura sanctacruces Arnold, new species.

Fig. 1. View of cast of dorsal portion, enlarged 3 times. Type. Coll. Leland Stanford Junior University, No. 1078. Upper Miocene (Santa Margarita formation), Scott Valley, Santa Cruz County, California.

2. View of cast of ventral portion, enlarged 3 times. Paratype. Cat. No. 165431, U.S.N.M. Same locality as fig. 1.
A NEW CALIFORNIAN MIOCENE BRITTLE STAR.

FOR EXPLANATION OF PLATE SEE PAGE 420.
THE LATE NIAGARAN STRATA OF WEST TENNESSEE.

By William F. Pate,

Of Lebanon, Kentucky.

and

Ray S. Bassler,

Curator, Division of Invertebrate Paleontology, U. S. National Museum.

Probably nowhere in America is a more complete and better exposed section of Niagaran strata than that shown along the Paleozoic geanticline of West Tennessee. This section is well exposed along the Tennessee River and its tributaries, but the many fine fossils that have made this classic ground for the paleontologist have come almost entirely from the conspicuous white-capped, rounded hills or "glades" scattered through portions of Decatur, Perry, Wayne, and Hardin counties. A portion of this Niagaran section contains rather thick beds of white clays and clayey limestones, which weather into soils unfavorable to the growth of much vegetation. Therefore, when these particular strata happen to occupy the top of the hills or are exposed along their slopes, spaces almost entirely barren of vegetation occur in otherwise well-wooded areas, and because of their white clayey soil, such bare spots or glades, as they are locally known, are visible for considerable distances. The strata whose disintegration primarily gave rise to these spots are usually very fossiliferous. In process of erosion the fossils are left behind, so that in the course of time most of the glades become ideal collecting grounds. Indeed, fossils are sometimes so abundant on the glades that specimens can be shoveled up literally by the bushel measure.

Despite the fine fossils and good sections afforded by the area, comparatively little has been done on its paleontology, and but one writer has published on its stratigraphy in any detail. The present contribution is based upon several short seasons of study and collecting by Mr. Pate, and upon a joint study of the rocks by both authors during two weeks of the summer of 1907. Much of the senior

author's time was devoted to collecting the echinoderm fauna of the area for Mr. Frank Springer, but, in tracing the various crinoid horizons, an exceptional opportunity was afforded to study the stratigraphy in detail. This collecting resulted in the addition of many new species to the already considerable crinoid fauna and in the discovery of material affording new data concerning the described forms. These crinoids are at present being studied by Mr. Springer, who expects to publish a special monograph upon them in the near future. Besides the study of the stratigraphy with Mr. Pate, the junior author paid particular attention to the collection of the other classes of fossils, so, by a combination of efforts, it is hoped to add something to the knowledge of the region. Practically all of the echinoderms found on these various trips are a part of the Springer collection, while all of the remaining specimens belong to the U. S. National Museum.

In 1847, Roemer visited this glade region and spent about five weeks collecting the fauna. The country was then very sparsely settled, and his efforts were, of necessity probably, confined to Decatur County, in the vicinity of Dixon Spring and Brownport Landing, where he could secure living accommodations. Practically all the species which in 1860 were described by him in "Die Silurische Fauna des Westlichen Tennessee" were collected on the glades of the locality mentioned. Since Roemer's species have been procured from the same sections and localities by subsequent collectors, there is now no doubt regarding their geologic position. Troost, Safford, Worthen, Wachsmuth, Rominger, and other paleontologists collected on the glades repeatedly, but, aside from the publication of a new species now and then, nothing further has been done upon the paleontology.

The first account of the stratigraphy of these Silurian rocks was given by Professor Safford in 1861, and later in his Geology of Tennessee, in 1869, where the Niagaran rocks are subdivided into two nearly equal portions, each about 100 feet thick, a lower or variegated bed and an upper or sponge-bearing bed. The general section presented by Professor Safford, taken from the type locality at Clifton, is as follows:

(2) Meniscus limestone.

(b) Sponge-bearing bed; gray, crinoidal, and argillaceous limestones, many of them glade-forming, highly fossiliferous, containing sparsely thin layers of chert. 90 feet.

(a) Variegated bed; gray, red, and mottled limestones, interstratified; many layers argillaceous; Orthocerata abundant in its lower part. Clifton is located in part upon it. 96 feet.

Entire thickness of the formation 186 feet.

The name Meniscus limestone is misleading, since the characterizing sponge, *Astraeospongia meniscus*, is found only in the upper or sponge-bearing bed. In 1876 this name was changed to the Clifton limestone by Safford and Killebrew in their Elementary Geology of Tennessee.

In 1903, Dr. A. F. Foerste published his valuable paper "Silurian and Devonian Limestones of Western Tennessee," by far the most important contribution to this subject. Doctor Foerste’s studies led him to recognize in Safford’s Variegated beds the Clinton, Osgood, Laurel, and Waldron formations of the western flank of the Cincinnati geanticline, and at the top of this division two new formations, the Lego limestones and Dixon beds. To Safford’s upper member, or sponge-bearing bed, as exposed at Clifton and Brownsport Furnace, Foerste applied the new name Brownsport. Other new names, the Maddox limestone of early Niagaran age, the Glenkirk limestone for a combination of the Laurel, Waldron, and Lego, when these could not be separated, and the Gant bed for an arenaceous limestone phase of a part of these late Niagaran rocks, were instituted. Doctor Foerste’s article contains much valuable information, but his arrangements of facts, particularly in the description of sections, is such that it is difficult to assemble his evidence. We are in accord with most of Foerste’s work on the lower portion of the Niagaran, and our efforts in this paper are to present a detailed account of the late Niagaran, with particular reference to the Brownsport division. We have made free use of Doctor Foerste’s work and wish to acknowledge our indebtedness to his publication.

A study of the stratigraphy of this general area has shown numerous unconformities in strata which are essentially horizontal. The geologic range is from the lowest Trenton to the Mississippian, but the main geologic divisions are seldom conformable. The lowest Trenton is succeeded by the uppermost Cincinnatian strata; the Niagaran rocks are followed by Helderbergian strata of New Scotland age, and even in these larger divisions unconformities are noted between their individual members.

Such minor unconformities are indicated in the table of sections on page 428. It may also be noted that, so far as observed, no single locality affords a complete and continuous section of all the Niagaran strata known to occur in the area. For example, at the type-locality, Clifton, in Wayne County, a considerable portion of the late Niagaran is wanting; even at Decaturville, where probably the most complete section of the entire area may be seen, several members are missing. It is, therefore, only by comparing section after section that the complete succession may be determined. The composite section offered on a subsequent page was thus compiled.

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As noted before, our attention was directed more particularly to the Brownsport bed and succeeding strata, or, in general terms, the late Niagaran rocks. These strata have furnished by far the most of the fossils from the glade region, and reference by most authors to the Niagaran fauna of Western Tennessee is not to the Clifton limestone as a whole, but to this particular division. Careful collecting and detailed stratigraphic work has convinced us that the post-Dixon strata of Niagaran age, instead of being a bed of heterogeneous clayey shale and limestone, referable to only one formation, the Brownsport, contains at least four divisions well marked faunally and lithologically, and interesting furthermore because of their unconformable development. Accepting the term Brownsport and defining it as a group, we would propose in addition the following new formations: Beech River, Bob, Lobelville, and Decatur. The several classifications proposed for these rocks may then be tabulated as follows:

**Niagaran strata of West Tennessee.**

<table>
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<th>Safford, 1869.</th>
<th>Foerste, 1903.</th>
<th>Pate and Bassler, 1908.</th>
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<td>Brownsport.</td>
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<td>Sponge bearing bed.</td>
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<td>Variegated bed.</td>
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**SECTIONS.**

In order to show the character and occurrence of these divisions, we have thought it best to first give detailed sections at (1) the type locality of the Clifton limestone, (2) at Brownsport Furnace, whence the Brownsport group derives its name, (3) at Decaturville, and (4) at several other localities where variation from these more complete sections have been noted. The individual formations of the late Niagaran are then discussed, followed by our interpretation of the complete section of the area, constructed from the various localities studied. Finally the occurrence of the same faunas in areas other than West Tennessee, is noted.
CLIFTON, TENNESSEE.

The section at Clifton is well exposed along the river bank, the lowest beds being shown north and south of the old cement mill, where a fault brings the Middle Ordovician Hermitage limestone in contact with the Dixon. Proceeding southward from this point, the Dixon and overlying formations are well exposed; northward along the river bank and then along the slope of the hill back of Clifton, the entire section can be made out in more or less detail. The Waldron, with its typical fauna, is well shown along the river bank about one-fourth of a mile south of the cement mill and also in the town of Clifton itself. The following section is a combination of these several exposures. In this, as well as in the following sections, the strata are arranged under the formations and subdivisions recognized by us, and described more in detail on succeeding pages.

Section at Clifton, Wayne County, Tennessee.

Gravel beds.

Silurian (Niagaran).


   b. Troostocrinus zone. Blue shales and limestones holding Troostocrinus and associated fossils and arranged as follows:

      5. Limestone layer
      4. Blue shale
      3. Compact limestone
      2. Blue shale
      1. Compact limestone in layers varying from 1 to 6 inches in thickness

      a. Coccocrinus zone:

      5. Blue shales with thin beds of nodular cherty limestone
      4. Blue shales with four or more well defined chert bands 1 to 2 inches thick
      3. Blue shales free from chert, irregularly developed
      2. Grayish white crinoidal limestone with a purplish tinge when freshly broken
      1. Blue shales weathering white upon exposure


Red shales and clayey limestones with occasional layers of white argillaceous limestones. Fistulipora hemispherica rather abundant.

8. Lego limestone.

   b. Compact gray limestone with layers of reddish, more argillaceous rock

   a. Compact, white, massive limestone

7. Waldron shale.

White indurated clay and white argillaceous limestones with the typical Waldron fauna, among the species being
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Eucalyptocerinus magnus, E. elrodii, Stephanocerinus gemmi-
formis, Dictyonella reticulata, Meristria maria, Homaro-
spira var. Nuculospira pisiformis, Anastropheia internas-
cens, Leptana rhomboidalis, Rhipidocelis hybridra, Cal-
lopora elegantihi, etc ......................................... 3

Massive, reddish purple argillaceous and subcrystalline lime-
stone .......................................................... 25

5. Osgood limestone.
Thin-beded reddish argillaceous limestone holding Stephan-
ocerinus osgoodensis and typical Caryocerinus ornatus......... 14

4. "Clinton" formation,a
White to light brown crystalline fossiliferous limestone with
greenish brown chert. This layer has yielded the follow-
ing fossils: Leptana rhomboidalis, Halmaclena elegantihi,
Phatystrophia daytonensis, Orthis flabellites, Cyclonema day-
tonensis, Halma daytonensis, Calymene coplesta, Cylloceras
subcompressum, Favorites favarix, F. niagarensis, and Haly-
sites extenuatus ............................................. 1

Ordovician (Cincinnatic).
3. Fernvale (Richmond) formation.
b. Bluish shales with Rhynchotrema capax, Dinorthis sub-
quadrata, D. proarita, and Rhombohyra quadrata,
Mannie clay of Foerste ...................................... 15½
a. Coarse-grained, cross-beded, light-colored phosphatic
limestone with Rhynchotrema capax and Strophomena
planidorsata. Leipers limestone,b ................................ 19

Coarsely crystalline phosphatic limestone weathering into
abundant chert fragments. Dinorthis retorsa, Leptana
rhomboidalis, and Rhynchotrema dentatum var., are the
most abundant brachiopods, while several species of bryo-
zoa are sometimes so numerous as to fill the entire layer.
The lowest layer of this formation is of dark-colored con-
glomeratic material made up of the casts of Cycloras,
and containing large and small fragments of the underly-
ing Hermitage limestone .................................... 0-3

Ordovician (Mohawkian).
1. Hermitage ("Salttilo") formation.
Bluish-gray, compact argillaceous limestone layers two to
five feet thick, alternating with blue shales of equal thick-
ness ........................................................... 70+

BROWNSPORT FURNACE, TENNESSEE.

In the vicinity of Brownsport Furnace two well-marked glades ex-
pose a fine section of the various beds belonging to the Beech River,
Bob, and Lobelville formations. The red limestones and shales of the
Dixon may be seen at the base of the southern glade, while the young-
est Paleozoic rocks of the section—the Devonian black shale—were
exposed in the hillside northwest of the furnace.

a This name is provisionally employed for the western rocks referred to the
Clinton by Foerste and others.

b Foerste, not Leipers formation, Hayes and Ulrich.
Section at Brownsport Furnace, Decatur County, Tennessee.

Gravel beds.
Devonian.

Chattanooga shale (exposed along hillside northwest of furnace) — Silurian.

3. Lobelville formation.  
Coral zone. Yellow clays and argillaceous limestones holding an abundant coral fauna. Contains numerous specimens of several species each of Furusites, Heliolites, Cladopora, Cystiphyllum, Amelolites, and Thecia, and Amphipora shumardi — 20

2. Bob formation.  
d. Somewhat massive argillaceous limestone with few fossils 15  
e. Blue clay and shales with many brachiopods. Merista maria-rameri, Dictyonella gibbosa, Gypidula rameri, Merista tennesseensis, Uncinulus tennesseensis, and Wilsonia saffordi, and a small form of Atrypa reticularis niagarensis particularly abundant 17  
a. Gray, rather massive limestone alternating with shale 4

1. Beech River formation.  
e. Eucalyptocrinus zone — 10  
b. Troostocrinus zone 24  
a. Coccocrinus zone 15

Dixon formation.  
Red argillaceous limestones and shales, exposed at base of southern glade —

DECATURVILLE, TENNESSEE.

The following section is exposed within a radius of 1 mile of Decaturville, and although exposures are numerous, the section as a whole can be observed at no particular place. The lower part of the section is brought up by an immense uplift just east of Decaturville, while the upper formations may be found on the higher land about the town. At Decaturville itself the Decatur limestone is represented by bowlders only, but at Tuck's Mill, 1 mile north of the town, 70 feet of this limestone is present, and, furthermore, its unconformable position upon the Eucalyptocrinus zone of the Beech River formation is excellently shown. At this point, blasting by Mr. Pate in the upper part of the Eucalyptocrinus zone resulted in a large crinoid fauna.

General section in the vicinity of Decaturville, Decatur County, Tennessee.

Gravel beds.
Devonian.  

Chattanooga shale 0–10  
Hardin sandstone 0–4  
Camden chert 4+
Linden formation.

Bluish shales with bryozoa........................................... 3
Residual limestone bowlders holding Camarocerinus and Helderbergian brachiopods .......................... 5

Silurian.

Decatur limestone. Massive, white crinoidal limestone becoming yellow and shaly at the top.............................. 70

Beech River formation.

Eucalyptocerinus zone. Bluish shales becoming yellow toward the top................................................................. 20
Troostocerinus zone. Fossiliferous shales varying from bluish through yellow to white in order, with a limestone band in the middle part.................................................. 24

Coeccerinus zone. Shaly limestone in the upper part and whitish limestone easily disintegrating into clay in the lower part........... 25

Dixon formation. Purplish shales in lower part and red crinoidal limestone in upper ................................................. 35

Lego limestone. Grayish limestone with a few red layers........... 30

Waldrum shale. Purplish shales with an intermediate layer of white limestone. Minusaudwaldronensis and other Waldrum fossils noted. 4

Laurel limestone. Pale purple, massive limestone.................... 25

Osgood limestone. Massive white crinoidal limestone with a tendency to form cliffs when favorably exposed.................. 10

Ordovician.

Aruheim ("Warren") formation. Coarsely crystalline phosphatic limestone .......................................................... 2

Hermitage ("Saitillo") formation. Argillaceous limestone and shale with usual Lower Trenton fossils. This, the lowest rock of the vicinity, is exposed for a distance of a mile along Rushing Creek east of Decaturville.................. 50

LADY'S BLUFF, PERRY COUNTY, TENNESSEE.

This in one of the highest and most beautiful bluffs along the Tennessee River, and furnishes an excellent section of the Niagara and Helderbergian rocks. Lady's Bluff is on the east side of the Tennessee River, 1 mile below Mousetail and just below the mouth of Lick Creek, in Perry County. In this section, which follows, the absence of the coral beds normally preceding the Decatur limestone is noteworthy.

Section at Lady's Bluff, Perry County, Tennessee.

Gravel beds.

Devonian.

Linden (Helderbergian) formation.

b. Shales with numerous bryozoa and brachiopods.................. 3

a. Massive crinoidal limestone with Camarocerinus.................. 4

Silurian.

Decatur limestone. Massive crinoidal limestone, gray, magnesian in upper part and more yellow in lower portion.................. 63

Lobelville formation.

Coral zone wanting.

Bryozoa zone.

Light blue soft shale....................................................... 2

White argillaceous limestone............................................. 2
Blue shale with bryozoa and a few corals.......................... 1
Purple shale and argillaceous limestone, containing many bryozoa and a few corals.............................................. 17

Bob formation.
Conchidiun zone. Nodular, cherty, crinoidal blue and gray limestone with Conchidiun in upper part especially. Other fossils few......................................................... 15
Dictyonella zone. Blue shales with rather numerous brachiopods... 5
Uncinulus zone. Grayish, cliff forming limestone breaking into large blocks................................................................. 16

Beech River formation.
Eucalyptocrinns zone. Blue and yellow shales with Eucalyptocrinus and other characteristic fossils. At one point in the near vicinity this bed has thickened to 40 feet................................................................. 20
Troostocrinus zone. Yellow shales and thin white limestone...... 24
Coccocrinus zone. Only topmost layer exposed....................

MOUSETAIL, PERRY COUNTY, TENNESSEE.

The local variability of the beds comprised in the late Niagaran is brought out in a comparison of the Lady's Bluff section and that at Mousetail, 1 mile south. The absence of the Bob formation in the Mousetail section is particularly noteworthy.

Section at Mousetail, Perry County, Tennessee.

Decatur limestone.
Massive gray and white coarsely crystalline limestone with few fossils... 8

Lobelville formation.
b. Coral zone. Yellowish clays and thin limestones with numerous specimens of Farosites, Heliolites, and other corals................... 8
a. Bryozoan zone. Soft shales holding many bryozoa and a few corals of the genera Farosites and Heliolites.
Bluish white shales................................................... 2
Purplish shales ................................................................ 7

Beech River formation.
c. Eucalyptocrinns zone. Yellowish shales with crinoids and other fossils characteristic of this horizon.................................... 27
b. Troostocrinus zone. Thin limestone and shales with T. reinwardti, etc........................................................................ 45
a. Coccocrinus zone................................................................ 15

Dixon formation.
Red shales. Top only exposed...........................................

In the remaining sections studied by us the differences in lithology and in fauna were so slight that it was deemed best to arrange these in tabular form. In this table the bottom and top of each section is indicated by the lowest and uppermost figures, or X, while blank spaces within these limits show the absence of formations. The various thicknesses are given in feet when accurately determined, but by X when only noted.
### Table of Sections

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1. Vicinity of Decaturville, Decatur County.
2. Robard's old mill, 2 miles northwest of Decaturville, Decatur County.
3. One mile south of Dixon Sulphur Spring, Decatur County.
4. Big Glade, 2 miles south of Perryville, Decatur County.
5. One and one-half miles southeast of Jeansette, Decatur County.
6. Brownsport Furnace, Decatur County.
7. Clifton, Wayne County.
8. Webb or Rice Mill, Perry County.
9. One mile east of Webb's Landing, Perry County.
10. Lady's Bluff, Perry County.
11. Mousetail, Perry County.
12. Lick Creek, 4½ miles east of Mousetail, Perry County.
13. Beardslow, Perry County.
14. Bridge over river 1 mile north of Lobelville, Perry County.
15. Spring one-half mile north of Lobelville, Perry County.
16. Wolf Creek, on road from Whitfield to Lobelville, Perry County.
17. Peler's pond, 1 mile north of Whitfield, Hickman County.
18. One-half mile north of Martin's mill, Wayne County.
19. Montgomery's mill, Hickman County.
20. Schoolhouse at Houston, Wayne County.
21. Two miles below Craven's old mill, on Indian Creek, Hardin County.
22. Bob, Decatur County.
POST-DIXON FORMATIONS.

Along the western flank of the Cincinnati axis the Silurian rocks following the Waldron shale are known as the Louisville limestone. In West Tennessee the same interval is occupied by several limestone and shale formations which have been named by Foerste, in ascending order, the Lego limestone, Dixon bed, Brownsport bed, and Gant bed. The Brownsport and Gant beds are the special subjects of this paper.

The term Brownsport was loosely defined. In fact, the name could hardly be considered as defined at all, since practically the only description of these strata given by the author of the name is to the effect that the name Brownsport bed is applied to the richly fossiliferous section overlying the Dixon red clay and containing the fauna studied by Roemer during his visit to Decatur County, Tennessee. In this sense the name would have reference mainly to the crinoid, brachiopod, and coral beds, so conspicuously shown in the section at Brownsport Furnace. Apparently the name was instituted only for convenience of reference, and not as a formal name. In the same article (p. 576) rocks now known to be equivalent to the brachiopod beds of the Brownsport Furnace section are named the Gant bed. The recognition of either or both of these names as formations is thus made questionable, and we were in doubt whether (1) to apply the name Brownsport as a group term to the post-Dixon Niagaran strata as exposed at Brownsport Furnace, (2) to extend the term so as to include all the Niagaran rocks following the Dixon, or (3) to restrict and redefine the formation entirely. After a consideration of all the sections, the first course seemed the wisest.

In the post-Dixon Niagaran interval four well-marked divisions can, we believe, be recognized. The lowest is a series of rather widely distributed, very fossiliferous white clays and thin-bedded limestones furnishing most of the crinoids afforded by the glades; argillaceous limestones and shales, quite similar lithologically to the Dixon but of more local distribution, succeed these white strata, and are overlaid in turn by blue shales bearing great numbers of brachiopods; just above the brachiopod beds are blue shales and cherty limestones in which the great coral fauna so well developed at Louisville, Kentucky, is likewise abundantly represented. In exposures of these strata in Tennessee the corals are sometimes so numerous that the ground is entirely hidden by the specimens. These three formations constitute the Brownsport group as here recognized. Finally, the Niagaran of West Tennessee is closed by a massive white, coarsely crystalline limestone, 70 or more feet thick, which seems to be of considerable extent, especially in the northern half of the area.
BEECH RIVER FORMATION.

As indicated previously, the lowest beds of the Brownsport group furnish most of the crinoids of the late Niagaran of West Tennessee. To this formation the name Beech River is applied from the conspicuous exposures along Beech River in Decatur County. The weathering of these beds gives rise to the most conspicuous of the West Tennessee glades. Their strata are almost exclusively fine shales of a gray, yellow, or bluish color, but weathering into a white clay. These shales are generally present where their proper place in the section is exposed; indeed, they form the most widely spread division of the late Niagaran. Their fauna is also the best known of any of the Niagaran divisions, probably because most of the well-known crinoids and blastoids from West Tennessee are derived from them. *Coccocrinus bacea*, *Troostocrinus reinwardti*, and *Eucalyptocrinus milliganus* are particularly abundant, and each was found to be characteristic of a certain zone. Numerous outcrops of these shales may be seen in the general area between Perryville and Clifton, but particularly fine exposures are found at Brownsport Furnace, thence northward to Perryville, and at numerous localities along Beech River. The Brownsport Furnace section has been given on a preceding page: the sections along Beech River are essentially the same, but the best exposed and most clearly defined section of the Beech River formation is found at the large glade about 2 miles south of Perryville.

*Section two miles south of Perryville, Decatur County, Tennessee.*

Decatur limestone. In large boulders covering formation below

Beech River formation.

Eucalyptocrinus zone.

Fine bluish fossiliferous shales in the lower part and yellow shales increasing in their yellow color and fossiliferous character toward the top. *Eucalyptocrinus milliganus* is not uncommon, while *Lampteroocrinus tennesseensis*, *Callicrocirus ramifer*, *Eucalyptocrinus ventricous*, *Marsupioocrinus tennesseensis*, and many other species of the same class are occasionally found. *Troostocrinus* is a rare fossil and the specimens are larger and more slender than the typical *T. reinwardti* of the beds below.

Troostocrinus zone.

Yellowish shales with numerous typical *Troostocrinus reinwardti* and *Callirocrinus bulbulis* less common

Gray, shaly limestone forming a bench on the glade

Very fossiliferous, bluish, and whitish shales, becoming tinged with yellow toward the top

Coccocrinus zone.

Rather shaly limestone, much more resisting than shales above and below. This limestone forms a well-marked bench separating the Coccocrinus zone below and the Troostocrinus zone above

---

Feet.

---

20

10

1-3

11

3
White and gray shaly limestones and shales which rapidly disintegrate into a white clay upon exposure. *Coccocrinus bacca* found throughout this division but most abundant near the middle.  

---

Gray, shaly, rather unfossiliferous limestones.  

---

Hard white limestone with a purplish tinge upon fresh fracture.  

---

White or greenish-white clay containing numerous dwarfed specimens of *Bilobites, Plectambonites, Pisocrinus*, etc.  

---

Dixon formation. Red and purple shales and shaly limestone.

---

*Astroaspongia monisca* is a very abundant and characteristic fossil of the Beech River, although not restricted to this formation. Specimens of this sponge in the later divisions of the Niagaran are rare. *Spiroceras oligothyclus, Orthoceras fissiplica, Dalmanella arenaria, Fistulipora hemispherica, Fenestella acuticosta, Astylomanon cratera* and varieties, *Caricomanon inciso-lobatum* and *C. stellatim-sulcatum*, are likewise abundant and range throughout the three beds.

The three subdivisions of the Beech River formation are, as a rule, quite similar lithologically and they are instituted mainly because of faunal differences. Mr. Springer's work upon the Crinoidea will illustrate this portion of the fauna in detail. The most abundant crinoid fauna has been found in the upper or Eucalyptocrinus zone, where Mr. Pate collected *Callicrinus ramifer, Lampterocrinus tennesseensis*, L., new species; *Eucalyptocrinus milliganii, E. centricosus, Allocrinus typus*, and three or four new species; *Marsupiocrinus tennesseensis*, M. *striatus, Lecanocrinus pisiformis, Herpetocrinus gorbyi, Calicecrinus*, two new species; *Pisocrinus milliganii, P. gessiformis, Thalamocrinus oratus, T. cylindricus, Thysanoocrinus milliganii, Sagencrinus*, new species, as well as other undescribed forms.

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**BOB FORMATION.**

Just below Bob Landing, along the west bank, the Tennessee River has exposed a section of red limestone and shales so similar in lithology to the Dixon formation that at first sight one would not hesitate to so refer them. A closer investigation of these strata shows that they overlie the Eucalyptocrinus zone of the Beech River formation, with its numerous characteristic fossils, and are succeeded by the bachiopod beds described below as the Dictyonella zone. Red strata holding the same position can be traced through the southern part of Decatur County and through Hardin and Wayne counties as far south as Indian Creek, so that these red rocks are known to occupy at least this limited area. These strata vary in thickness from 5 or 6 feet in their southern outcrop along Indian Creek at a bridge about half way between Olive Hill and the mouth of the creek to 20 feet or more at Bob. Large examples of *Uncinulus stricklandi* are quite common in this division, so, for convenience of reference, these strata may be called the Uncinulus bed or zone.
Following these red beds are shales and limestones holding an abundance of brachiopods. A discussion of these strata follows.

In the discussion of the Lower Helderberg rocks, Safford, in his Geology of Tennessee, described a locality near Esq. A. B. Gant's home, on Indian Creek, in Wayne County, 14 miles from Waynesboro and 22 from Savannah, where a bed of limestone, holding a fauna of more or less mixed character, was presented immediately below the Black shale and above the Meniscus layers. The section here, as given by Professor Safford, is as follows:

1. Black Shale Group, represented by its lowest member—the sandstone... Feet.
2. A layer of gray limestone, containing the fossils of column C, which are silicified... 10
3. Space, rocks not seen... 8
4. Argillaceous limestone at the foot of the hill, which may be referable to the Meniscus formation... 5

The list (column C) mentioned in the section was of brachiopods about equally divided between the Niagaran and "Lower Helderberg" species. The bed was, therefore, apparently transitional and of considerable interest in an area where the Niagaran and Helderbergian were elsewhere unconformable.

Doctor Foerste included this locality in his studies and found that a considerable stratigraphic interval separated layer 3 of Professor Safford's section from the Hardin sandstone (layer 4). He also proposed that "for purposes of discussion it will be found convenient to apply the name Gant limestone to the coarse sandy limestone under discussion [layer 3], and the term Gant bed to the top of Silurian section, including the Gant limestone at its base." At the Gant locality he found the "Gant limestone" to contain Spirifer saffordi, Dictyonella gibbosa, Nuclospora concentrica, Wilsonia saffordi, Uncinalus stricklandi, and Schuchertella (Orthothetes) subplanus. At other localities in the vicinity the "Gant limestone" was found to contain Meristina maria-roemeri and Gypidula roemeri, in addition to the brachiopods already mentioned, and beneath this limestone were found whitish clays and soft limestone containing sponges, brachiopods, and crinoids characteristic of the Glade exposures of the Beech River formation.

The following section, which has been compiled from Foerste's remarks upon this subject, is rather characteristic of his "Gant bed" in apparently the only area where it has hitherto been recognized.

Section on hillside just northeast of Martin's mill, Tennessee.

Bob formation. Feet.
Layer C. Much weathered and poorly exposed limestone with Astylosporina praeumorsa, Caryomanaa stellatim-sulcatum, Meristina maria-roemeri, and Wilsonia saffordi... 14
Layer B. Bluish limestone, partly fine grained and partly crinoidal, with Wilsonia saffordi, Uncinulus stricklandi, Schuchertella subspharums, Gypidula roemeri, Camarotoechia neglecta, Nucleospira concentrica, and Meristina maria-roemeri

Layer A. Sandy "Gant limestone" forming a projecting ledge

Beech River formation.

Whitish clays and soft limestone, with sponges, brachiopods, and crinoids

Dixon formation. Red shale and shaly limestone.

Foerste did not recognize his "Gant bed" in any but a small area along Indian Creek in the vicinity of Martin's mill and the Gant homestead. We have found limestones and shales, carrying great numbers of brachiopods of the species listed by Foerste, succeeding the Beech River formation and extending from a point just south of Decaturville continuously eastward and southward through the area drained by the Tennessee River and Indian Creek. At Brownsport Furnace these brachiopod beds are 25 feet in thickness, and it is strange that the similarity of their fauna to that of the "Gant limestone" was not noticed hitherto. One-half mile below Bob, on the west bank of the Tennessee River, the red limestones and shales are succeeded by about 42 feet of limestones and shales abounding in brachiopods. The section here is as follows:

Section one-half mile below Bob, Decatur County, Tennessee.

Lobelville formation

Bob formation.

(f) Hard grayish clay at top, soft yellow clay in middle part, and soft blue clay at the base with brachiopod fauna listed below

(under (c))

(e) Hard buff limestone, blue upon fresh exposure

(d) Soft blue clay with brachiopod fauna of bed below

(c) Yellow argillaceous limestone layers, two to three inches thick, alternating with soft yellow clay. Brachiopods numerous. Gypidula roemeri, Meristina maria-roemeri, Nucleospira concentrica, Dictyonella gibbosa, Uncinulus tennessensis, and Wilsonia saffordi, being particularly abundant

(b) Rather massive white limestone in 8 to 12 inch courses. Uncinulus stricklandi not uncommon

(a) Red limestones and shales to water's edge. Large Uncinulus stricklandi quite abundant

As noted in the above section, all of these brachiopod bearing strata are grouped together in the Bob formation, this name being selected on account of the excellent exposure at Bob Landing, Decatur County, Tennessee.

The Bob formation is likewise found at a number of points north of the general area just described, and here the limestone part of the strata seems better developed. At Lady's Bluff, 16 feet of limestone.
and 5 of shale were noted in the section. It is possible that the original distribution of the formation was equivalent to that of the underlying Beech River, and that erosion preceding the advance of the sea in which the succeeding formation—the most widespread of all—was laid down, has removed these strata, particularly in the more northern areas.

Although we might have adopted the term "Gant formation" for these limestones and shales with an abundant and characteristic brachiopod fauna, we came to the conclusion that the name had better not be employed. At present there is scarcely any exposure at the original Gant locality, and in a few years vegetation will have completely covered the rocks here. The place is found with great difficulty, and, moreover, Gant no longer lives there. The term is not a geographical one, and, in addition, the entire section is not developed there. An excellent exposure of these strata occurs about 1 mile from Swift on the Swallow Bluff road where the shales and limestones hold fine specimens of the brachiopods. Here the limestone layers, usually present at the base of the formation, have disintegrated in shaly material and the large Uncinulus stricklandi noted in this particular bed occur free.

Typical "Giant" limestone and clays are also well exposed on the west side of Buffalo River in Perry County, at Beardstown. The section along the Tennessee River in the vicinity of Bob is by far the most complete and conspicuous, and it seemed most fitting, as stated above, to apply this new name to the formation.

The uppermost division of the Bob formation is of nodular, cherty limestone or hard shale in which brachiopods of the genus Conchidium are the most characteristic fossils. On the east side of the Tennessee River this zone, to which we have applied the name Conchidium, is well shown in the Lady's Bluff section, while west of the river good exposures are found at Brownsport Furnace.

Lobelville formation.

The third formation here recognized is characterized paleontologically by a fauna of corals so abundant in species and specimens that the identification of the beds is attended with little difficulty. These corals are most abundant in the upper half of the formation, and wherever their strata are well exposed many fine specimens may be had. Halysites cataralatus, so abundant at Louisville, Kentucky, in the late Niagaran, is represented in the West Tennessee strata, with the exception of the Clinton, only at this horizon. The same occurrence in the late Niagaran only, holds true for almost all of the following species, likewise very characteristic of the Louisville coral bed: Alcorolites louisvillensis, A. niagarensis, Amplexus shumardi, Cladopora complanata, C. reticulata, Coenites verticillata,
Favosites cristatus, F. cristatus-major, F. discus, F. favosus, F. louis-villeensis, F. niagarcensis, F. spongilla, Heliolites subtubulata, H. inter-stinctus, Plasmopora follis, Calceola tennesseensis, Thecia major, and T. minor. Short Creek, near Linden, Tennessee, is a famous locality for these corals, and most of the West Tennessee specimens in paleontological collections were procured here. The strata, however, are exposed in Perry County from Linden to a point about 2 miles north of Lobelville, and, as the two faunal divisions which we recognize in the formation are well shown in the vicinity of the latter place, the name Lobelville is proposed for this formation. West of the Tennessee River the Lobelville formation is widely distributed, but is not so continuously exposed. Its presence in the Brownsport Furnace section has been indicated on a previous page, and other localities where the formation is well shown, especially in the southern half of Decatur County, might be named.

Red, purple, and blue shales, holding many bryozoa and a number of the corals noted above, follow the Conchidium limestone of the Bob formation and are succeeded by the strata in which the coral fauna is so well developed. These strata, for which we employ the subdivision Bryozoan zone, seem to be but 9 feet thick in the Mousetail section. At Lady's Bluff, where a more detailed section was made (page 426), a thickness of 22 feet was noted. Peeler's Pond, a locality 1 mile northwest of Whitfield, in Hickman County, shows a section of red shales at the bottom closely resembling the Dixon lithologically, and of blue shales at the top. These red shales are without doubt not Dixon, but are the bryozoan beds noted at Mousetail and Webb's Mill. The bryozoa of these beds are mainly of new species. Several species of Fistulipora and a new Nicholsonella are particularly abundant. The occurrence of these red strata at the base of the Lobelville formation, as well as similar red rocks at the same position in the Bob formation, is believed to be very significant in indicating previous land conditions.

Section at Peeler's Pond, Hickman County, Tennessee.

<table>
<thead>
<tr>
<th>Strata</th>
<th>Feet.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Devonian,</td>
<td></td>
</tr>
<tr>
<td>Chattanooga black shale</td>
<td></td>
</tr>
<tr>
<td>Silurian,</td>
<td></td>
</tr>
<tr>
<td>Decatur limestone</td>
<td></td>
</tr>
<tr>
<td>Massive white limestone</td>
<td>6</td>
</tr>
<tr>
<td>Lobelville formation</td>
<td></td>
</tr>
<tr>
<td>Coral zone. Shales and thin bedded limestone with an abundance of Favosites, etc.</td>
<td>27</td>
</tr>
<tr>
<td>Bryozoan zone.</td>
<td></td>
</tr>
<tr>
<td>Soft blue shale with many bryozoa and a few corals</td>
<td>23</td>
</tr>
<tr>
<td>Red clayey shales, greatly resembling Dixon formation, but containing characteristic Lobelville bryozoa and corals</td>
<td>8+</td>
</tr>
<tr>
<td>Bottom not exposed</td>
<td></td>
</tr>
</tbody>
</table>
A section very similar to the above is exposed at the Webb or Rise Mill, just south of Linden. The formations and thicknesses exposed here are as follows:

Section at Webb or Rise Mill, near Linden, Tennessee.

<table>
<thead>
<tr>
<th>Formation</th>
<th>Feet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chattanooga black shale</td>
<td>—</td>
</tr>
<tr>
<td>Decatur limestone</td>
<td>16</td>
</tr>
<tr>
<td>Lobelville formation</td>
<td></td>
</tr>
<tr>
<td>Coral zone</td>
<td>40</td>
</tr>
<tr>
<td>Bryozoan zone</td>
<td></td>
</tr>
<tr>
<td>Blue shales with bryozoa and corals</td>
<td>18</td>
</tr>
<tr>
<td>Red clay shales with base not observed</td>
<td>11</td>
</tr>
</tbody>
</table>

A columnar section of this locality was given by Foerste in *Journal of Geology, XI, 1903, p. 578.* in which the basal red shales are referred to the Dixon. In his text this reference is made doubtful, and he notes that the exposures around Linden are peculiar in not displaying the great wealth of brachiopods and sponges characteristic of more southern exposures. If our studies are correct, these peculiarities are readily explained by the position of the strata above the brachiopod (Bob) and sponge (Beech River) beds. To us the most striking feature of this and other localities near Linden is the great resemblance of the coral beds to the late Niagaran section at Louisville, Kentucky.

The upper zone of the Lobelville formation is so well characterized by its prolific coral fauna that no difficulty should be experienced in its recognition. The strata are usually whitish shales so prolific in fossils that their disintegration upon hillsides leaves the ground fairly covered by the specimens. A particularly fine example of a glade formed by the weathering of these coral beds is the Graveyard Glade, 1\(\frac{1}{2}\) miles west of Bob. The section here extends from probably the top of the Beech River formation to the Decatur limestone occurring in bowlders on the top of the hill, but the corals from the coral beds have so covered the underlying strata that the succession could not be determined with accuracy in the time available. The corals, determined from a preliminary study of the fauna in this horizon at the Graveyard Glade, are listed below. Every one of these species occurs in the uppermost Niagaran strata at Louisville, Kentucky, and we do not know of a clearer case of equivalent rocks, judged by faunal evidence.

*Journal of Geology, XI, 1903, p. 578.*
Corals at Graveyard Glade, 1½ miles west of Bob, Tennessee.

Thecia major Rominger.
Thechia minor Rominger.
Heliolites interstinctus Linnaeus.
Heliolites subulatus McCoy.
Plasmodora follis Edwards and Haine.
Amplexus shumardi (Edwards and Haine).
Favosites discus Davis.
Favosites spongilla Rominger.
Favosites farosus Goldfuss.
Favosites niagarensis Hall.
Favosites cristatus Edwards and Haine.
Favosites cristatus major Davis.
Favosites louisillensis Davis.
Favosites venustus Hall.
Romingeria canndata Davis.
Eridophyllum dividum Davis.
Cladopora reticulata Hall.
Cladopora complanata Davis.
Umplynum verrucosa Rafinesque and Clifford.
Alcyolites niagarensis Rominger.
Alcyolites louisillensis Davis.
Cystiphyllum niagarensis (Hall).
Cystiphyllum granilincatum Hall.
Heliophyllum dentilincatum Hall.
Heliophyllum geumiferum Hall.
Heliophyllum radicula (Rominger).
Halysites catenatus Linnaeus.
Halysites neezus Davis.
Striatopora huronensis Rominger.
Cocmites verticillata Davis.

Localities affording good exposures of the coral zone have been noted in several of the sections already presented, but the Graveyard Glade, Brownsport Furnace, Peeler's Pond, Lobelville, and Jacks Branch, near Linden, are worthy of special mention.

Decatur Formation.

The closing member of the Niagaran in West Tennessee is a massive, white crinoidal limestone with some magnesian beds, sometimes reaching a thickness of 70 or more feet. This has been noted in several sections given on previous pages as the Decatur limestone. In the immediate vicinity of Decaturville this limestone is represented mainly by residual bowlders, but at Tuck’s Mill, 1½ miles north of Decaturville, the formation is well exposed. The section at the latter place may be considered as typical for the formation, but its occurrence at many places in Decatur County has given rise to the name. At the bridge crossing Beech River, 1½ miles north of Decaturville on the road to Parsons, the white, coarse-grained Decatur limestone rests unconformably upon the Eucalyptocirrus beds of the Beech River formation, a short distance above the level of the river. The section continues up the hill back of the mill, and altogether about 70 feet are exposed. Fossils are apparently not abundant, but Uncinulus stricklandi, Wilsonia saffordi, Pachydictya crassa, Pennicepore sp., and other Niagaran fossils were observed. It will be noted that all of these fossils have an extended range, so that the characteristic fossils of the Decatur limestone can not yet be given. Toward the top of the Tuck’s Mill section this limestone becomes slightly shaly, and here fossils are found in most abundance.
Along the river bank one-half mile northeast of Perryville a large quarry has been opened in the Decatur limestone and a good exposure of the rocks is presented. Foerste quotes *Astraeospongia meniscus* as occurring in this quarry immediately beneath the Linden limestone. Careful collecting here shows other Niagaran fossils, so that there is little doubt of the correctness of the reference of this limestone to the Decatur.

The section at Lady's Bluff presents the Decatur limestone so well that the following subdivisions can be noted:

*Decatur limestone at Lady's Bluff, Tennessee.*

<table>
<thead>
<tr>
<th>Formation</th>
<th>Feet.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Linden formation</td>
<td>0</td>
</tr>
<tr>
<td>Decatur limestone</td>
<td></td>
</tr>
<tr>
<td>Yellow, argillaceous limestone</td>
<td>2</td>
</tr>
<tr>
<td>Massive, white magnesian limestone</td>
<td>30</td>
</tr>
<tr>
<td>Argillaceous, grayish limestone weathering into shale</td>
<td>11</td>
</tr>
<tr>
<td>Massive, magnesian limestone, grayish at top and yellowish toward bottom</td>
<td>20</td>
</tr>
</tbody>
</table>

Lobelville formation

Although the three localities mentioned above afford the best sections of the Decatur limestone known to us, still favorable exposures for its study are found at numerous other places in Decatur and Perry counties. Southward this, as well as the underlying Lobelville formation, is usually absent, the Chattanooga black shale or Helderbergian strata resting upon the Bob formation.

The following composite section of the Ordovician-Devonian strata of west Tennessee was prepared from a study of the numerous individual sections studied in this area.
Composite section of Ordovician-Devonian rocks of west Tennessee.

<table>
<thead>
<tr>
<th>Period</th>
<th>Thickness</th>
<th>Columnar section</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Silurian (Niagaran)</td>
<td>70'</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Devonian</td>
<td>35' +</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>50'</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>10'</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>10'</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Chattanooga black shale.**
Black, fissile, carbonaceous shale, often with a band of phosphatic material at the base and a layer of phosphate nodules at the top.

**Hardin sandstone member.**
Sandy shales and sandstones containing fish remains.

**Camden chert.**
Siliceous limestone weathering into beds of angular chert fragments. Fossils of Lower Oriskany age often extremely abundant.

**Linden formation.**
Massive crinoidal limestone in lower half and blue shales and thin limestones in upper part. *Cenotrochius effordii* is the most conspicuous fossil of the lower limestone (Ross bed of Foerste). The upper shaly beds (Pyburn beds of Foerste) are crowded with fossils of New Scotland age, *S minutus, Parosites caniens, Callopora peredparation.*, *Eridotyrannus corticosa,* and *Lioclema cellulorum* being particularly abundant.

**Decatur limestone.**
Massive, white, coarsely crystalline, crinoidal and magnesian limestone becoming yellow and slightly shaly at the top.

**Lobelville formation.**
Coral zone (45'). Yellow clays and thin clayey limestone crowded with corals. Several species of *Parosites, Heliolites, Theca, Cystiphylum, Halysites,* and *Plasmopora* are very abundant. Bryozoan zone (31'). White to blue shales holding a few corals and many bryozoa in the upper part; red to purple shales and argillaceous limestone with the same fauna making up the lower division.
Composite section of Ordovician-Devonian rocks of west Tennessee—Continued.

<table>
<thead>
<tr>
<th>Period</th>
<th>Columnar section (Lobelville)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Silurian (Shinarud)</td>
<td></td>
</tr>
<tr>
<td>Triassic</td>
<td></td>
</tr>
<tr>
<td>Jurassic</td>
<td></td>
</tr>
<tr>
<td>Cretaceous</td>
<td></td>
</tr>
<tr>
<td>Tertiary</td>
<td></td>
</tr>
<tr>
<td>Quaternary</td>
<td></td>
</tr>
</tbody>
</table>

Bob formation.
Conchidium zone (15').
Massive crinoidal to argillaceous limestone with few fossils, species of Conchidium being most characteristic.

Dictyonella zone (30').
Blue clay and shales crowded with brachiopods. Dictyonella gibbosa, Gyptidula rosami, Merista tennesseensis, Uncinalis tennesseensis, and Wilsonia suffruti are among the more common or characteristic forms.

Uncinalis zone (30').
Gray massive limestone at top and red shaly strata in lower two thirds. Large examples of Uncinalis stricklandi are numerous and the most noticeable fossils.

Beech River formation.
Eucalyptoceratius zone.
Fossiliferous, dark blue shales and thin cherty limestone, becoming yellowish toward top. Eucalyptoceratius milliganiae and other crinoids characteristic fossils.

Troostoceratius zone.
Blue shales with a bed of compact limestone 5 or more feet thick at the base and a similar limestone band developed in the middle part. Troostoceratius reinwardti abundant and characteristic of this division.

Cococeratius zone.
Blue to white shales and shaly limestone readily disintegrating into clay. Fossils abundant with Cococeratius baron as the diagnostic form.

Dixon formation.
Red to purple shales and clayey limestones with occasional layers of white argillaceous rock. Fistulipora hemispherica the only abundant fossil.
Composite section of Ordovician-Devonian rocks of west Tennessee—Continued.

<table>
<thead>
<tr>
<th>Period</th>
<th>Columnar section (Dixon)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lower Silurian (Niagaran)</td>
<td></td>
<td>Lego limestone. Compact gray to white argillaceous and subcrystalline limestone with few fossils.</td>
</tr>
<tr>
<td>6&quot;</td>
<td></td>
<td>Waldron shales. White indurated clay and argillaceous limestone, holding the typical Waldron fauna.</td>
</tr>
<tr>
<td>4'</td>
<td></td>
<td>Laurel limestone. Massive, pink to reddish purple argillaceous and crystalline limestone.</td>
</tr>
<tr>
<td>28'</td>
<td></td>
<td>Osgood limestone. Thin bedded, reddish, argillaceous limestone containing <em>Stephanocrinus osgoodensis</em>, <em>Pisoceris gemmiformis</em>, and typical <em>Caryocrinus ornatus</em>.</td>
</tr>
<tr>
<td>14'</td>
<td></td>
<td>&quot;Clinton&quot; formation. White to light brown crystalline, fossiliferous limestones with greenish brown chert.</td>
</tr>
<tr>
<td>1'</td>
<td></td>
<td>Fernvale formation. Bluish shales in upper half, coarse grained, cross-bedded, light colored phosphatic limestone in lower. <em>Rhyenochorema capax</em>, <em>Dinorthis subquadrate</em>, <em>D. procera</em>, <em>Strophomena planodorsata</em>, and <em>Rhombotrema quadrata</em> observed.</td>
</tr>
<tr>
<td>3'</td>
<td></td>
<td>Arnhem (&quot;Warren&quot;) formation. Coarsely crystalline phosphatic limestone weathering into abundant chert. The lowest layer is of dark conglomeratic material, made up of the casts of Cyclions and containing large and small fragments of the underlying Hermitage limestone.</td>
</tr>
<tr>
<td>70' +</td>
<td></td>
<td>Hermitage (&quot;Saltillo&quot;) formation. Bluish gray, compact argillaceous limestone alternating with blue shales. Fossils few but <em>Datmanella tenuidinia var. fertilis</em>, <em>Leptobolus lepis</em>, <em>Trematis punctata</em>, <em>Schizocrania radiata</em>, <em>Whitewarsia sp.</em>, <em>Zygopecta modesta</em>, and <em>Hindia sphaeroidalis</em> are occasionally seen.</td>
</tr>
</tbody>
</table>
NOTES ON DISTRIBUTION OF THE BROWNSPORT GROUP.

The general distribution of the various late Niagaran formations in the valley of the Tennessee River has been noted briefly in the preceding pages. Leaving this area and proceeding toward the Central Basin of Tennessee, the most eastern exposure of the Brownsport, according to Foerste, is along the Nashville, Chattanooga, and St. Louis Railroad, at the bridge 1 1/4 miles west of Pegram, about 21 miles east of Dixon, Tennessee. Here, following Foerste's description and section, the base of the Brownsport is a very fossiliferous clay, 8 feet in thickness, directly overlaid by Mesodevonic limestone. The limestones underlying this clay bed are referred by Foerste to the Dixon and Lego, the latter formation being made the equivalent of the Louisville. We can not agree with these determinations and believe the sections presented below will prove at least that his so-called basal beds of the Brownsport are the equivalent of the coral beds of the Lobelville formation, while the argillaceous limestone at the base of this section appears to belong to the lower part of the same formation.

Section at railroad bridge, 1 1/4 miles west of Pegram, Tennessee.

Devonian.

Chattanooga black shale. Lower layers with rather numerous linguloids

Hardin sandstone. Rather massive, sandy shales with Cycloras and linguloids

Mesodevonic limestone:

(b) Massive, arenaceous limestone with Tropidoleptus carinatus, Ancyrocrinus, etc. (Hamilton)

(a) Coarsely crystalline, massive, crinoidal limestone with Polypora shumardi, Cystodietya yilherti, Nuclceocrinus verneullianus, etc. (Onondaga)

Silurian.

Lobelville formation.

Fossiliferous blue and yellow shales holding the following species: Calceola tennesseensis, Farosites discus, F. farosus, F. ravena, Thecla major, T. minor, Heliolites intertextus, H. subturritus, H. microporatus, Halyssites cuneatus, Chaladopora reticulata, Atypha reticularis niagarensis, Spirifer foggi, Uncinatus stricklandi, Meristina maria-roemeri, Wilsonia saffordi, etc.

Argillaceous limestone with a few shale layers

Fossils few, but several corals of species occurring in the shale above were noted.

A very instructive Niagaran section is exposed in the quarry 3 miles west of Newsom, Tennessee, at the end of a short spur from the Nashville, Chattanooga, and St. Louis Railroad. At the time the section at this locality was made the quarry face was so steep that

\[a \text{ Journal of Geology, XI, 1903, p. 577.}\]
it was almost impossible to collect from the various strata in place, but enough paleontologic evidence was secured to indicate the correctness of the correlations indicated.

Section at quarry, 3 miles west of Newson, Tennessee.

<table>
<thead>
<tr>
<th>Strata</th>
<th>Feet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Devonian (Chattanooga) black shale</td>
<td>0</td>
</tr>
<tr>
<td>Devonian limestone (Onondaga)</td>
<td>6</td>
</tr>
<tr>
<td>Silurian.</td>
<td></td>
</tr>
<tr>
<td>Lobelville formation.</td>
<td></td>
</tr>
<tr>
<td>Yellow shales with the coral fauna of the Lobelville formation</td>
<td>½</td>
</tr>
<tr>
<td>Massive, argillaceous limestone in upper part and more crystalline</td>
<td></td>
</tr>
<tr>
<td>toward bottom. Probably equivalent to lower part of Lobelville</td>
<td>15</td>
</tr>
<tr>
<td>formation</td>
<td></td>
</tr>
<tr>
<td>Waldron shale.</td>
<td></td>
</tr>
<tr>
<td>Fossiliferous blue shales and limestones holding the typical Waldron</td>
<td></td>
</tr>
<tr>
<td>fauna.</td>
<td></td>
</tr>
<tr>
<td>(d) Blue limestone</td>
<td>1</td>
</tr>
<tr>
<td>(c) Blue shale</td>
<td>½</td>
</tr>
<tr>
<td>(b) Massive limestone</td>
<td>3</td>
</tr>
<tr>
<td>(a) Typical Waldron shales, dark blue in color and very</td>
<td>4-5</td>
</tr>
<tr>
<td>fossiliferous</td>
<td></td>
</tr>
<tr>
<td>Laurel limestone (to base of section).</td>
<td></td>
</tr>
<tr>
<td>Massive gray and pinkish crystalline limestone</td>
<td></td>
</tr>
</tbody>
</table>

Proceeding northeastward from the West Tennessee geanticline, no strata older than the Mississippian are encountered until the Wells Creek Basin, just southwest of Cumberland City on the Cumberland River, is reached. Here a local uplift exposes strata as old as earliest Ordovician. Foerste has studied this area and the following section is compiled from his notes. In this the identification of the Dixon and Brownsport limestones is of particular interest, and the general section is apparently that prevailing in the Tennessee River Valley.

Section at Wells Creek Basin, Tennessee.

<table>
<thead>
<tr>
<th>Strata</th>
<th>Feet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Devonian black shale</td>
<td>0</td>
</tr>
<tr>
<td>Helderbergian (Linden) limestone</td>
<td>0</td>
</tr>
<tr>
<td>Brownsport limestone.</td>
<td></td>
</tr>
<tr>
<td>Astrapospongia meniscus found near base</td>
<td>170</td>
</tr>
<tr>
<td>Dixon formation. Dark, red brick clay rock</td>
<td>32</td>
</tr>
<tr>
<td>&quot;Glenkirk&quot; limestone (Laurel, Waldron, and Lego combined)</td>
<td>0</td>
</tr>
<tr>
<td>Osgood limestone. Red clayey shales and limestones</td>
<td>21</td>
</tr>
<tr>
<td>&quot;Clinton&quot; limestone. Massive white limestone; cherty in upper part</td>
<td>22</td>
</tr>
<tr>
<td>Ordovician (&quot;Saltillo&quot;) limestone</td>
<td></td>
</tr>
</tbody>
</table>

In East Tennessee and in the Appalachian in general, Niagaran strata proper are wanting, with the exception of several small areas near Sneedville, Hancock County, Tennessee. In his Geology of Tennessee, Professor Safford described the occurrence of the Meniscus limestone, giving it the special name Sneedville limestone, in the

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*Journal of Geology, XI, 1903, p. 630.*
Powell Mountain group of ridges in East Tennessee, and publishes a section in which the Meniscus limestone is identified between the Dyestone (Rockwood) group and the Black Shale. *Halysites catenula tus* and other fossils were noted. We have not visited this locality, but specimens in the U. S. National Museum collections indicate the probable equivalence of this limestone with the coral beds of the Lobelville formation in West Tennessee. This identification is in keeping with the facts concerning the wide extension of this coral zone, but the section here must be restudied before a definite correlation can be made. Professor Safford notes a locality 4 miles southeast of the salt works in Anderson County where a cherty bed in contact with the black shale is well charged with corals. The fauna in the U. S. National Museum collections noted from Sneedville are *Halysites catenulatus* (large and small mesh), *H. near nesus*, *Favosites favosus*, *F. venustus*, *Heliotites cfr. micropora*, and several species of large Orthocerata.

In southern Indiana and northern Kentucky the strata of Silurian age between the Waldron shale and the overlying Devonian rocks have been designated the Louisville limestone by Foerste. The publications of Hall, Nettelroth, Lyon, Davis, and others have made known a large fauna from these strata, but, to the best of our knowledge, no detailed account of their stratigraphy has ever been printed. Such an account can not now be furnished, but enough is known to indicate that the Niagaran limestone in the immediate vicinity of Louisville, Kentucky, have representatives of the Coral and possibly the Conchidium beds of West Tennessee. The uppermost 8 feet of the Louisville Silurian section are of argillaceous cherty limestone, holding great numbers of the corals listed on page 437. Beneath these layers are about 30 feet of strata similar lithologically but containing fewer corals. The next lower rocks are exposed along Bear Grass Creek, where the strata are seen to be blue in color and cherty. Here fossils are scarcer, but the prevailing forms are pentameroid brachiopods. The Louisville limestone, therefore, in the immediate vicinity of Louisville is apparently equivalent to our Lobelville formation and not to the entire post-Dixon Niagaran formations of West Tennessee.

*Geology of Tennessee, 1869, p. 294.*
ON THE OCCURRENCE OF CALCIUM SULPHIDE (OLD-HAMITE) IN THE ALLEGAN METEORITE.

By Wirt Tassin,
Assistant Curator, Division of Mineralogy, U. S. National Museum.

The occurrence of calcium sulphide in meteorites was first noted in 1862 by N. Story-Maskelyne, in the Bustee stone and by him called "Oldhamite." In 1870, the same author fully described this mineral as occurring in small, isotropic, chestnut brown nodules having a cubic cleavage; a hardness of 3.5 to 4; a specific gravity of 2.58; and of the following composition:

\[
\begin{array}{cc}
\text{CaS} & \text{MgS} \\
\text{A} & 89.369 & 3.246 \\
\text{B} & 90.244 & 3.264
\end{array}
\]

The magnesium sulphide present being regarded by the author either as a constituent of the mineral or as a mechanically mixed ingredient.

Maskelyne, in the same paper, states that Oldhamite is apparently present in the Bishopville aerolite, and that it occurs in small, nearly round, spherules embedded in enstatite or augite, or in a mixture of both.

Flight, in some further work on the mineral separated from the Bustee stone, noticed that when slightly warmed and illuminated by burning magnesium wire, Oldhamite emitted an orange-colored phosphorescence. Later Friedheim found in the meteorite from Nagaya, a very small amount of calcium sulphide. In the Aubres stone, Brezina calls attention to the occurrence of minute, yellowish to reddish-brown spherules which resemble the Oldhamite as described by Maskelyne. Merrill, in his paper on the Hamblen meteorite.

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\[c\] Chapter in the History of Meteorites, London, 1887, p. 119.
\[e\] Meteoritensamm. k. k. nat-hist. Hofmus., May 1895, X, p. 239.

calls attention to the possible presence of Oldhamite, which, though not visible in the thin sections or in the mass, is suggested by his qualitative and micro-chemical tests.

While working over some fragments of the Allegan aerolite with especial reference to the separation of its chromite and schreibersite contents, it was noticed that certain portions gave, while being treated, a marked evolution of hydrogen sulphide under conditions that led to the belief that some sulphide other than troilite was present.

Acting upon this, a portion of the fine powder was carefully freed from all magnetic particles and analyzed with the following results:

\[
\begin{align*}
\text{Ca} & \quad 9.12 \\
\text{S} & \quad 7.30 \\
\text{SiO}_2 & \quad 39.95 \\
\text{Al}_2\text{O}_3 & \quad 0.09 \\
\text{FeO} & \quad 14.40 \\
\text{MgO} & \quad 29.40 \\
\end{align*}
\]

which may be calculated to an olivine-enstatite mixture with 16.66 per cent of calcium sulphide.

An analysis of another fragment of the meteorite, in which only the calcium and sulphur were determined gave:

\[
\begin{align*}
\text{Ca} & \quad 4.070 \\
\text{S} & \quad 2.632 \\
\end{align*}
\]

a result that is in close agreement with the figures required for calcium sulphide.

In most of the previous descriptions of the occurrence of calcium sulphide in meteorites attention is called to its honey-yellow to reddish-brown color, when freed from incrusting calcium sulphate, and to its nodular form. The material here described was entirely free from sulphate. Exposure to strong sunlight or to burning magnesium did not cause a visible phosphorescence. It did not occur in nodules having a honey-yellow to chestnut-brown color and all attempts on my part to distinguish it under the microscope failed. Doctor Merrill, who made a complete petrographic examination of the meteorite, tells me that he found nothing that resembled Oldhamite.

It is not possible to describe the appearance of this calcium sulphide except by saying that neither macroscopically nor microscopically is it to be distinguished from the dust-like ash-gray interstitial material of the groundmass. It is present in aggregations of very fine grains in certain portions of the Allegan stone, but the great friability of the meteorite and the extreme difficulty of determining the mineral character of the interstitial material of the groundmass renders its recognition almost impossible.

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THE NOMENCLATURE OF THE RECENT CRINOIDS.

By Austin Hobart Clark,
Of the United States Bureau of Fisheries.

In view of the present demand for the strict application of certain fixed and definite rules governing all cases in zoological nomenclature, it has become necessary to carefully review the literature on the recent crinoids in an effort to unravel the somewhat complicated tangle into which their nomenclature has been thrown, owing to the unfortunate carelessness of a few of the writers on the subject.

Mr. F. A. Bather has already made a beginning in attempting to show where we stand in reference to the genera of Pentacrinitidae (not Pentacrinidae), and to the fossil genus Encrinus. Although it will be shown that his conclusions are incorrect, except in the case of Isocrinus and Metacrinus (and the first references to both of these are omitted), the fact remains that he was the first to realize the necessity of a revision of the nomenclature of the recent crinoids, and to act upon that realization.

The present paper is a continuation of the work begun by Mr. Bather; an attempt is made to bring together all the generic and specific names which have ever been applied to recent crinoids (and names of genera which have been used for recent species), giving the correct first reference, the types of genera and the type-localities of species, the derivation of the names, and the present locality of the type specimen of each species, so far as known. The revised international code has been followed strictly. It has not been considered worth while in this connection to enter into detail in regard to such genera as Astrophyton, Ophiura, and Euryale, belonging to quite a different class of animals, as their use can in no way cause any confusion. In the numerous cases where a name has subsequently been emended or misspelled, each variation is shown, as the changes are often quite misleading; while eschrichtii, eschrichtii, and eschrichti for eschrichtii, Actinomedra, Actinometer, and Actinometra for Actinometra are obvious enough, mawonema and mucronata for macronema, variispina for variipinna, crassispina for crassipinna, serota for sentosa, aster for

asteria, monobrachius for macrobrachius, and radiata and aldrichianus for pectinata and aldrichianus are not quite so evident.

More or less confusion has arisen from the use by Professor von Graff and others of a number of manuscript names furnished by Prof. C. Semper and Dr. P. H. Carpenter, as many of the species to which they refer have never been described, or have been described under different names. The manuscript names published by Doctor Lütken and by Dujardin and Hupé seem to have entirely escaped the notice of subsequent workers. In the case of a nomen nudum, the name is referred to the first author who published it; if the same species to which the original name referred was subsequently described under that name, the name of the species is credited to the one who first described it; but the first reference to it as a nomen nudum is cited. Many names ran for years as nomina nuda before being definitely attached to any species, while a large amount of anatomical work has been done on species mentioned by name, but never properly described. Such a case is that of Actinometra nigra, the anatomy of which was worked out in part, and a number of figures of arm sections and other features, interesting from an anatomical, but wholly worthless from a systematic point of view, published. Finally, after twelve years from the first appearance of the name, a meager summary of its specific characters is found, but no good description has ever been published. While anatomical characters constitute an "indication" in the strict sense of the term, they are largely worthless, so far as our present knowledge goes, for correct specific determination; but, as names based on them are not nomina nuda, they must be considered in the same way as a description, and these names must receive the same treatment as names accompanied by a satisfactory diagnosis.

In regard to the names published by Prof. F. J. Bell in 1882 accompanied by certain so-called specific formulae, the formulae must be taken as constituting descriptions, however non-diagnostic they may be, and Professor Bell had no right to change certain of the names when, two years later, he published detailed descriptions. The same applies to the formulas published by Doctor Carpenter in footnotes in his report on the Challenger stalked crinoids; he evidently supposed them to be diagnostic, and it becomes necessary to date many of his free crinoids from these formulas given in 1884, instead of from the detailed descriptions published four years later.

In addition to specific names applied to recent species, in the genera Eudicrinus, Attelecrinus, Comatula, Antedon, and Actinometra those applied to fossil species have also been included, to guard against the possibility of future writers using these names over again. These are indicated by a dagger (†); a dagger preceding a generic name indicates that all the included species are fossil.

The present paper is in no way a synonymy of the group, and so remarks under the respective names are avoided so far as possible; but
it has been thought best to here call attention to certain flagrant errors, for instance where, as in the case of Antedon capensis, Antedon salateri, Antedon magnicirra, Antedon scalaris, and Antedon basset smithi, species have been described in "groups" widely different from those in which they belong. These cases, however, are remarkably few; and the student of the recent crinoids is to be congratulated upon the masterly way the group has been handled by practically every worker upon it, and the excellent shape in which it has been left. Dr. P. H. Carpenter, especially, in his two magnificent monographs and his numerous other writings, giving us the results of years of study and research, has, by his investigations of the types of almost all of the earlier species, laid the foundation for a solid, stable nomenclature.

I wish here to express my appreciation of the kindness of Dr. Leonard Stejneger and Dr. Charles W. Richmond, of the U. S. National Museum, who have generously lent their aid in elucidating many difficult nomenclatorial problems.

Actinomedra von Graff, 1883.


Actinometer Springer, 1903.


Actinometra J. Müller, 1841.

1841. J. Müller, Wiegm. Archiv für Naturgesch., 1, p. 140. Type.—Actinometra imperialis J. Müller (n. sp.) = Comatula solaris Lamarck, 1816. (See under Comatula.) aktiz=a ray + μετρεω (in passive) to be surrounded.

† Actinometra abnormis.

Actinometra affinis P. H. Carpenter, 1882. ("Lütken MS."")


A few characters only are given; but such as they are they may be found to have systematic value; the name can not be considered a nomen nudum.

Actinometra albonotata Bell, 1882.


See Actinometra solaris var. albonotata.

Proc. N. M. vol. xxxiv—08—29
Actinometra alternans P. H. Carpenter, 1881.
_Type-locality._—Unknown.
_alternans_ = changing, varying.
Leyden Museum.

Actinometra annulata Bell, 1882 (not Comatula annulata Risso, 1826).
_Type-locality._—Cape York, North Australia.
_annulata_ = ornamented with rings.
British Museum.

Actinometra armata P. H. Carpenter, 1879. ("Semper MS.")
_A nomen nudum._
_Type-locality._—Philippines. Prof. C. Semper.
_armata_ = armed.

Actinometra bellii P. H. Carpenter, 1888.
1888. P. H. Carpenter, Challenger Reports, XXVI, Zoology, p. 339, pl. lxiv, figs. 1, 2; detailed description, p. 334; first mentioned, p. 59.
_Type-locality._—10° 30' south latitude, 142° 18' east longitude (Prince of Wales Channel, near Cape York, north Australia); 8 fathoms. H. M. S. Challenger.
Prof. F. Jeffrey Bell.
British Museum.

Actinometra blakei von Graff, 1883. ("P. H. Carpenter MS.")
_A nomen nudum._
_A nomen nudum._
U. S. S. Blake.

It is unfortunate that this name, together with Actinometra carinata and a number of others, should have been allowed to remain as _nomen nudum_ so long; but, as it is known to what species Doctor Carpenter applied these names in the manuscript list he furnished Professor von Graff, I look forward to seeing them described in the near future.

Actinometra brachymera Lütken, 1877.
_A nomen nudum._
_A nomen nudum._
$\beta \rho\alpha \chi \upsilon \zeta =$ short $+$ $\mu \rho \rho \delta \varsigma =$ joint.
Actinometra brasiliensis P. H. Carpenter, 1888. ("Lütken MS.")
A nomen nudum.

brasiliensis = of Brazil.

† Actinometra calloviensis.

† Actinometra cheltonensis.

Actinometra coccodistoma P. H. Carpenter, 1883. ("Mus. Paris MS."")
A nomen nudum.

κόκκος = a kernel, a berry + διστομός = with two openings.

Actinometra conjungens P. H. Carpenter, 1888.
Editorial error for Antedon conjungens.

Actinometra coppingeri Bell, 1882.

Type-locality.—Flinders; Clairmont (Cape York Peninsula, Queensland). H. M. S. Alert.
Dr. R. W. Coppinger, surgeon of the Alert. British Museum.

Actinometra difficilis P. H. Carpenter, 1888.
A nomen nudum.

dificilis = difficult.

Actinometra discoidea P. H. Carpenter, 1888.
A nomen nudum.

A nomen nudum.


Type-locality.—Caribbean Islands; 88-118 fathoms. U. S. S. Blake.

δισκοειδής = discoidal.

Actinometra dissimilis P. H. Carpenter, 1884.
See also P. H. Carpenter, Challenger Reports, XXVI, Zoology, p. 337 (1888).
Type-locality.—Zamboanga; 10 fathoms. H. M. S. Challenger.

This name is available for a varietal form (according to Doctor Carpenter) of the species called *Actinometra nobilis*,

dissimilis = unlike.

British Museum.

**Actinometra distincta** P. H. Carpenter, 1888.

1888. P. H. Carpenter, *Challenger* Reports, XXVI, Zoology, p. 295, pl. iv, fig. 1; first mentioned, p. 57.

Type-locality.—Zamboanga, Philippines; 10 fathoms. H. M. S. Challenger.

distincta = distinguished.

British Museum.

**Actinometra divaricata** P. H. Carpenter, 1888.

1888. P. H. Carpenter, *Challenger* Reports, XXVI, Zoology, p. 330, pl. lxiii, figs. 6–8; detailed description, p. 332; first mentioned, p. 15.

Type-locality.—Banda (Moluccas); 17 fathoms. H. M. S. Challenger.

divaricata = spreading.

British Museum.

**Actinometra duplex** P. H. Carpenter, 1888.


Type-locality.—Banda (Moluccas); 17 fathoms. H. M. S. Challenger.

duplex = broad, large.

British Museum.

**Actinometra elongata** P. H. Carpenter, 1888 (not *Comatula elongata* J. Müller, 1849).

1888. P. H. Carpenter, *Challenger* Reports, XXVI, Zoology, p. 311, pl. lvii, figs. 2–4; first mentioned, p. 45.

Type-locality.—Banda (Moluccas). H. M. S. Challenger.

elongata = elongate.

British Museum.

In 1849 J. Müller (Abh. d. k. Ak. d. wiss., 1847 [1849], p. 257) placed the species which in 1841 he described as *Alecto elongata* in the genus *Comatula*. Now, although he did this wrongly (*Alecto elongata* being referable to *Himerometra*), the fact remains that he made the combination, thus invalidating the specific name *elongata*, in so far as *Comatula* (= *Actinometra*) is concerned. The species may be renamed *Comatula helianthus*.

† **Actinometra formæ.**

**Actinometra fusca** Lütken, 1877.


A nonen nudum.

A nomen nudum.

_fusca_ = brown, dark.

**Actinometra gracilis** Lütken, 1874.


A nomen nudum.

_gracilis_ = slender.

**Actinometra gracilis** Hartlaub, 1890 (not **Actinometra gracilis** Lütken, 1874).


_Type-locality_, Pulo Edam.

_gracilis_ = slender.  

Lütken’s **Actinometra gracilis**, being a nomen nudum, does not, of course, invalidate this.

**Actinometra grandicalyx** P. H. Carpenter, 1882.


_Type-locality_.—Canton, China.

_grandis_ = large + _calyx_ = “calyx.”  

Hamburg Museum.

† **Actinometra guirandi**.

**Actinometra guttata** Hartlaub, 1893. (‘Lütken MS.’)


A nomen nudum.

_guttata_ = spotted.

**Actinometra imperialis** J. Müller, 1841.


_Type-locality_.—Unknown.

_imperialis_ = imperial.  

Vienna Museum.

**Actinometra intermedia** Bell, 1884.


_Type-locality_.—Albany Island.  

_intermedia_ = intermediate.  

British Museum.

**Actinometra intricata** Lütken, 1874.


A nomen nudum.


A nomen nudum.

_intricata_ = intertwined.

Doctor Carpenter in many different places introduces names credited to “Lütken MS.;” but it seems to have entirely escaped his notice that many of these names were really published by
Doctor Lütken in the lists of crinoids given in the catalogue of the collections in the Museum Godetfroy. The names as given by Doctor Lütken are pure *nomina nuda*, followed by a locality.

**Actinometra iowensis** Springer, 1902.

*Type-locality.*—Florida reefs; ½ fathom. Dr. C. C. Nutting. *iowensis*; for the University of Iowa. Springer Collection.

**Actinometra jukesii** P. H. Carpenter, 1879.

*Type-locality.*—Northeast coast of Australia. Professor Jukes. Professor J. Bute Jukes.
This name, in common with all others ending in "**ii**" was later emended by Doctor Carpenter, appearing as *jukesi*.

**Actinometra lineata** P. H. Carpenter, 1880.

1880. P. H. Carpenter, Journ. Linn. Soc. (Zool.), XV, p. 198, pl. xii, figs. 27 a, b; better description on p. 213.
*Type-locality.*—Bahia, Brazil; 7–20 fathoms. H. M. S. Challenger.
*lineata* = marked with lines. British Museum.

**Actinometra litoralis** Pfeffer, 1900.

Emendation.

**Actinometra littoralis** P. H. Carpenter, 1888.

1888. P. H. Carpenter, *Challenger* Reports, XXVI, Zoology, p. 330, pl. lxvii, figs. 1, 2; detailed description, p. 346; first mentioned, p. 15.
*Type-locality.*—Banda (Moluccas): 17 fathoms. H. M. S. Challenger.
*littoralis* = of the seashore. British Museum.

†**Actinometra loveni**.

**Actinometra macrobrachius** Hartlaub, 1890.

*Type-locality.*—China Sea.

**Actinometra maculata** P. H. Carpenter, 1888.

1888. P. H. Carpenter, *Challenger* Reports, XXVI, Zoology, p. 304, pl. v, figs. 1–d; pl. iv, fig. 2; detailed description, p. 307; first mentioned, p. 20.
*Type-locality.*—10° 30' south latitude, 142° 18' east longitude (Prince of Wales Channel, near Cape York, north Australia); 8 fathoms. H. M. S. Challenger.
*maculata* = spotted. British Museum.
Actinometra magnifica P. H. Carpenter, 1884.


Type-locality.—Philippines.
magnifica=splendid, magnificent.

Actinometra meridionalis var. carinata von Graff, 1883 (not Comatula carinata, Lamarck, 1816).

A nomen nudum.

1884. von Graff, Challenger Reports, X, Zoology, Pt. 27, pp. 15, 16, 19.
A nomen nudum.
carinata=keeled.

Actinometra meridionalis var. quadrata von Graff, 1883.

A nomen nudum.

A nomen nudum.
quadrata=quadrate (in reference to the shape of the brachials).

Actinometra meyeri P. H. Carpenter, 1882.

Type-locality.—Australia.

Dr. A. B. Meyer, formerly director of the Dresden Museum.

Hamburg Museum.

Actinometra monobrachius Minchin, 1892.

1892. Minchin, in Zoological Record for 1891, Echinodermata, p. 80.
A nomen nudum.

μόνος=single, βραχίων=arm.

There can be no excuse for quoting macrobrachius as monobrachius; the absurdity of the latter in reference to crinoids should have been obvious. The mistake is the more unfortunate coming as it does in an index to the literature on the group.

Actinometra morsei von Graff, 1884.

A nomen nudum.

Prof. E. S. Morse, of Salem, Mass.

†Actinometra mülleri.
Actinometra multibrachiata P. H. Carpenter, 1888.

1888. P. H. Carpenter. Challenger Reports, XXVI, Zoology, p. 295, pl. lvi, figs. 3, 4; detailed description, p. 299; first mentioned, p. 27.

Type-locality.—Banda (Moluccas); 17 fathoms. British Museum.

multibrachiata=many armed.

Actinometra multifida P. H. Carpenter, 1888 (not Alecto multifida J. Müller 1841=Comatula multiradiata Lamarck= Asterias multiradiata Linnaeus [not Asterias multiradiata Schweigger nor Comatula multiradiata Goldfuss nor Comatula multiradiata Leuckart]).


Type-locality.—Not given.

multifida=divided into many parts. Paris Museum.

Alecto multifida of Müller, according to the author's own statement, is clearly a synonym of Comatula multiradiata Lamarck. Müller took the ground that Lamarck's description was not identifiable, but that the same name had been applied by Goldfuss to quite a different species, which was adequately described, so that the name held for the latter: multifida was proposed to cover Lamarck's type specimens. We know now what the Comatula multiradiata of Lamarck really is, and that it is the same as one of the species included by Linnaeus in his Asterias multiradiata; therefore, it is really the Comatula multiradiata of Goldfuss which needs a new name, and the Alecto multifida of Müller becomes a pure synonym of Comatula multiradiata Lamarck. This leaves Actinometra multifida P. H. Carpenter (not of Müller) without a name; it may be called Comaster carpenteri.

Actinometra mutabilis von Graff, 1884. ("P. H. Carpenter MS.")


mutabilis=changeable.

According to Carpenter (Challenger Reports, XXVI, Zoology, 1888, p. 55) this name originated with Lütken.

Actinometra nigra P. H. Carpenter, 1888. ("Semper MS.")


A nomen nudum.


Type-locality.—Bohol, Philippines. Prof. C. Semper.

nigra=black.

Actinometra nobilis P. H. Carpenter, 1884.


Type-locality.—11° 37' north latitude, 123° 31' east longitude (Philippines); 18 fathoms. H. M. S. Challenger.

nobilis=noble; distinguished. British Museum.

Actinometra notata P. H. Carpenter, 1889.


1889. P. H. Carpenter, Journ. Linn. Soc. (Zool.), XXI, p. 312. Type-locality.—King Island, Mergui Archipelago (off Tenasserim); "sublittoral." Dr. John Anderson.

notata=distinguished. British Museum.

Actinometra parvicurva Springer, 1901.


Actinometra paucicirra Bell, 1882.


Type-locality.—Prince of Wales Channel, or Thursday Island (near Cape York). H. M. S. Alert.

pauci=few+cirra="cirri." British Museum.

Actinometra peregrina Bell, 1891.


peregrinus=exotic. British Museum.

Actinometra peronii P. H. Carpenter, 1881.


M. François Péron. Leyden Museum.
Actinometra polymorpha P. H. Carpenter, 1879.
A nomen nudum.

1879. P. H. Carpenter, Trans. Linn. Soc. (Zool.), 2d ser., II, p. 51, pl. 11, figs. 2-11; pl. 11, figs. 1-10 (except fig. 4); pl. 14, figs. 1-24; pl. 17, figs. 1 a-d, 2 a-d, 3 a-d, 4 a-d, 5 a-d, 6 a-d; pl. 18.

_Type-locality._—Bohol, Philippines. Prof. C. Semper.

Actinometra quadrata P. H. Carpenter, 1888 (not Actinometra meridionalis var. quadrata von Graff 1883).
1888. P. H. Carpenter, Challenger Reports, XXVI, Zoology, p. 330, pl. lxii, fig. 1; detailed description, p. 331; first mentioned, p. 45.

_Type-locality._—Tongatabu Reefs (Tonga Islands). H. M. S. Challenger.

_quadrata=_quadrate (in reference to the shape of the brachials). British Museum.

Actinometra ranvilliensis.

Actinometra regalis P. H. Carpenter, 1888.

_Type-locality._—Banda, 17 fathoms. H. M. S. Challenger.

_regalis=_regal.

British Museum.

Actinometra robusta P. H. Carpenter, 1879. ("Lütken MS.")

_Type-locality._—Australia.

_robusta=_sturdy, robust.

Hamburg Museum.

Actinometra robustipinna P. H. Carpenter, 1881.
1881. P. H. Carpenter, Notes from the Leyden Museum, III, p. 177; detailed description, p. 201.

_Type-locality._—Moluccas. M. Macklot.

_robustus=_stout + _pinna_= "pinnules._

Leyden Museum.

The type of this species is a much mutilated specimen, without the highly characteristic cirri; for the first really satisfactory description of this common form see Kæhler, Rev. Suisse Zool., III, p. 290 (1895).
Actinometra schlegelii P. H. Carpenter, 1881.

Type-locality.—? East Indies.
Professor Hermann Schlegel. Leyden Museum.

Actinometra sentosa P. H. Carpenter, 1888.

1888. P. H. Carpenter, Challenger Reports, XXVI, Zoology, p. 317, pl. lxxvi, figs. 4–6; detailed description, p. 325; first mentioned, p. 43.
Type-locality.—Banda. H. M. S. Challenger.
sentosa = thorny. British Museum.

Actinometra sertosa Latter, 1889.

1889. Latter in Zoological Record for 1888, Echinodermata, p. 15.
sertos = a festoon.
Editorial error for Actinometra sentosa.

Actinometra simplex P. H. Carpenter, 1888 (not Comatula simplex P. H. Carpenter 1879 and 1881).

1888. P. H. Carpenter, Challenger Reports, XXVI, Zoology, p. 311, pl. lix, fig. 1; detailed description, p. 312; first mentioned, p. 58.
Type-locality.—Admiralty Islands; 16 to 25 fathoms. H. M. S. Challenger.
simplex = simple. British Museum.
This species has been renamed Comatula orientalis.

Actinometra solaris var. albonotata Bell, 1884.

Type-locality.—Albany Island. H. M. S. Alert.
albus = white + nota = marked. British Museum.
This is the same species which was named by Bell in 1882 Actinometra albonotata.

Actinometra stellata P. H. Carpenter, 1879.

A nomen nudum.

Type-locality.—Fiji.
stellata = star-shaped.
In the later reference Doctor Carpenter gives a few non-diagnostic characters; but in 1881 and 1888 he merely cites the name in the synonymy of Phanogena typica of Lovén.
Actinometra stelligera P. H. Carpenter, 1880.
Type-locality.—About 19° 6' south latitude, 178° 18' east longitude (near Kandavu Fiji); 255, 610, or 210 fathoms. H. M. S. Challenger.
*stelligera* = ornamented with a star.

British Museum.

Actinometra stewarti P. H. Carpenter, 1888.
*A nomen nudum.*
Prof. Charles Stewart.

Actinometra strata P. H. Carpenter, 1888.
*A nomen nudum.*

strata = spread out.

Actinometra strotata P. H. Carpenter, 1884.
*A nomen nudum.*
Type-locality.—Cape York, Australia.
στρωτός = spread out.

This refers to the same species as does the preceding.

Actinometra tenax Lütken, 1874.
*A nomen nudum.*
*A nomen nudum.*
tenax = tenacious.

Actinometra trachygaster Perrier, 1886.
Emendation.
τραχύς = rough + γαστήρ = the ventral side.

Actinometra trachygaster Lütken, 1869.
*A nomen nudum.*
*A nomen nudum.*

τραχύς = rough + γαστήρ = the ventral side.

†Actinometra vagnasensis.
Actinometra valida P. H. Carpenter, 1888.

1888. P. H. Carpenter, Challenger Reports, XXVI, Zoology, p. 311, pl. lix, fig. 3; detailed description, p. 314; first mentioned, p. 58.

Type-locality.—10° 30' south latitude, 142° 18' east longitude (Prince of Wales Channel); 8 fathoms. H. M. S. Challenger.

valida = stout, robust. British Museum.

Actinometra variabilis Bell, 1882.


Type-locality.—Thursday Island. H. M. S. Alert.

variabilis = changeable. British Museum.

†Actinometra wurtembergica.

Actinometra (Comatula) armata P. H. Carpenter, 1876. ("Semper MS.")


A nomen nudum.

armata = armed.

Actrinometra Hartlaub, 1893.


Adelometra A. H. Clark, 1907.


Type.—Alecton angustiradia P. H. Carpenter, 1888.

ἀδηνός = obscure + metra.

Adelometra tenuipes A. H. Clark, 1908.


Type-locality.—Off Havana, Cuba; 211 fathoms. U. S. S. Albatross.


Actinometra P. H. Carpenter, 1881.

1881. P. H. Carpenter, Notes from the Leyden Museum, III, p. 204.

Typographical error.

Alecto Leach, 1815.


Type.—Alecto horrida Leach (n. sp.) (first species) not recognizable.

Ἀλκητίδα = Alecto, one of the Furies.

The genus Alecto has no standing whatever, as Alecto horrida is quite unrecognizable from the description or the figure, and
the type-specimen has been lost. In 1819 Schweigger (Beobachtungen auf Naturhistorischen Reisen. Berlin, 1819, p. 66) referred it to the Linnaean Asterias multiradiata, and figured certain parts of a specimen supposed to belong to the species. The figures, however, are as unrecognizable as those of Leach, but probably do not represent the Linnaean species as now restricted. The mere fact that he assigned Alecto horrida to Asterias multiradiata would seem to imply that the two were identical, in which case the Actinometra of Müller, 1841, and the Comatula of Lamarck, 1816, would become synonyms of Alecto, 1815; but it must be remembered that nothing was known of the specific, or even of the generic, characters of free crinoids until a much later date, and any multibrachiate form was considered "Asterias multiradiata Linnaeus," regardless of whether it belonged to the Antedonidae or Actinometridae. We find this well illustrated by Leuckart, who in 1859 (Isis, V, p. 612) referred to what is most probably Himicometra savignii (Müller) under the name of Comatula multiradiata. Therefore, in the absence of any proof as to which of the two families Alecto horrida really belonged, to say nothing of its specific relations, we can do nothing but consider it unrecognizable, and the generic name Alecto as quite meaningless.

**Alecto bennetti** J. Müller, 1841.


**Alecto carinata** Leach, 1815.


There can be little doubt that this is the same species as Comatula carinata Lamarck, 1816, as was suggested by Lamarck himself. The description, however, is quite useless, and the type has been lost. We know what Lamarck's species really is. Therefore, we must date the name from Lamarck, 1816, with Alecto carinata Leach, 1815, as a questionable synonym.

**Alecto echinophora** J. Müller, 1843.


**Alecto echinoptera** J. Müller, 1841.

1841. J. Müller. Wiegmann's Archiv für Naturgesch., I, p. 143. Type-locality.—Unknown. Captain Wendt. ἐκιντλός=rough, prickly + πτέρων=wing (i. e. arm).

Berlin Museum.

Doctor Carpenter believes, with good reason, that this species was originally brought from the West Indies.
NOMENCLATURE OF RECENT CRINOIDS—CLARK.

Alecto elongata J. Müller, 1841.
1841. J. Müller, Wiegmann’s Archiv für Naturgesch., I, p. 146.
_Type-locality._—New Guinea. Salomon Müller.
_elongata_ = lengthened, elongate. Leyden Museum.

Alecto eschrichtii J. Müller, 1841.
1841. J. Müller, Wiegmann’s Archiv für Naturgesch., I, p. 142; first mentioned, p. 139.
_Type-locality._—Greenland. Herr D. F. Eschricht.

Prof. D. F. Eschricht.
Anatomical and Zoological Museum, Berlin.
(See Comatula eschrichtii.)

Alecto europaea Leach, 1815.
_Type-locality._—“In oceano Europaeo.”
_europaea_ = European.

Alecto flagellata J. Müller, 1841. ("Mus. Leyd. MS.")
_Type-locality._—Unknown. Herr Brugmann.
_flagellata_ = whip-shaped (in reference to the arms).

Leyden Museum.

Alecto glacialis Leach (previous to 1830).
_Type-locality._—80° 26’ north latitude, 12° 30’ east longitude (off the northwest coast of Spitzbergen); 226 fathoms. H. M. S. Dorothea. Or, 80° 26’ north latitude, 11° 32’ east longitude (same locality); 250 fathoms. H. M. S. Trent.
 glacialis = icy (in reference to the habitat).

Type apparently lost.

I have not been able to find the original reference to this species in any of Doctor Leach’s published works. Nothing more than a sketch of the digestive system is given in any of the seven later references, so that the species is quite unidentifiable. This form was named _Alecto eschrichtii_ by J. Müller in 1841.

Alecto horrida Leach, 1815.
1815. Leach, Zool. Miscell., II, p. 61, pl. lxxx.
Not recognizable.
_horridus_ = bristly, prickly, uncouth. Type lost.

Alecto japonica J. Müller, 1841.
_Type-locality._—Japan. Herr von Siebold.
_japonica_ = Japanese.

Leyden Museum.
Alecto meridionalis Agassiz and Agassiz, 1865. ("A. Agassiz MS.")
_Type-locality._—Coast of South Carolina, United States.
 meridionalis=southern. Museum of Comparative Zoology.

Alecto multifida J. Müller, 1841.
1841. J. Müller, Wiegmann's Archiv für Naturgesch., I, p. 147; first mentioned, p. 144.
_multifida_=divided into many parts.

_Alecto multifida_ was based on the specimens which served Lamarck as the basis of his description of Comatula multiradiata, and which (together with the Linnaean types of _Asterias multiradiata_) have subsequently been carefully examined and specifically determined by Doctor Carpenter. Müller took the ground that these specimens are not specifically identical with that described as _Comatula multiradiata_ by Goldfuss, and that, whereas Goldfuss's description is diagnostic and Lamarck's is not, the name _multiradiata_ should be retained for the form adequately described, i. e., _Comatula multiradiata_ Goldfuss, and a new name should be conferred on Lamarck's types. It is unnecessary to state that, as we know exactly what the _multiradiata_ of Linnaeus and Lamarck is, the name must be retained for that species, and Müller's _multifida_, being proposed merely as a substitute, becomes a synonym of it.

Alecto novæ-guineæ J. Müller, 1841. ("Mus. Leyd. MS.")
_Type-locality._—Eidouma, New Guinea. Salomon Müller. 

Alecto palmata J. Müller, 1841.
_Type-locality._—India. Herr D. F. Eschricht. 

Alecto parvicirra J. Müller, 1841.
_Type-locality._—Unknown. 
_parvus_=small; _cirra_="cirri." Paris Museum.

Alecto petasus Düben and Køren, 1844.
_Type-locality._—Swedish coast, near Fiskebäckskilh in Bohuslän.
_πέτασος_=a spreading or broad-brimmed hat.

Alecto phalangium J. Müller, 1841.
1841. J. Müller, Wiegmann's Archiv für Naturgesch., I, p. 142; first mentioned, p. 140.
Type-locality.—Mediterranean Sea; Nice and Naples. Doctor Peters. Berlin Museum.

Alecto pollyarthra J. Müller, 1841. 1841. J. Müller, L’Institut for October 21, 1841, p. 357. Typographical error.

Alecto polyarthra J. Müller, 1841. 1841. J. Müller, Wiegmann’s Archiv für Naturgesch., I, p. 144. Type-locality.—Unknown. πολύς = many + ἀρθρόα = segments. Berlin Anatomical Museum. Not recognizable; the species is founded on some arm fragments.


Alecto savignii J. Müller, 1841. 1841. J. Müller, Wiegmann’s Archiv für Naturgesch., I, p. 144. Based on Comatula multiradiata Audouin (not Asterias multiradiata Linnéus) in Savigny, Description de l’Égypte; Échinodermes pl. 1, figs. 1–6 (1817). Type-locality.—Red Sea. M. Savigny. M. Marie Jules César Lelorgne de Savigny. Berlin Museum. The specimen which served as the basis for Müller’s description was brought from the Red Sea by Hemprich and Ehrenberg, and is now in the Berlin Museum. This name has been very generally emended to “savignyi.”


Alecto wahlbergii J. Müller, 1843.

Type-locality.—Port Natal. Herr J. A. Wahlberg.

Alectro Say, 1825.

This is clearly an emendation of Alecto, as the genus is referred to Leach.

Alectro dentata Say, 1825.

Type-locality.—Great Egg Harbor, New Jersey, United States.
Mr. Titian Peale.

Alectro Say, 1825.

Type-locality.—Great Egg Harbor, New Jersey, United States.
Mr. Titian Peale.

typa = with teeth. Museum of the Philadelphia Academy.

Antedon de Fréminville, 1811.

Type.—Antedon gorgonia de Fréminville (n. sp.) = Asterias bifida Pennant. 1777 = Comatula mediterranea Lamarck. 1816.
Aθηνόςαν, ("the flowery one") a nymph (from Pausanias).

Antedon abbotii A. H. Clark, 1907.

Type-locality.—Pulo Taya, China Sea. Dr. W. L. Abbott.

Antedon abyssicola P. H. Carpenter, 1888.

1888. P. H. Carpenter, Challenger Reports, XXVI, Zoology, p. 158, pl. xxxiii, figs. 1, 2; detailed description, p. 191; first mentioned, p. 30.
Type-locality.—35° 22' north latitude, 169° 53' east longitude (north Pacific) ; 2,900 fathoms. H. M. S. Challenger.
abyssicola = inhabiting great depths. British Museum.

The fact that this species was only dredged twice by the Challenger at stations 78° apart, the single specimen from Station No. 160 showing certain differences from those from Station No. 244, makes it necessary, if possible, to fix upon a definite type-locality, in case the differences should prove to be constant. Now, where the characters are first given (in the key on p. 158) the only differential character mentioned is the number of cirrus segments. The single specimen from Station No. 160 had no cirri, and therefore could not have been the original from which this character was taken. The type-locality must, then, of necessity, be the other station.

Antedon abyssorum P. H. Carpenter, 1888.

A nomen nudum.


Type-locality.—16° 16' south latitude, 48° 27' east longitude (near the Crozet Islands); 1,600 fathoms. H. M. S. Challenger.

abyssorum=of great depths. British Museum.

Antedon acacea P. H. Carpenter, 1884.

1884. P. H. Carpenter, Challenger Reports, XI, Zoology, pp. 57, 83, 84, 93, etc., pl. lv, figs. 1–4; pl. lv, fig. 5; detailed description in Challenger Reports, XXVI, Zoology, p. 132, pl. n, fig. 3; pl. xvi.

Type-locality.—4° 33' north latitude, 127° 06' east longitude (off the Meangis Islands); 500 fathoms. H. M. S. Challenger.

acacea=without hollows. British Museum.

Antedon aculeata P. H. Carpenter, 1888.

1888. P. H. Carpenter, Challenger Reports, XXVI, Zoology, p. 103, pl. xxiii, fig. 3; detailed description, p. 128; first mentioned, p. 54.

Type-locality.—4° 33' north latitude, 127° 06' east longitude (off the Meangis Islands); 500 fathoms. H. M. S. Challenger.

aculeata=sharp-pointed. British Museum.

Antedon acuticirra P. H. Carpenter, 1882.


Type-locality.—Unknown.

acutus=sharp+cirrus=“cirri.” Hamburg Museum.

Antedon acutiradia P. H. Carpenter, 1888.


A nomen nudum.

1888. P. H. Carpenter, Challenger Reports, XXVI, Zoology, p. 102, pl. xi, figs. 3, 4; detailed description, p. 113; first mentioned, p. 32.

Type-locality.—19° 02' south latitude, 177° 10' east longitude (near Kandavu, Fiji); 1,350 fathoms. H. M. S. Challenger.

acutus=sharp+radia=“rays.” British Museum.

† Antedon admirabilis.

Antedon adrestine A. H. Clark, 1907.

Type-locality.—Off the southern coast of Hondo, Japan; 45 to 48 fathoms. U. S. S. Albatross.

*Apókestryn*; a feminine name. U. S. National Museum.

†*Antedon* æquimarginata.

*Antedon* æquiplina P. H. Carpenter, 1882.


Type-locality.—Unknown.

aequus = equal; plina = "pinnules." Hamburg Museum.

*Antedon* affinis Hartlaub, 1890. ("Lütken MS.")


Type-locality.—Amboina.


*Antedon* afræ Hartlaub, 1890. ("Lütken MS.")


Type-locality.—Bowen, Queensland.

Æ̂ρφε = Aphrodite. Hamburg Museum.

*Antedon* agassizii Hartlaub, 1895.

1895. Hartlaub. Bull. Mus. Comp. Zool., XXVII, No. 4, p. 131, pl. i, figs. 4, 7, 8; pl. ii, figs. 16, 18, 19; pl. iii, fig. 23; pl. iv, fig. 26; first mentioned, p. 129.

Type-locality.—6° 35' 00" north latitude, 81° 44' 00" west longitude (off Panama); 782 fathoms; 0° 12' 30" north latitude, 90° 32' 30" west longitude (off the Galapagos Islands); 684 fathoms; or 0° 18' 40" north latitude, 90° 34' 00" west longitude (Galapagos Islands); 327 fathoms. U. S. S. Albatross.

Mr. Alexander Agassiz.

Type will be deposited in the U. S. National Museum.

*Antedon* alata Pourtalès, 1878.


Type-locality.—Barbados (British West Indies): 100 fathoms. U. S. S. Hassler.

alata = winged. Museum of Comparative Zoology.

This is the name which must be used for the species called *Actinometra pulchella* by Doctor Carpenter, who discarded alata as not being so appropriate as pulchella.

*Antedon* alboflava A. H. Clark, 1907.

Type-locality.—30° 54' 40" north latitude; 130° 37' 30" east longitude (off Kagoshima Gulf, Japan); 103 fathoms.  
U. S. S. Albatross.

albus=white+flavus=yellow.  
U. S. National Museum.

†Antedon allardi.

†Antedon almerai.

Antedon alternata P. H. Carpenter, 1888.

1887. von Graff, Challenger Reports, XX, Zoology, Pt. 61, p. 6. A nomen nudum.
1888. P. H. Carpenter, Challenger Reports, XXVI, Zoology, p. 158, pl. xviii, figs. 1–3; pl. xxxii, fig. 5–9; detailed description, p. 179; first mentioned, p. 27.

Type-locality.—37° 34' south latitude, 179° 22' east longitude; 700 fathoms. H. M. S. Challenger.  
alternata=alternating.  
British Museum.

†Antedon alticeps.

†Antedon ambiguus.

Antedon amboinensis Hartlaub, 1890.


Type-locality.—Amboina. Dr. J. Brock.  
amboinensis=of Amboina.  
Göttingen Museum.

Antedon anceps P. H. Carpenter, 1888.

1888. P. H. Carpenter, Challenger Reports, XXVI, Zoology, p. 194, pl. xxxv, figs. 1–3; detailed description, p. 254; first mentioned, p. 54.

Type-locality.—6° 54' north latitude, 122° 18' east longitude; 10 fathoms. H. M. S. Challenger.  
anceps=having two heads; (i. e., double; dimorphic).  
British Museum.

Antedon andersoni P. H. Carpenter, 1889.


Type-locality.—King Island, Mergui Archipelago. Dr. John Anderson.  
Dr. John Anderson.  
British Museum.

The original description of this species is based on a much mutilated individual, and, in addition, contains some misleading statements. For the first good description see Hartlaub Nova Acta Acad. German., LVIII, No. 1, p. 78 (1893).
Antedon anglesensis.

Antedon angusticalyx P. H. Carpenter, 1884.

A nomen nudum.

1884. P. H. Carpenter, *Challenger Reports, XI*, Zoology, p. 57 (footnote), pl. lvi, fig. 5; pl. lv, fig. 6: full description in P. H. Carpenter, *Challenger Reports, XXVI*, Zoology, p. 242, pl. ii, figs. 4 a–d; pl. i, figs. 1, 2; woodcut, p. 246, fig. 5 B (1888).

Type-locality.—4° 33' north latitude, 127° 06' east longitude (off the Meangis Islands); 500 fathoms. H. M. S. Challenger.

angustus=narrow+calyx=" calyx.” British Museum.

Antedon angustipinna P. H. Carpenter, 1888.

1888. P. H. Carpenter, *Challenger Reports, XXVI*, Zoology, p. 158, pl. xxix, figs. 1–4; detailed description, p. 189; first mentioned, p. 54.

Type-locality.—37° 17' south latitude, 53° 52' west longitude; 600 fathoms. H. M. S. Challenger.

angustus=narrow+pinna=" pinnules.” British Museum.

Antedon angustiradia P. H. Carpenter, 1888.

1888. P. H. Carpenter, *Challenger Reports, XXVI*, Zoology, p. 252, pl. xlvi, fig. 4; detailed description, p. 253; first mentioned, p. 55.

Type-locality.—5° 49' 15'' south latitude, 132° 14' 15'' east longitude (near the Ki Islands); 140 fathoms. H. M. S. Challenger.

angustus=narrow+radia=" rays.” British Museum.

Antedon antarctica P. H. Carpenter, 1880.

1880. P. H. Carpenter, *Journ. Linn. Soc. (Zool.), XV*, p. 198, pl. xii, figs. 29 a, b; detailed description in P. H. Carpenter, *Challenger Reports, XXVI*, Zoology, p. 138, pl. i, figs. 6 a–d, 7 a, b; pl. xxv; detailed description, p. 144 (1888).

Type-locality.—52° 50' 30'' south latitude, 73° 33' 30'' east longitude (near Heard Island); 75 fathoms. H. M. S. Challenger.

antarctica=of the antarctic regions. British Museum.

Antedon anthus A. H. Clark, 1907.

NO. 1623. Nomenclature of Recent Crinoids—Clark.

Type-locality.—30° 54' 40'' north latitude, 130° 37' 30'' east longitude (off Kagoshima Gulf, Japan); 103 fathoms. U. S. S. Albatross.

\( \vartheta \vartheta 05 \) = a flower.

U. S. National Museum.

Antedon arctica A. H. Clark, 1907.


Type-locality.—Camp Clay, Cape Sabine (arctic coast of Alaska). Lieut. Adolphus W. Greeley, U. S. A.

arctica = arctic.

U. S. National Museum.

Antedon armata Pourtales, 1869.


Type-locality.—West of the Tortugas, Florida; 35 fathoms. U. S. S. Bibb.

armata = armed.

Museum of Comparative Zoology.

†Antedon arnaudi.

†Antedon aspera.

Antedon aspera A. H. Clark, 1908 (not †Antedon aspera).


A nomen nudum.

Error for Trichometra aspera.

Antedon asperrima A. H. Clark, 1907.


Type-locality.—54° 02' 50'' north latitude, 166° 45' 00'' west longitude (Bering Sea); 406 fathoms. U. S. S. Albatross.

asperrima = very rough.

U. S. National Museum.

Antedon aster A. H. Clark, 1907.


Type-locality.—35° 11' 25'' north latitude, 139° 28' 20'' east longitude (Sagami Bay, Japan); 369 to 405 fathoms. U. S. S. Albatross.

\( \alpha \sigma \tau \eta \rho \) = a star.

U. S. National Museum.

Antedon australis P. H. Carpenter, 1882. ("Lütken MS.")


Type-locality.—Sydney, New South Wales.

australis = southern.

Copenhagen Museum.

A few characters are given which may prove to be of systematic importance.
1888. P. H. Carpenter, Challenger Reports, XXVI, Zoology, p. 138; pl. xxvi, figs. 4, 5; pl. xxvii, figs. 14–20; detailed description, p. 146; first mentioned, p. 33.
Type-locality.—52° 04' south latitude, 71° 22' east longitude (near Kerguelen Island); 150 fathoms. H. M. S. Challenger.
australis=southern.

This species has been renamed Heliometra glabra.

†Antedon avenionensis.

†Antedon avenionensis var. minor.

Antedon barentsi P. H. Carpenter, 1886.
1886. P. H. Carpenter, Bijdragen tot de Dierkunde, afl. xiii, p. 9, pl. 1, figs. 1–5; first mentioned, p. 3.
Type-locality.—70° 40' north latitude, 31° 10' east longitude (north of Nardö, Norway); 132 fathoms. Dutch S. S. Willem Barents.
S. S. Willem Barents.

Antedon basicurva P. H. Carpenter, 1884.
1884. P. H. Carpenter, Challenger Reports, XI, Zoology, p. 84; pl. liv, fig. 9; pl. lv, fig. 7; detailed description in Challenger Reports, XXVI, Zoology, p. 102; pl. ii, figs. 2 a–d; pl. xxii, fig. 3; pl. xxii, figs. 3, 4; woodcut, p. 122, figs. 2 A, B (1888).
Type-locality.—29° 45' south latitude, 178° 11' west longitude (near the Kermadec Islands); 630 fathoms. H. M. S. Challenger.
basis=base+curvus=bent.

British Museum.

Antedon bassett-smithi Bell, 1894.
Type-locality.—Macclesfield Bank: 13 to 36 fathoms.
Dr. P. W. Bassett-Smith, Surgeon, R. N. British Museum.
This species was, unfortunately, wrongly described in the "Spinifera group," with which it has no affinities; it is in reality a species of the "Palmata group" of Dr. Carpenter, as is obvious from the shape of the lower pinnules, as given in the plate.
It should be noticed that the description does not agree with the figure in respect to the number of arms or cirri, or the length of the first pinnule.
†Antedon beaugrandi.

Antedon bella Hartlaub, 1890.


Type-locality.—Noordwachter Eiland (North Watcher Island), Gulf of Tonkin; 15 to 20 fathoms.

bella=pretty. Göttingen Museum.

Antedon bella var. brunnea Hartlaub, 1893.

1893. Hartlaub, Nova Acta Acad. German, LVIII, No. 1, p. 44.

Type-locality.—Amboina. Dr. J. Brock.


†Antedon bimaculata.

Antedon bengalensis Hartlaub, 1890.


Type-locality.—Bay of Bengal.

bengalensis=of Bengal. Göttingen Museum.

Antedon bicolor P. H. Carpenter, 1879. ("Mus. Paris MS.")


A nomen nudum.

bicolor=of two colors.

Antedon bidentata Bell, 1884.


Type-locality.—Torres Straits. H. M. S. Alert.

bidentata=having two teeth (on the cirri). British Museum.

Antedon bidentata von Graff, 1884. ("P. H. Carpenter MS.")

1884. von Graff, Challenger Reports, X, Zoology, Pt. 27, pp. 15, 16, 17.

A nomen nudum.

bidentata=having two teeth.

Antedon bigradata Hartlaub, 1895.


Type-locality.—6° 30' 00" north latitude, 81° 44' 00" west longitude (off Panama); 355 fathoms; or between Chatham and Hood Islands, Galapagos; 385 fathoms. U. S. S. Albatross.

bigradata=with two steps.

Type will be deposited in U. S. National Museum.

Antedon bimaculata P. H. Carpenter, 1881.


Type-locality.—Amboina.

bimaculata=(here) two-colored. Leyden Museum.
Antedon bipartipinna P. H. Carpenter, 1882.
Type-locality.—Hongkong.
bipartio="bisect+pinna=" pinnules.” Hamburg Museum.

Antedon bispinosa P. H. Carpenter, 1888.
1888. P. H. Carpenter. Challenger Reports, XXVI, Zoology, p. 102; pl. xx, figs. 3, 4; detailed description, p. 115; first mentioned, p. 33.
Type-locality.—46° 16' south latitude, 18° 27' east longitude (near the Crozet Islands); 1,600 fathoms. H. M. S. Challenger.
bispinosa="with two spines." British Museum.

†Antedon bituricensis.

Antedon bowersi A. H. Clark, 1907.
Type-locality.—30° 58' 30" north latitude, 130° 32' 00" east longitude (off Kagoshima Gulf); 152 to 103 fathoms. U. S. S. Albatross. Hon. George M. Bowers. U. S. National Museum.

Antedon brachymera A. H. Clark, 1907.
Type-locality.—43° 01' 40" north latitude, 140° 22' 40" east longitude. (Sea of Japan); 172 fathoms. U. S. S. Albatross.

Antedon brasiliensis P. H. Carpenter, 1879. ("Lütken MS.")
A nomen nudum.
brasiliensis="of Brazil."

Antedon braziliensis Rathbun, 1879. ("Lütken MS.")
A nomen nudum.
Type-locality.—Coast of Brazil.
brasilienisis="of Brazil.

†Antedon breviceps.

Antedon brevicirra Bell, 1894.
**Type-locality.**—Macclesfield Bank; 20 to 35 fathoms.

*brevis* = short + *cirra* = "cirri."

This species is quite unidentifiable from the description.

**Antedon brevicuneata** P. H. Carpenter, 1881.


*Type-locality.*—Amboina.

*brevis* = short + *cuneata* = wedge-shaped.

**Antedon breviradia** P. H. Carpenter, 1888.

1888. P. H. Carpenter, *Challenger* Reports, XXVI, Zoology, p. 102, pl. iii, figs. 4, 5 a–c; pl. xi, fig. 5; pl. xix; pl. xx, figs. 1, 2; detailed description, p. 110; first mentioned, p. 20.

*Type-locality.*—29° 45′ south latitude, 178° 11′ west longitude (near the Kermadec Islands); 630 fathoms. H. M. S. *Challenger*.

*brevis* = short + *radia* = "rays."

**Antedon briareus** Bell, 1882.


The specific formula given for this species is particularly misleading, as it should have been given under "Actinometra," not *Antedon*; full description in Bell, Rep. Zool. Coll. H. M. S. *Alert*, p. 163, pl. xiv (1884).

*Type-locality.*—Port Denison. H. M. S. *Alert*.

*Brιαρεος* = Briareus or *Ægæon*.

**Antedon briseis** A. H. Clark, 1907.


*Type-locality.*—Sea of Japan.

*Brισηνις* = Briseis or Hippodamia.

**Antedon brockii** Hartlaub, 1890.


*Type-locality.*—Amboina. Dr. J. Brock.

Dr. J. Brock.

**Antedon brownii**.

**Antedon burgundiaca**.

**Antedon callista** A. H. Clark, 1907.


*Type-locality.*—32° 31′ 10″ north latitude, 128° 33′ 20″ east longitude (Eastern Sea); 139 to 107 fathoms. U. S. S. *Albatross*.

*καλλιστος* = very beautiful.

**Antedon callista** A. H. Clark, 1907.
†Antedon calloviensis.
†Antedon campichei.
†Antedon canaliculata.

**Antedon capensis Bell, 1905.**

1905. Bell, Marine Investigations in South Africa, III, p. 139, pl. II.

*Type-locality.*—South Africa; 13–27 fathoms.

capensis; in reference to the Cape of Good Hope.

Professor Bell described this species in the "Basicurva group," whereas it really belongs with *Comatula carinata* of Lamarck, placed by Doctor Carpenter in the "Milberti group."

I have examined some of the original specimens and can not separate them from true *Comatula carinata* from Mauritius or Zanzibar. *Comatula carinata* from East Africa varies very little, but specimens from the West Indies and Brazil are very variable, especially in regard to the carination of the arms.

Six-rayed individuals also are common in the latter locality.

†Antedon carabœufi.

†Antedon carentonensis.

**Antedon carpenteri Bell, 1884.**


*Type-locality.*—Port Curtis (Queensland). H. M. S. Alert.

Dr. P. Herbert Carpenter. British Museum.

†Antedon cartenniensis.

**Antedon challengeri A. H. Clark, 1907.**


New name for Antedon lineata P. H. Carpenter, 1888, not Antedon lineata Pomel, 1887.

H. M. S. Challenger.

†Antedon changarnieri.

†Antedon choffati.

**Antedon ciliata A. H. Clark, 1907.**


*Type-locality.*—43° 00' 00'' north latitude, 140° 10' 30'' east longitude (Sea of Japan); 390 to 428 fathoms. U. S. S. Albatross.

Antedon cirri Honeyman, 1889.
Type-locality.—Off Halifax. cirrus=a lock of hair. Halifax Museum.

Probably this combination was not intended as a new name, but, taking the context into consideration, I do not see how it can be treated otherwise. The specimen was presented to the museum by Sir C. Wyville Thomson under the name of Antedon eschrichtii, of which species it is a synonym; but in case a definite geographical variety should be proved to inhabit the vicinity given, this name would have to be used. The character of "single claws" given is somewhat obscure, and the number of cirrus segments is equally worthless, falling, as it does, within the range of a large number of species of various genera.

Antedon clarae Hartlaub, 1890.
Type-locality.—Amboina. Dr. J. Brock. Göttingen Museum.

Antedon clemens P. H. Carpenter, 1888.
1888. P. H. Carpenter, Challenger Reports, XXVI, Zoology, p. 225, pl. xxxix, fig. 5; detailed description, p. 229; first mentioned, p. 54.
Type-locality.—6° 54' north latitude, 122° 18' east longitude (Celebes Sea); 10 fathoms. H. M. S. Challenger. clemens=placid, calm. British Museum.

Antedon clio A. H. Clark, 1907.

Antedon columnaris P. H. Carpenter, 1881.
1881. P. H. Carpenter, Bull. Mus. Comp. Zool., IX, No. 4, p. 169, pl. i, fig. 8; first mentioned, p 152.
Type-locality.—Off St. Lucia, British West Indies; 422 fathoms. U. S. S. Blake.
columnaris=columnar. Museum of Comparative Zoology.

Antedon comata von Graff 1887. ("P. H. Carpenter Ms.")
1887. von Graff, Challenger Reports, XX. Zoology, Pt. 61, p. 2. A nomen nudum. comata=with long hair.
Antedon planata.

Antedon compressa P. H. Carpenter, 1888.
1888. P. H. Carpenter, Challenger Reports, XXVI, Zoology, p. 212, pl. xli; detailed description, p. 222; first mentioned, p. 54.
Type-locality.—5° 49’ 15” south latitude, 132° 14’ 15” east longitude (near the Ki Islands); 140 fathoms. H. M. S. Challenger.
compressa = compressed. British Museum.

Antedon conifera Hartlaub, 1890.
Type-locality.—Japan. Dr. F. Hilgendorf.

Antedon conjungens P. H. Carpenter, 1888.
1888. P. H. Carpenter, Challenger Reports, XXVI, Zoology, p. 225, pl. xix, fig. 1; detailed description, p. 233; first mentioned, p. 55.
Type-locality.—Zebu Reefs. H. M. S. Challenger.
conjungens = binding together; uniting. British Museum.

Antedon costata.

Antedon crassipinna Hartlaub, 1890.
Type-locality.—Amboina; Cochin China.
crassus = stout, thick; pinna = “ pinnules.”
Göttingen and Hamburg Museums.

Antedon crassispina Köhler, 1895.
crassus = thick; spina = thorn.
Editorial error for crassipinna.

Antedon crenulata P. H. Carpenter, 1882.
Type-locality.—Borneo.
crenulata = crenulate. Hamburg Museum.

Antedon cubensis Pourtalès, 1869.
Type-locality.—Off Cojima, near Havana, Cuba; 450 fathoms. U. S. S. Bibb.
cubensis = of Cuba. Museum of Comparative Zoology.

Antedon cumingii Pfeffer, 1900.
Editorial error for Comatula cumingii J. Müller.
Antedon cupulifera Hartlaub, 1893. ("Lütken M.S.")

1893. Hartlaub, Nova Acta Acad. German., LVIII, No. 1, p. 82.

A nomen nudum.

cupulifera = bearing small casks; i.e., with barrel-shaped segments.

†Antedon decameros.

Antedon decameros J. E. Gray, 1848.


Type-locality. — Plymouth Sound. Dr. W. E. Leach.

A nomen nudum. Antedon decipiens H. Harting, 1893.

1893. Harting, Nova Acta Acad. German., LVIII, No. 1, p. 82.

A nomen nudum. Antedon decameros J. E. Gray, 1848.


Type-locality. — Plymouth Sound. Dr. W. E. Leach.

Antedon decipiens Bell, 1882.


Type-locality. — Arafura Sea; 32 to 36 fathoms. H. M. S. Alert.

decipiens = deceiving. British Museum.

Antedon deflecta P. H. Carpenter, 1888.


Type-locality. — Caribbean Sea; 77 to 242 fathoms. U. S. S. Blake.

defecta = imperfect. Museum of Comparative Zoology.

†Antedon delgadoi.

Antedon delicatissima A. H. Clark, 1907.


Type-locality. — 30° 12' 00'' north latitude, 130° 44' 00'' east longitude (Eastern Sea); 84 fathoms. U. S. Albatross.


Antedon denticulata P. H. Carpenter, 1888.

1888. P. H. Carpenter, Challenger Reports, XXVI. Zoology, p. 103, pl. xxii. figs. 1, 2; detailed description, p. 130; first mentioned, p. 34.

Type-locality. — 8° 56' north latitude, 136° 05' east longitude (near the Pelew Islands); 49 fathoms. H. M. S. Challenger.

denticulata = set with teeth. British Museum.
Antedon depereti.
Antedon depressa.
Antedon desori.

Antedon diadema A. H. Clark, 1907.
_Type-locality._—30° 58' 30'' north latitude, 130° 32' 00'' east longitude (off Kagoshima Gulf); 152 to 103 fathoms. U. S. S. _Albatross._


Type-locality.—54° 30' north latitude, 130° 32' 00'' east longitude (off Kagoshima Gulf); 152 to 103 fathoms. U. S. S. _Albatross._


_Type-locality._—31° 28' 20'' north latitude, 130° 35' 30'' east longitude (off the southern coast of Japan); 51 fathoms. U. S. S. _Albatross._


Antedon diomedea A. H. Clark, 1907.
_Type-locality._—Zebu Reefs. H. M. S. _Challenger._
diomedea=distinguished. British Museum.

Antedon disciformis P. H. Carpenter, 1888.
1888. P. H. Carpenter, _Challenger_ Reports, XXVI, Zoology, p. 225, pl. iv, figs. 2 a-d; pl. xxxix, fig. 4; detailed description, p. 228; first mentioned, p. 8.
_Type-locality._—Zebu Reefs. H. M. S. _Challenger._
discus=a disk, formis=shape. British Museum.

Antedon discoidea P. H. Carpenter, 1888.
1888. P. H. Carpenter, _Challenger_ Reports, XXVI, Zoology, p. 132, pl. x, figs. 1, 2; detailed description, p. 134; first mentioned, p. 54.
_Type-locality._—5° 49' 15'' south latitude, 132° 14' 15'' east longitude (near the Ki Islands); 140 fathoms. H. M. S. _Challenger._
discoidea=discoidal. British Museum.

Antedon distincta P. H. Carpenter, 1888.
1888. P. H. Carpenter, _Challenger_ Reports, XXVI, Zoology, p. 241, pl. li, fig. 1; detailed description, p. 247; first mentioned, p. 45.
_Type-locality._—9° 26' north latitude, 123° 45' east longitude (off Panglao and Siquijor); 375 fathoms. H. M. S. _Challenger._
distincta=distinguished.

Antedon dividua P. H. Carpenter, 1879. ("Mus. Paris MS.")


Type-locality.—9° 26' north latitude, 123° 45' east longitude (off Panglao and Siquijor); 375 fathoms. H. M. S. _Challenger._
dividua=divided.
Antedon döderleini de LORIOL, 1900.

1900. de LORIOL, Rev. Suisse Zool., VIII, p. 93, pl. ix, figs. 2 a-i. Type-locality.—Kagoshima, Japan. Doctor Döderlein.

Dr. Ludwig Döderlein.

†Antedon d’orbignyi.

Antedon dübenii BÖHLSCHIE, 1866.

1866. BÖHLSCHIE, Wiegmam’s Archiv für Naturgesch., 1866, I, p. 92 (fig.). Type-locality.—Rio Janeiro, Brazil.

Dr. M. W. von Düben.

The type specimen is figured in Challenger Report, XXVI, Zoology, pl. xxxvii, fig. 2 (1888).

"Antedon dübenii" is the young of Comatula carinata Lamarck.

Antedon dubia P. H. CARPENTER, 1888. ("Semper M. S.")

1884. von Graff, Challenger Reports, X, Zoology, pp. 15, 18, 47.


dubia=uncertain. British Museum.

Antedon duplex P. H. CARPENTER, 1888.


duplex=broad, large.

Antedon echinata P. H. CARPENTER, 1888.

1888. P. H. CARPENTER, Challenger Reports, XXVI, Zoology, p. 102, pl. xxi, figs. 4, 5; detailed description, p. 119; first mentioned, p. 54. Type-locality.—29° 45' south latitude, 178° 11' west longitude (near the Kermadec Islands); 630 fathoms. H. M. S. Challenger.

echinata=prickly. British Museum.

Antedon elegans BELL, 1884.


elegans=beautiful. British Museum.

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Antedon emendatrix Bell, 1892.
Type-locality.—Mauritius.
emendatrix = an improver.
British Museum.

Antedon erinacea Hartlaub, 1890.
Type-locality.—Cebu. Captain Ringe.
erinacea = spiny.
Hamburg Museum.

Antedon erythrizon A. H. Clark, 1907.
Type-locality.—42° 58' 15" north latitude, 140° 09' 10" east longitude (Sea of Japan); 406 to 390 fathoms. U. S. Albatross.
U. S. National Museum.

Antedon eschrichti var. magellanica Bell, 1882.
Type-locality.—Straits of Magellan. Dr. R. W. Coppinger.
magellanica = for the Straits of Magellan. British Museum.
This species has never been adequately described. The character separating it from A. rhomboidea in the key in the Challenger report does not hold.

Antedon eschrichtii var. acadiae Verrill, 1879.
1879. Verrill, Preliminary check-list of the marine invertebrata of the Atlantic coast from Cape Cod to the Gulf of St. Lawrence. New Haven, 1879, p. 15.
A nomen nudum.
Acadia, of Acadia, i. e., Nova Scotia.

Antedon eschrichtii var. maxima A. H. Clark, 1907.
Type-locality.—43° 01' 35" north latitude, 140° 10' 40" east longitude (Sea of Japan); 248 fathoms. U. S. S. Albatross.
maxima = largest.
U. S. National Museum.

Antedon eschrichtii W. B. Carpenter, 1884.
Typographical error.

Antedon eschrichtii Wyville Thomson, 1872.
Typographical error.
†Antedon essenensis.

Antedon eversa P. H. Carpenter, 1888.
1888. P. H. Carpenter, *Challenger* Reports, XXVI, Zoology, pl. 111, fig. 5.
*Type locality.*—$29^\circ 45' \text{south latitude}, 178^\circ 11' \text{west longitude}$ (near the Kermadec Islands); 630 fathoms. H. M. S. *Challenger*.
*eversa*=turned outward.

Antedon exigua P. H. Carpenter, 1888.
1888. P. H. Carpenter, *Challenger* Reports, XXVI, Zoology, p. 158, pl. xxxii, figs. 1–4; detailed description, p. 178; first mentioned, p. 54.
*Type locality.*—Off Marion Island; 50 to 140 fathoms. H. M. S. *Challenger*.
exigua=small.

†Antedon exilis.

Antedon fieldi Bell, 1894.
*Type locality.*—Macclesfield Bank: 22 to 30 fathoms. Commander A. M. Field, R. N. British Museum.
This species is quite unrecognizable from the description; a redescriptions of the type is very desirable. It certainly does not belong to the “Spinifera group,” in which it was described.

†Antedon filiformis.

Antedon fimbriatus Lütken, 1871.
For *Comatula* (or *Actinometra*) *fimbriata*.

Antedon finschii Hartlaub, 1890.
*Type locality.*—New Britain. Dr. O. Finsch. Dr. O. Finsch. Berlin Museum.

†Antedon fischeri.

Antedon flava Koeiher, 1895.
*Type locality.*—$45^\circ 57' \text{north latitude}, 6^\circ 21' \text{west longitude}$ (Bay of Biscay); 1,410 meters. French S. S. *Caudan*.
flava=yellow.
Antedon flavomaculata Bell, 1894.

Antedon flavopurpurea A. H. Clark, 1907.

Antedon flexilis P. H. Carpenter, 1888.

Antedon fluctuans P. H. Carpenter, 1884.

†Antedon fontannesi.
†Antedon formosus.

Antedon fragilis A. H. Clark, 1907.
†Antedon gaivensis.

**Antedon garrettiana** A. H. Clark, 1907.


*Type locality.*—32° 32′ 00″ north latitude, 128° 32′ 00″ east longitude (Eastern Sea); 95 fathoms. U. S. S. Albatross. Lieut.-Commander L. M. Garrett, U. S. N.

U. S. National Museum.

†Antedon gevreyi.

†Antedon gillerioni.

†Antedon glandiferus.

†Antedon globosus.

**Antedon gorgonia** de Fréminville, 1811.


*Type locality.*—Havre, France.

γοργόνωσ = belonging to the Gorgon.

It is difficult to see just why there has been so much confusion in regard to this species. Dr. P. H. Carpenter follows Lamarck in placing it with a query in the synonymy of *Comatula carinata* Lamarck, 1816, and says that the type of *Antedon* is a tropical species. It is wholly improbable that any *Antedon* could cling to the growth on a ship's bottom from the most northern point in the range of *Comatula carinata* all the way to Havre without getting swept off or killed by the violent wave action to which it would of necessity be subjected; moreover, it is extremely doubtful if *Comatula carinata* from the littoral zone of the tropics could survive the cold surface water of the ocean off the coast of France, even in the summer. On the other hand, if there were any individuals of *Antedon bifida* living about the dock (and the old-fashioned dry dock is very attractive to marine organisms) it is quite probable that they would become disturbed by the commotion caused by an entering ship and swim about; and they would be as likely to settle on the ship's bottom as anywhere else. Therefore it seems to me that there can be no doubt that the type of *Antedon gorgonia* came from Havre. The figure to which de Fréminville refers undoubtedly refers to *Asterias bifida*. *Antedon gorgonia* was referred unconditionally to *Asterias bifida* by Bell in 1892, but he did not state his reasons for doing it at the time, nor has anything been published on the subject since. As it is of considerable importance to have a definite type for the genus, the preceding remarks may not be entirely superfluous.

†Antedon gracilis.
Antedon gracilis P. H. Carpenter, 1888.

1888. P. H. Carpenter. *Challenger* Reports. XXVI. Zoology, p. 102, pl. xii, figs. 3–5; pl. xv, figs. 1–4; detailed description, p. 107; first mentioned, p. 54.

*Type-locality.*—1° 33' north latitude, 127° 06' east longitude (off the Meangis Islands); 500 fathoms. H. M. S. *Challenger.*

Dr. P. H. Carpenter repeatedly asserted the identity of *Solanocrinites* Goldfuss with *Antedon* de Fréminville, and in his synonymy of *Antedon* in the *Challenger* report he places *Solanocrinites* under it, and in his remarks on the genus again asserts their identity. However, with curious inconsistency, almost invariably when he mentions certain of the fossil species he uses the generic name *Solanocrinites*, even though he explicitly states that it has no standing. It is here understood that the inclusion unconditionally of one generic name under another implies the regarding of all species described under the former as members of the latter; therefore *Solanocrinites gracilis* becomes, according to the ruling proposed (but not put into effect) by Carpenter, *Antedon gracilis*. This species, however, is not the *Antedon gracilis* of Carpenter, 1888, which therefore requires a new name. It has been called in consequence *Antedon pergracilis*.

Antedon granulifera Pouthalès, 1878.


*Type-locality.*—25° 33' north latitude, 84° 21' west longitude (west of southern Florida); 101 fathoms. U. S. S. *Blake.*

*granulifera* = bearing small grains.

Museum of Comparative Zoology.

†Antedon greppini.

†Antedon gresslyi.

†Antedon guirandi.

Antedon gyges Bell, 1884.


*Type-locality.*—Thursday Island. H. M. S. *Alert.*

*Gyges (= Gyles, son of Daseylus).* British Museum.

Antedon hana A. H. Clark, 1907.


*Type-locality.*—32° 31' 10" north latitude, 128° 33' 20" east longitude (Eastern Sea); 139 to 107 fathoms. U. S. S. *Alert.*

Antedon hartlaubi A. H. Clark, 1907.


Type-locality.—30° 58' 30" north latitude, 130° 32' 00" east longitude (off Kagoshima Gulf); 152 to 153 fathoms. U. S. S. Albatross.

Dr. Clemens Hartlaub.

U. S. National Museum.

Antedon hawaiensis A. H. Clark, 1907.


Type-locality.—30° 58' 30" north latitude, 130° 32' 00" east longitude (Hawaiian Islands); 351 fathoms. U. S. S. Albatross.


Antedon hepburniana A. H. Clark, 1907.


Type-locality.—32° 26' 30" north latitude, 128° 36' 30" east longitude (Eastern Sea); 135 fathoms. U. S. S. Albatross.


†Antedon herberti.

Antedon hirsuta P. H. Carpenter, 1888.

1888. P. H. Carpenter, Challenger Reports, XXVI, Zoology, p. 158, pl. xxxi, fig. 5; detailed description, p. 188; first mentioned, p. 54.

Type-locality.—46° 43' 00" south latitude, 38° 04' 30" east longitude (near Marion Island); 140 fathoms. H. M. S. Challenger.

hirsuta=rough, bristly. British Museum.

Antedon hondoensis A. H. Clark, 1907.


Type-locality.—38° 09' 24" north latitude, 141° 51' 30" east longitude (off Kinka San light, east coast of Hondo); 129 fathoms. U. S. S. Albatross.

hondoensis, for the island of Hondo. U. S. National Museum.

Antedon hupferi Hartlaub, 1890.


Type-locality.—Wapoo (Ivory coast, west Africa); 21 fathoms. Captain Hupfer.

Captain Hupfer. Hamburg Museum.
Antedon hystrix P. H. Carpenter, 1884.
Type-locality.—"Cold area" Faroe Channel. H. M. S. Porcupine.

Antedon iheringi. British Museum.

Antedon imparipinna P. H. Carpenter, 1882.
Type-locality.—Unknown.
impar=uneven+pinna=’ pinnules.” Hamburg Museum.

Antedon imperialis.

Antedon impinnata P. H. Carpenter, 1888.
Type-locality.—North Bay, Mauritius; 15 fathoms. Professor Karl Möbius.
impinnata=lacking “ pinnules.” Kiel.

Antedon impressa.

Antedon inaequalis P. H. Carpenter, 1884.
1884. P. H. Carpenter, Challenger Reports, XI, Zoology, p. 83, pl. 14, fig. 8; better description in P. H. Carpenter, Challenger Reports, XXVI, Zoology, p. 241, pl. 11, figs. 5 a-d; pl. 11, fig. 2; woodcut, p. 246, fig. 5 a; detailed description, p. 244 (1888).
Type-locality.—29° 45‘ south latitude, 178° 11‘ west longitude (near the Kermadec Islands); 630 fathoms; or 19° 06‘ south latitude, 178° 18‘ east longitude (about) (near Kadavu, Fiji); 210 to 610 fathoms. H. M. S. Challenger.
inaequalis=uneven. British Museum.

Antedon incerta P. H. Carpenter, 1884.
1884. P. H. Carpenter, Challenger Reports, XI, Zoology, p. 57, pl. 14, figs. 6, 7; better description in P. H. Carpenter, Challenger Reports, XXVI, Zoology, p. 102, pl. xviii, figs. 4, 5; detailed description, p. 106 (1888).
Type-locality.—29° 45' south latitude, 178° 11' west longitude (near the Kermadec Islands); 630 fathoms. H. M. S. Challenger.

*incerta* = doubtful, uncertain.

British Museum.

**Antedon incisa** P. H. Carpenter, 1888.


A nomen nudum.


A nomen nudum.

1888. P. H. Carpenter, *Challenger* Reports, XXVI, Zoology, p. 102, pl. ii, figs. 1 a–d; pl. xxi, figs. 1, 2; detailed description, p. 124; first mentioned, p. 54.

Type-locality.—29° 45' south latitude, 178° 11' west longitude (near the Kermadec Islands); 630 fathoms. H. M. S. Challenger.

*incisa* = incised.

British Museum.

**Antedon incommoda** Bell, 1888.


Type-locality.—Port Philip (Victoria). Mr. J. Bracebridge Wilson.

*incommoda* = troublesome.

British Museum.

†**Antedon incurva.**

**Antedon inexpectata** A. H. Clark, 1907.


Type-locality.—56° 00' 00'' north latitude, 154° 20' 00'' west longitude (south of Alaska peninsula); 159 fathoms. U. S. S. Albatross.

*inexpectata* = unexpected.

U. S. National Museum.

**Antedon informis** P. H. Carpenter, 1888.

1888. P. H. Carpenter *Challenger* Reports, XXVI, Zoology, p. 194, pl. xxxiii, fig. 3; detailed description, p. 205; first mentioned, p. 54.

Type-locality.—11° 37' north latitude, 123° 31' east longitude (Philippine Islands); 18 fathoms. H. M. S. Challenger.

*informis* = deformed.

British Museum.

†**Antedon infracretacea.**

**Antedon inopinata** Bell, 1894.

Type-locality.—Macclesfield Bank; 31 to 36 fathoms. H. M. S. Penguin.
inopinata=unexpected. British Museum.
Described in Dr. P. H. Carpenter’s “Granulifera group,” but evidently belonging to his “Savignii group;” the species is not recognizable from the description.

**Antedon insignis** Bell, 1882.
Type-locality.—Port Denison. H. M. S. Alert.
insignis=well-marked. British Museum.
This species was redescribed in 1884 under the name of

*Antedon lovenii* (q. v.), which name had been used in 1882 for a different species. Now, while the specific formula given in 1882 is quite non-diagnostic, the fact remains that it was intended for a description, and therefore the name has a standing in nomenclature.

**Antedon irregularis** Bell, 1882.
Type-locality.—Prince of Wales Channel; Torres Straits. H. M. S. Alert.
irregularis=irregular. British Museum.

**Antedon isis** A. H. Clark, 1907.
Type-locality.—30° 21' 00" north latitude, 129° 06' 00" east longitude (about 90 miles W. S. W. of Kagoshima Gulf); 361 fathoms. U. S. S. Albatross.
†**Antedon italica.**
†**Antedon jaegeri.**
†**Antedon japonica** Hartlaub, 1890.
Type-locality.—Japan. Dr. F. Hilgendorf.
†**Antedon jutieri.**
**Antedon klunzingeri** Hartlaub, 1890.
Type-locality.—Koseir, on the Red Sea. Herr Klunzinger.
Herr Klunzinger. Stuttgart.
†Antedon koprivnicensis.

Antedon kraepelini Hartlaub, 1890.


*Type-locality.*—Akyab (Arakan, Burma).
Prof. Karl Kräpelin, Director of the Hamburg Museum.
Hamburg Museum.

†Antedon ladioixensis.

Antedon laevicirra P. H. Carpenter, 1881.


*Type-locality.*—Aru Islands. Coll. von Rosenberg.
laevus = unsuitable + cirra = "cirri."

Leyden Museum.

Antedon lævipiwna P. H. Carpenter, 1882.


*Type-locality.*—Canton, China.
laevus = unsuitable + pinnula = "pinnules."

Hamburg Museum.

Antedon laevis P. H. Carpenter, 1888.

1888. P. H. Carpenter, Challenger Reports XXVI, Zoology, p. 158, pl. xxxi, fig. 6; detailed description, p. 187; first mentioned, p. 54.

*Type-locality.*—31° 33' north latitude, 127° 06' east longitude (off the Meangis Islands); 500 fathoms. H. M. S. Challenger.

laevis = insignificant.

British Museum.

†Antedon lamberti.

Antedon laodice A. H. Clark, 1907.


*Type-locality.*—33° 23' 40' north latitude, 135° 33' 00' east longitude (off southern Japan); 587 fathoms. U. S. S. Albatross.

Aνοδηκη = Laodice, a nymph.

U. S. National Museum.

Antedon lata A. H. Clark, 1907.


*Type-locality.*—30° 22' 00' north latitude, 129° 08' 30' east longitude (Eastern Sea); 361 fathoms. U. S. S. Albatross.
lata = broad.

U. S. National Museum.

†Antedon latipinna.

Antedon latipinna P. H. Carpenter, 1888.

1888. P. H. Carpenter, Challenger Reports, XXVI, Zoology, p. 102, pl. x, fig. 3; detailed description, p. 116; first mentioned, p. 54.
Type-locality.—35° 11' north latitude, 139° 28' east longitude (off southern Japan): 315 fathoms. H. M. S. Challenger.

*Antedon lenticularis.*

**Antedon lepida** Hartlaub, 1890.


Type-locality.—Tonga Islands.

*lepidus* = pretty. Hamburg Museum.

*Antedon leucomelas* Hartlaub, 1893.


*leuco* = white; *melan* = black.

**Antedon lineata** P. H. Carpenter, 1888 (not *Antedon lineatus* Pomel, 1887).

1888. P. H. Carpenter, *Challenger* Reports, XXVI, Zoology, p. 158, pl. xiii, figs. 4, 5; detailed description, p. 183; first mentioned, p. 54.

Type-locality.—37° 17' south latitude, 53° 52' west longitude; 600 fathoms. H. M. S. Challenger.

*lineata* = marked with lines. British Museum.

This species has been renamed *Antedon challengeri*.

*Antedon lineatus* Pomel, 1887.


Type-locality.—Sahelian, Algeria.

*lineatus* = marked with lines.

**Antedon longicirra** P. H. Carpenter, 1888.

1888. P. H. Carpenter, *Challenger* Reports, XXVI, Zoology, p. 102, pl. xvii; detailed description, p. 103; first mentioned, p. 22.

Type-locality.—5° 49' 15" south latitude, 132° 14' 15" east longitude (near the Ki Islands); 140 fathoms. H. M. S. Challenger.

*longus* = long + *cirra* = "cirri." British Museum.

*Antedon longimana.*

**Antedon longipinna** P. H. Carpenter, 1888.

1888. P. H. Carpenter, *Challenger* Reports, XXVI, Zoology, p. 158, pl. xxx, figs. 1–3; detailed description, p. 185; first mentioned, p. 54.

Type-locality.—37° 17' south latitude, 53° 52' west longitude (off Montevideo); 600 fathoms. H. M. S. Challenger.

*longus* = long + *pinna* = "pinnules." British Museum.
†Antedon lorioli.

**Antedon loveni** Bell, 1882.


*Type-locality.*—Port Jackson; 0 to 5 fathoms. H. M. S. Alert.

Prof. Sven Lovén.

British Museum.

This species is based on a non-diagnostic specific formula. In 1884 it was described in detail and figured by Professor Bell under the name of *Antedon pumila* (q. v.), which, of course, becomes a pure synonym of *A. loveni*. The species now known as *A. loveni* must become *Antedon insignis*, and the species now known as *A. pumila, Antedon loveni*.

**Antedon loveni** Bell, 1884 (not *Antedon loveni* Bell, 1882).


*Type-locality.*—Port Denison (Queensland). H. M. S. Alert.

Prof. Sven Lovén.

British Museum.

This is a pure synonym of *Antedon insignis* Bell, 1882, being founded on the type of that species. On pl. x there are two figures lettered "B" and none lettered "C;" the upper figure "B," however, represents this species, and should have been lettered "C."

†Antedon ludgreni.

**Antedon ludovici** P. H. Carpenter, 1882.


*Type-locality.*—Hongkong.

Prof. Hubert Ludwig.

Hamburg Museum.

**Antedon lusitanica** P. H. Carpenter, 1884.


*Type-locality.*—39° 39' north latitude, 9° 39' west longitude (off the coast of Portugal); 740 fathoms. H. M. S. Porcupine.

*Lusitanica* = Portugal.

**Antedon macrocnema** P. H. Carpenter, 1879.


Emendation.

**Antedon macrodiscus** Hara, 1895.


*Type-locality.*—Misaki, Japan; 3 fathoms.

μακρόσ = long + δισκός = "disk." Imperial University, Tokyo.

The affinities of this remarkable species are with *Antedon afra* Hartlaub, from which, however, it is quite distinct, the length
of the lower pinnules being especially remarkable. It is strange that specimens of these two species should be so rare in collections. I have only been able to examine one of each.

**Antedon macropoda** A. H. Clark, 1907.

*Type-locality.*—30° 37' 20" north latitude, 130° 35' 10" east longitude (off Kagoshima Gulf); 103 fathoms. U. S. S. Albatross.

$\mu\alpha\kappa\rho\sigma$=long+$\pi\nu\iota\varsigma$=foot. U. S. National Museum.

**Antedon macropygus** Hartlaub, 1890. ("Lutken M.S.")

A *nomen nudum.*

$\mu\alpha\kappa\rho\sigma$=long+$\pi\upsilon\gamma\omega\nu$=elbow (segment).

**Antedon magnicirrus** Bell, 1905.

*Type-locality.*—East London; 300 to 450 fathoms.

*macrus*=large+$\zeta\upsilon\upsilon\zeta$="cirri."

This species was described as appearing "to stand next to A. angustiradia" (i.e., in the "Savignyi group") of Dr. P. H. Carpenter); it has not the remotest relation to any species of that group, however, but belongs to the "Granulifera group," falling in the genus Thalassometra.

**Antedon magnicirrus** Bell, 1905.

Typographical error.

**Antedon magnicirinus** Bell, 1905.

Editorial error.

**Antedon manca** P. H. Carpenter, 1888.

A *nomen nudum.*


*Type-locality.*—5° 49' 15" south latitude, 132° 14' 15" east longitude (near the Ki Islands); 140 fathoms. H. M. S. Challenger. manca=maimed. British Museum.

**Antedon marginata** P. H. Carpenter, 1888.

A *nomen nudum.*

Type-locality.—11° 37' north latitude, 123° 31' east longitude (off Manila, Philippines); 18 fathoms. H. M. S. Challenger. marginata = bordered.

Antedon mariae A. H. Clark, 1907.

Type-locality.—35° 04' 50'' north latitude, 139° 38' 18'' east longitude (Uraga Straits, entrance to Tokyo Gulf); 70 fathoms. U. S. S. Albatross.

Mrs. Mary W. Clark.

Antedon marmorata P. H. Carpenter, 1888. (" Vienna Mus. MS.")

A nomen nudum.

marmorata = marbled.

Antedon martensi Hartlaub, 1890.

Type-locality.—Singapore. Prof. Ed. von Martens.
Prof. Ed. von Martens.

Berlin Museum.

Antedon mauonema Bell, 1882.

Typographical error.

†Antedon mediterraneaeformis.

Antedon meridionalis Verrill, 1866.

For Comatula meridionalis.

†Antedon michelottii.

Antedon microdiscus Bell, 1882.


Type-locality.—Port Molle (Queensland); 12 fathoms. H. M. S. Alert.

μκρός = small + δίσκος = "disk." British Museum.

†Antedon minimus.

Antedon minor A. H. Clark, 1907 (not Antedon ovationensis var. minor).

Type-locality.—33° 35' 20'' north latitude, 135° 10' 50'' east longitude (off southern Japan); 191 fathoms. U. S. S. Albatross.

minor = lesser.

This species has been renamed Nanometra minckerti.
Antedon minuta A. H. Clark, 1907.
Type-locality.—Off the southern coast of Hondo, Japan; 13 fathoms. U. S. S. *Albatross.*

†Antedon micoensis.

Antedon monocantha Hartlaub, 1890.
Type-locality.—Mortlock Island; Torres Straits.
μωός=single; ἀκαρβα=spine
Göttingen and Hamburg Museums.

Antedon moorei Bell, 1894.
Type-locality.—Macclesfield Bank; 13 fathoms.
This species is quite unrecognizable from the published description. It certainly does not belong in the "Spinifera group," but is probably a member of the "Palmata group."

Antedon moræ Honeyman, 1889.
Type-locality.—41° 38' north latitude, 51° 06' west longitude (Grand Banks); 570 fathoms. British cable S. S. *Minia.*
moræ=a delay, a hindrance.
Halifax Museum.
The description is quite worthless, and the name is, to all intents and purposes, a nomen nudum.

†Antedon morierei.

Antedon mucronata Hamann, 1907.
Editorial error for *Anjedon mucronema.*

Antedon multicolor A. H. Clark, 1907.
Type-locality.—32° 33' 00" north latitude, 128° 32' 10" east longitude (Eastern Sea); 95 fathoms. U. S. S. *Albatross.*

Antedon multiradiata P. H. Carpenter, 1884.
A nomen nudum.


*Type-locality.*—10° 36' south latitude, 141° 55' east longitude (off Booby Island, Torres Straits); 6 fathoms. H. M. S. *Challenger.*

multiradiata=many-rayed. B British Museum.

**Antedon multispina** P. H. Carpenter, 1888.

1888. P. H. Carpenter, *Challenger* Reports, XXVI, Zoology, p. 102, pl. xiii, figs. 1–3; pl. xiv, figs. 5–7; pl. lxix, figs. 1–4; detailed description, pp. 117 (241), 248; first mentioned, p. 33.

*Type-locality.*—7° 54' 20" south latitude, 14° 28' 20" west longitude (near Ascension Island); 420 fathoms. H. M. S. *Challenger.*

*multispina=many-spined.* B British Museum.

†**Antedon mystica.**

**Antedon nana** Hartlaub, 1890.


*Type-locality.*—Amboina (Dr. J. Brock); Tonga Islands.

*nana=a dwarf.* Göttingen and Hamburg Museums.

**Antedon nematodon** Hartlaub, 1890.


*Type-locality.*—Bowen, Queensland.

*vīma=a thread + ὀδὸν=a tooth.* Hamburg Museum.

†**Antedon nicolasi.**

**Antedon notata** P. H. Carpenter, 1888.


*Type-locality.*—1° 54' 00" south latitude, 146° 39' 40" east longitude; 150 fathoms. H. M. S. *Challenger.*

*notata=marked.* B British Museum.

†**Antedon oblita.**

**Antedon occulta** P. H. Carpenter, 1888.


Proc. N. M. vol. xxxiv—08—32
A nomen nudum.

1888. P. H. Carpenter, *Challenger* Reports, XXVI, Zoology, p. 226, pl. XLIII, figs. 1, 2; pl. XLIX, figs. 3, 4; detailed description, p. 236; first mentioned, p. 50.

Type-locality.—19° 06′ south latitude, 178° 18′ east longitude (about) (near Kandavu, Fiji); 210–610 fathoms. H. M. S. *Challenger*.


Type-locality.—West coast of Ceylon and Gulf of Manaar; 8 to 36 fathoms.

Mr. Robert Okell. British Museum.

†Antedon orbignyi.

Antedon orientalis A. H. Clark, 1907.


Type-locality.—Off Kagoshima Gulf, Japan; 152 fathoms. U. S. S. *Albatross*.


Antedon orion A. H. Clark, 1907.


Type-locality.—30° 58′ 30″ north latitude, 130° 32′ 00″ east longitude (Eastern Sea); 152 to 103 fathoms. U. S. S. *Albatross*.

Antedon oxyacantha Hartlaub, 1890.


Type-locality.—Amboina. Dr. J. Brock. ὀξυαχάνθα=sharp+καρπόν=spine. Göttingen Museum.

†Antedon pannulatus.

†Antedon paradoxa.

†Antedon paronai.

Antedon parvicirra P. H. Carpenter, 1888.

1888. P. H. Carpenter, *Challenger* Reports, XXVI, Zoology, p. 194, pl. XXXVI, figs. 7, 8; detailed description, p. 204; first mentioned, p. 54.

Type-locality.—11° 37′ north latitude, 123° 31′ east longitude; 18 fathoms. H. M. S. *Challenger*.

parvicirra=small+κιρρον=“cirri.” British Museum.
Antedon parvipinna P. H. Carpenter, 1888.

1888. P. H. Carpenter, *Challenger* Reports, XXVI, Zoology, p. 103, pl. xv, fig. 9; detailed description, p. 127; first mentioned, p. 54.

*Type-locality.*—5° 49' 15" south latitude, 132° 14' 15" east longitude (near the Ki Islands); 140 fathoms. H. M. S. *Challenger.*

*parvus* = small; *pinna* = pinnules.

British Museum.

Antedon parvula Hartlaub, 1895.


*Type-locality.*—Off Cocos Islands (near Panama); 978 fathoms. *parvula* = very small.

Type will be deposited in U. S. National Museum.

Antedon patula P. H. Carpenter, 1888.


*Type-locality.*—5° 49' 15" south latitude, 132° 14' 15" east longitude (near the Ki Islands); 140 fathoms. H. M. S. *Challenger.*

*patula* = broad and flat.

British Museum.

†Antedonpellati.

†Antedonpennatus.

†Antedonperforata.

Antedon pergracilis A. H. Clark, 1907.


New name for *Antedon gracilis* P. H. Carpenter, 1888, pre-occupied.

*pergracilis* = very slender.

†Antedonperculi.

Antedon perplexa A. H. Clark, 1907.


*Type-locality.*—47° 29' 30" north latitude, 125° 43' 00" west longitude (off the coast of Washington); 636 fathoms. U. S. S. *Albatross.*

*perplexa* = obscure.

U. S. National Museum.

Antedon perspinosa P. H. Carpenter, 1881.


*Type-locality.*—Island of Jobie. Coll. von Rosenberg.

*perspinosa* = very spiny.

Leyden Museum.
Antedon pertusa.

Antedon petosus M'Chin, 1891.


Editorial error for Antedon petasus.

Antedon picteti.

Antedon pilularis.

Antedon pinnata.

Antedon pinniformis P. H. Carpenter, 1881.


_Type-locality._—Andai, New Guinea.

pinna = a feather + formis = shape.

Leyden Museum.

Antedon pinnulatus.

Antedon polyactinis P. H. Carpenter, 1879. ("Mus. Paris MS.")


A _nomen nudum._

πολύτεις = many + ακτίς = a ray.

Antedon polypus Hartlaub, 1893. ("Lütken MS.")


A _nomen nudum._

πολύπους = many-footed.

Antedon porrecta P. H. Carpenter, 1888.


_Type-locality._—7° 54' 20'' south latitude, 14° 28' 20'' west longitude (near Ascension Island): 420 fathoms. H. M. S. Challenger.

porrecta = extended.

British Museum.

Antedon pourtalesi P. H. Carpenter, 1888.


A _nomen nudum._


A _nomen nudum._


_Type-locality._—West Indies: 124 to 262 fathoms. U. S. S. Blake.

Mr. L. F. de Pourtalès. Museum of Comparative Zoology.

Antedon prisca.
Antedon prolixa Sladen, 1881.

1881. Sladen in Duncan and Sladen Memoir Arctic Echinoderms, p. 77.

Type-locality.—Discovery Bay, 81° 41' north latitude; 25 fathoms. Capt. H. W. Feilden.

prolixa = long.

Antedon propinqu'a A. H. Clark, 1907.


Type-locality.—32° 33' 10'' north latitude, 128° 32' 10'' east longitude (Eastern Sea); 95 fathoms. U. S. S. Albatross.

propinqu'a = near.

Antedon protectus Lütken, 1879.


A nomen nudum.


Type-locality.—Tonga Islands.

protectus = roofed over.

The very insufficient characters given in the reference cited must be accepted as the first description of this species; although now known to be non-diagnostic, at the time it was written they separated this species sharply from all others which had been described. In 1881 P. H. Carpenter (Notes from the Leyden Museum, III, p. 192 ["protecta"] gave some additional data, and compared the species with Himerometra spicata; in 1888 (Challenger Reports, XXVI, Zool., p. 225) he inserted it in his key to the "Palmata group," thereby making its specific relations clear. Ignoring all this, Hartlaub in 1890 described it as a new species (Nachr. Ges. Göttingen, May, 1890, p. 180). although in his later work (Nova Acta Acad. German., LVIII, No. 1, p. 63) he acknowledged the priority of Carpenter, 1888.

Antedon psyche A. H. Clark, 1908.


A nomen nudum.


Type-locality.—Southern Japan.

ψυχή = a spirit. Museum of Comparative Zoology.

Antedon pubescens A. H. Clark, 1907.

Type-locality.—30° 34' 00" north latitude, 129° 19' 30" east longitude (Eastern Sea); 440 fathoms. U. S. S. Albacross.


Type-locality.—West Indies.
pulchella = pretty.

This is the same species as Antedon alata Portaües, 1878, described on the previous page; alata is, of course, the name which must be used. Doctor Carpenter discarded alata and used pulchella because he thought the latter more appropriate. Pulchella is, moreover, preoccupied.

Antedon pulcher Hartlaub, 1893. ("Lütken MS.")


A nomen nudum.
pulcher = beautiful.

Antedon pumila Bell, 1884.


Type-locality.—Port Jackson; 0 to 5 fathoms. H. M. S. Alert.
pumila = a dwarf.

This is a pure synonym of Antedon loreni Bell, 1882, being founded on the same specimen.

On pl. x there are two figures lettered "B;" the present species is represented by the lower fig. B, the upper one being a misprint for "C."


1888. P. H. Carpenter, Challenger Reports, XXVI, Zoology, p. 103, pl. xxiii, fig. 1; detailed description, p. 131; first mentioned, p. 54.

Type-locality.—5° 49' 15" south latitude, 132° 14' 15" east longitude (near the Ki Islands); 140 fathoms. H. M. S. Challenger.
pusilla = little.

British Museum.

Antedon quadrata P. H. Carpenter, 1884.


Type-locality.—60° 22' 40" north latitude, 8° 21' west longitude; or 60° 31' 15" north latitude, 8° 14' west longitude (north Atlantic); 327 to 430 fathoms. H. M. S. Triton.

quadrata = quadrate (in reference to the brachials).

British Museum.
Antedon quinduplicateva P. H. Carpenter, 1888.
1888. P. H. Carpenter, Challenger Reports, XXVI, Zoology, p. 253, pl. iv, fig. 1 a-d; pl. xxxvii, figs. 4, 5; detailed description, p. 262; first mentioned, p. 9.
*Type-locality.*—6° 54' north latitude, 122° 18' east longitude; 10 fathoms. H. M. S. Challenger.
*quinduplicateva*—doubled five times.

British Museum.

Antedon quinquecostata P. H. Carpenter, 1888.
1888. P. H. Carpenter, Challenger Reports, XXVI, Zoology, p. 211, pl. iii, figs. 6 a-d; pl. xxxviii, figs. 1-3; detailed description, p. 215; first mentioned, p. 8.
*Type-locality.*—5° 49' 15" south latitude, 132° 14' 15" east longitude (near the Kermadec Islands); 630 fathoms. H. M. S. Challenger.
*quinquecostata*—five-costate=ribbed.

British Museum.

Antedon radiospina P. H. Carpenter, 1888.
1888. P. H. Carpenter, Challenger Reports, XXVI, Zoology, pl. iii, fig. 4 a-c (centrodorsal only).
*Type-locality.*—29° 45' south latitude, 178° 11' west longitude (near the Kermadec Islands); 140 fathoms. H. M. S. Challenger.
*radiospina*—radiate+spina=a spine.

British Museum.

† Antedon ransomei.

Antedon rara A. H. Clark, 1907.
*Type-locality.*—32° 27' 30" north latitude, 128° 33' 00" east longitude (Eastern Sea); 181 fathoms. U. S. S. Albatross.
*rara*—extraordinary.

U. S. National Museum.

Antedon rathbuni A. H. Clark, 1907.
*Type-locality.*—41° 04' 20" north latitude, 145° 28' 00" east longitude (Yezo Straits); 533 fathoms. U. S. S. Albatross.
Dr. Richard Rathbun.

U. S. National Museum.

Antedon regalis P. H. Carpenter, 1888.
*Type-locality.*—Tongatabu Reefs. H. M. S. Challenger.
*regalis*—regal.

British Museum.
Antedon reginae Bell, 1882.
Non-diagnostic specific formula given; full description in Bell,
Type-locality.—Port Molle, Queensland, H. M. S. Alert.
regina = a queen.
British Museum.

Antedon remota P. H. Carpenter, 1888.
1888. P. H. Carpenter, Challenger Reports, XXVI. Zoology, p. 158, pl. xxix, figs. 5–9; detailed description, p. 184; first mentioned, p. 27.
Type-locality.—46° 16' south latitude, 48° 27' east longitude near the Crozet Islands); 1,600 fathoms, H. M. S. Challenger.
remota = remote.
British Museum.

†Antedon retzii.

†Antedon rhodanica.

Antedon rhomboidea P. H. Carpenter, 1888.
1888. P. H. Carpenter, Challenger Reports, XXVI. Zoology, p. 138, pl. xii, figs. 1, 2; pl. xxiv, figs. 1–3; detailed description, p. 118; first mentioned, p. 30.
Type-locality.—50° 08' 30'' south latitude, 74° 41' 00'' west longitude; 175 fathoms. H. M. S. Challenger.
ρομβοεδής = rhomboidal.
British Museum.

†Antedon ricordeanus.

†Antedon ricordenus.

Antedon robusta P. H. Carpenter, 1888.
1888. P. H. Carpenter, Challenger Reports, XXVI. Zoology, p. 212, pl. xlv, fig. 1; detailed description, p. 220; first mentioned, p. 54.
Type-locality.—5° 49' 15'' south latitude, 132° 14' 15'' east longitude (near the Ki Islands); 140 fathoms. H. M. S. Challenger.
robusta = stout.
British Museum.

†Antedon rotunda.

Antedon ruber A. H. Clark, 1907.
Type-locality.—32° 33' 00'' north latitude, 128° 32' 10'' east longitude (Korean Straits); 95 fathoms. U. S. S. Albatross.
ruber = red.
U. S. National Museum.
Antedon rubiginosa Poutalès, 1869.
_Type-locality._—Off Orange Key, Bahama Bank; 9 fathoms. U. S. S. Bibb.
rubiginosa = rusty. Museum of Comparative Zoology.

Antedon rubroflava A. H. Clark, 1907.
_Type-locality._—34° 16' 00" north latitude, 130° 16' 00" east longitude (Korean Straits); 59 fathoms. U. S. S. Albatross.
ruber = red; flava = yellow. U. S. National Museum.

Antedon scalaris A. H. Clark, 1907.
_Type-locality._—30° 22' 00" north latitude, 129° 08' 30" east longitude (Eastern Sea); 361 fathoms. U. S. S. Albatross.
scalaris = belonging to a flight of steps. U. S. National Museum.

Antedon schleumbergeri.

Antedon sclateri Bell, 1905.
_Type-locality._—East London; 250 to 300 fathoms. Mr. W. L. Sclater.

This species was referred by the describer to Doctor Carpenter’s “Savignyi group;” in reality, however, it is a member of Carpenter’s “Granulifera group,” and is very close to Charitometra inaequalis.

Antedon scrobiculata.

Antedon semiglobosa.

Antedon (Ophiocrinus) semperi P. H. Carpenter, 1888.
1888. P. H. Carpenter, Challenger Reports, XXVI, Zoology, pl. iii.
_For Eudiocrinus semperi._

Antedon separata A. H. Clark, 1907.
_Type-locality._—32° 32' 00" north latitude, 128° 32' 50" east longitude (Eastern Sea); 106 fathoms. U. S. S. Albatross.

Antedon sequanus.
Antedon serrata A. H. Clark, 1908.
A nomen nudum.
Type-locality.—Tokio Bay, Japan; 8–12 fathoms. Alan Owston.
serrata=spiny.

Antedon serratissima A. H. Clark, 1907.
Type-locality.—48° 14' 00'' north latitude, 123° 20' 40'' west longitude (off the coast of Washington); 40 fathoms. U. S. S. Albatross.
serratissima=very serrate.

Antedon serripinna P. H. Carpenter, 1881.
Type-locality.—Andai, New Guinea.
serra=saw; pinna=pinnae.”

Antedon setosa P. H. Carpenter, 1888.
1888. P. H. Carpenter, Challenger Reports, XXVI, Zoology, p. 34.
A nomen nudum.
setosa=bristly.
†Antedon sigillata.

Antedon similis P. H. Carpenter, 1888.
1887. von Graff, Challenger Reports, XX, Zoology, Pt. 61, p. 4.
A nomen nudum.
Type-locality.—19° 06' south latitude, 178° 18' east longitude (about) (near Kandavu, Fiji); 210 to 260 fathoms. H. M. S. Challenger.
similis=like.

†Antedon solutus.
†Antedon speciosus.
†Antedon sphæroides.

Antedon spicata P. H. Carpenter, 1881.
Type-locality.—Banda Sea. Coll. Doctor Semmelink.
spicata=set with spines.
NOMENCLATURE OF RECENT CRINOIDS—CLARK.

Antedon spinicirra P. H. Carpenter, 1888.
1888. P. H. Carpenter, Challenger Reports, XXVI, Zoology, p. 102, pl. xi, figs. 1, 2: detailed description, p. 112; first mentioned, p. 54.
*Type-locality.*—34° 08' south latitude, 152° 00' east longitude (near Port Jackson); 950 fathoms. H. M. S. Challenger. 

*spinicirra* = a thorn+cirri=" cirri."

British Museum.

Antedon spinifera P. H. Carpenter, 1881.
*Type-locality.*—Guadeloupe. M. Duchassaing. 

*spinifera* = thorn-bearing. 

Paris Museum.

Antedon spinipinna Hartlaub, 1890.
*Type-locality.*—Ambon. Dr. J. Brock. 

*spinipinna* = thorn+pinna=" pinnules."

Göttingen Museum.

Antedon stella A. H. Clark, 1907.
*stella* = a star.

This name was proposed as a substitute for *Antedon tenuis*, A. H. Clark, 1907, not *Antedon tenuis*, P. H. Carpenter, 1887; the latter, however, is a nomen nudum, so that *Antedon stella* becomes a synonym of *Antedon tenuis* A. H. Clark, 1907.

†Antedon stellatus.

†Antedon striatus.

Antedon stylifer A. H. Clark, 1907.
*Type-locality.*—30° 12' 30" north latitude, 130° 43' 00" east longitude (Eastern Sea); 84 fathoms. U. S. S. Albatross. 

*stylifer* = spike-bearing. 

U. S. National Museum.

Antedon subtilis Hartlaub, 1895.
*Type-locality.*—Gaspard Strait (between Banka and Billiton, Dutch East Indies).

*subtilis* = delicate. 

Museum of Comparative Zoology.

†Antedon sulcata.

Antedon tanneri Hartlaub, 1895.
1895. Hartlaub, Bull. Mus. Comp. Zool., XXVII, No. 4, p. 141, pl. i, fig. 9; pl. ii, fig. 13; pl. iii, figs. 20, 22; first mentioned, p. 129.
Type-locality.—Entrance to Bay of Panama; 286 fathoms. 
U. S. S. Albatross.
Capt. Z. N. Tanner, U. S. N.

Type will be deposited in U. S. National Museum. 

†Antedon taurinensis.

Antedon tenax von Graff, 1884. ("Lütken MS.")
A nomen nudum.
tenax=tenacious.

Antedon tenelloides A. H. Clark, 1907.
detailed description, p. 73.
Type-locality.—35° 04' 50" north latitude, 139° 38' 18" east longitude (Uraga Straits, entrance to Tokyo Gulf): 70 fathoms. U. S. S. Albatross.
tenelloides=resembling (Antedon) tenella.

U. S. National Museum.

Antedon tener Lütken, 1877.
A nomen nudum.
This refers, however, to the succeeding species.

Antedon tenera Hartlaub, 1890.
tenera=tender, soft.

Hamburg and Göttingen Museums.
This specific name was misspelled tenera by Hartlaub, 1893,
and has since been similarly misspelled by other authors.

Antedon tenuicirra Hamann, 1907.
Editorial error for Antedon tenuicirra.

Antedon tenuicirra P. H. Carpenter, 1888.
1888. P. H. Carpenter, Challenger Reports, XXVI, Zoology, p. 158, pl. xxx, figs. 4–8; pl. xxxiii, figs. 4, 5; detailed description, p. 186; first mentioned, p. 54.
Type-locality.—1° 54' 00" south latitude, 146° 39' 40" east longitude: 150 fathoms. H. M. S. Challenger.
tenuis=slender+cirra=“cirri.”

British Museum.

Antedon tenuipinna Hartlaub, 1890.
detailed description, p. 178.
Type-locality.—Matupi, New Britain. Dr. O. Finsch.
tenuis=slender+pinna=“pinnules.”

Berlin Museum.
Antedon tenuis P. H. Carpenter, 1887.
A nomen nudum.
tenuis = slender.

Antedon tenuis A. H. Clark, 1907 (not Antedon tenuis P. H. Carpenter, 1887).
Type-locality.—47° 38' 40" north latitude, 141° 24' 30" east longitude (Gulf of Tartary); 318 fathoms. U. S. S. Albatross.
tenuis = slender.

This species has been renamed Antedon stella. It must be known as Antedon tenuis, however, as Carpenter's name, being a nomen nudum, has no effect on the validity of the specific name tenuis as applied to this species.

†Antedon tessoni.

Antedon thetis A. H. Clark, 1907.
Type-locality.—8.83 miles west of Suno Saki, Hondo, Japan; 46 fathoms. U. S. S. Albatross.
Θετίς = a sea nymph.

†Antedon thiollierei.

Antedon tigrina A. H. Clark, 1907.
Type-locality.—Kagoshima Bay, Japan. U. S. Exploring Expedition.
tigrina = striped like a tiger.

†Antedon tortiæ.

Antedon triqueta von Graff, 1884. ("P. H. Carpenter MS.")
1884. von Graff, Challenger Reports, X. Zoology, Pt. 27, pp. 13, 15, 16.
A nomen nudum.
triqueta = three-cornered.

†Antedon truncata.

Antedon tuberculata P. H. Carpenter, 1888.
1887. von Graff, Challenger Reports, XX. Zoology, Pt. 61, p. 4.
A nomen nudum.
Type-locality.—19° 06' south latitude, 178° 18' east longitude (near Kandavu, Fiji); 210 to 610 fathoms. H. M. S. Challenger.

*Antedon tuberosa* P. H. Carpenter, 1888.


1888. P. H. Carpenter, *Challenger* Reports, XXVI, Zoology, p. 103, pl. xiv, fig. 9; pl. xxiii, fig. 2; detailed description, p. 126.

Type-locality.—9° 26' north latitude, 123° 45' east longitude (off Panglao and Siquijor); 375 fathoms. H. M. S. Challenger.

*Antedon typica* Hartlaub, 1890.


*Antedon valida* P. H. Carpenter, 1888.

1888. P. H. Carpenter, *Challenger* Reports, XXVI, Zoology, p. 102; pl. xv, figs. 5–8; detailed description, p. 104; first mentioned, p. 51.

Type-locality.—4° 33' north latitude, 127° 06' east longitude (off the Meangis Islands); 500 fathoms. H. M. S. Challenger.

*Antedon variipenna* P. H. Carpenter, 1888.


*Antedon variipinna* P. H. Carpenter, 1882.


Type-locality.—Canton, China.

*varius*=varied *pinna* = "pinnules." Hamburg Museum.

*Antedon variispina* Bell, 1894.


*Antedon versicolor* A. H. Clark, 1907.


Type-locality.—32° 32' 00" north latitude, 129° 30' 45" east longitude (Eastern Sea); 53 fathoms. U. S. S. *Albatross*.

Antedon vicaria Bell, 1894.

Type-locality.—Macclesfield Bank; 30 to 40 fathoms.

vicaria=various.

This species is not identifiable from the published description. Although described in the "Spinifera group," it is in reality a member of the "Palmata group."

Antedon villosa A. H. Clark, 1907.

Type-locality.—52° 01' 00'' north latitude, 174° 39' 00'' east longitude (Bering Sea); 1,046 fathoms. U. S. S. Albatross.

villosa=rough, bristly.

Antedon wilsoni Bell, 1888.

Type-locality.—Port Phillip. Mr. J. Bracebridge Wilson.

Mr. J. Bracebridge Wilson. British Museum.

Antedon wood-masoni Bell, 1893.

Type-locality.—Sahul Bank, North Australia.

Mr. J. Wood-Mason. British Museum and Indian Museum, Calcutta.

Antedon Stebbing, 1877.

This is considered to be the correct spelling for "Antedon," and has recently been accepted by Minckert, Zool. Anz., XXVIII, p. 491, and following (1905).

Asterias Linnaeus, 1758.

Type.—Asterias rubens (n. sp.). (Belongs to the Asteroidea, not to the Crinoidea.)

Asterias bifida Pennant, 1777.
1777. Pennant, British Zoology, IV, p. 65, No. 70.

Type-locality.—Cornwall, England.

bifida=divided into two parts (in reference to the arms).

Asterias decacnemus Pennant, 1777.
1777. Pennant, British Zoology, IV, p. 66, No. 71, pl. xxxiii.

Type-locality.—Western coasts of Scotland.

δέκα=ten + νῆμα=thread.
Asterias multiradiata **Linnaeus**, 1758.


*Type-locality.*—Indian Seas.

*multiradiata* = many-rayed.

Lund Museum.

This, of course, is not the *Asterias multiradiata* of Gray, which forms the type of his genus *Heliaster*.

Asterias pectinata **Linnaeus**, 1758.


*Type-locality.*—Indian Seas.

*pectinata* = combed.

Lund Museum.

Like the preceding, this was originally a composite species, but Doctor Carpenter has revised them both and restricted each name to a definite specific type. Fortunately, the history of each name is such as to permit of accepting his conclusions. *Pectinata* originally included the *Asterias bifida* of Pennant, and was used exclusively for that species by Barbut in 1783, Olivi in 1792, and by Adams in 1800; in 1777 Pennant restricted *pectinata* by removing *Asterias bifida* from it, leaving the name for certain tropical forms, among which was the *Actinometra pectinata* of Carpenter (the *Asterias pectinata* of Retzius, 1783), to which the name is now fixed.

Asterias radiata W. B. Carpenter, 1866.


Editorial error for *Asterias pectinata*.

Asterias tenella Retzius, 1783.


*Type-locality.*—Santa Cruz (? Danish West Indies); later this is corrected to read "in oceanoAmericano."

*tenella* = delicate.

Lund Museum.

Astrophyton, a genus of Ophiuroidea.

*αστρυ&omicron;= star+ φυ&omicron;τον= a creature.

Astrophyton elizabethae McIntosh, 1866.


*Type-locality.*—North Uist, outer Hebrides; 6 fathoms.

"Named after a zoological benefactress."

This is the *Asterias bifida* of Pennant.

Atecto J. Müller, 1843.


Typographical error.
Atelecrinus P. H. Carpenter, 1881.


Type.—Atelecrinus balanoides P. H. Carpenter (n sp.).

Atelecrinus balanoides P. H. Carpenter, 1881.


Type-locality.—Off Nevis, British West Indies; 356 fathoms. U. S. S. Blake.


†Atelecrinus belgicus.

Atelecrinus conifer A. H. Clark, 1908.


Type-locality.—Off the north coast of Molokai, Hawaiian Islands; 552–809 fathoms. U. S. S. Albatross.


Atelecrinus cubensis P. H. Carpenter, 1881.


cubensis = of Cuba.

Doctor Carpenter referred this name to the Antedon cubensis of Pourtalès; but, as the type of that species is quite a different form, and two species of two distinct families obviously can not share a single specific name, even although it was originally a composite, this species has been renamed Atelecrinus pourtalesi.

Atelecrinus pourtalesi A. H. Clark, 1907.


Type-locality.—Off Cojima, near Havana, Cuba; 450 fathoms. U. S. S. Bibb.

Mr. L. F. de Pourtalès. Museum of Comparative Zoology.

New name for Atelecrinus cubensis P. H. Carpenter, 1881, not Antedon cubensis Pourtalès, 1869.

Atelecrinus wyvillii P. H. Carpenter, 1882.


Type-locality.—19° 07' 50'' south latitude, 178° 19' 35'' east longitude (near Fiji); 610 fathoms. H. M. S. Challenger. Sir C. Wyville Thomson. British Museum.

Bathycrinus Wyville Thomson, 1878.


Editorial error for Bathycrinus.

Proc. N. M. vol. xxxiv—08—33
Bathycrinus Wyville Thomson, 1872.


Type.—Bathycrinus gracilis Wyville Thomson (n. sp.).

Bathycrinus alarchianus Perrier, 1885.


Editorial error for aldrichianus.

Bathycrinus aldrichianus Wyville Thomson, 1878.


Type-locality.—1° 47' north latitude, 24° 26' west longitude; 1,850 fathoms. H. M. S. Challenger.

Lieut. Pelham Aldrich, R. N.

British Museum.

Bathycrinus australis A. H. Clark, 1907.


Type-locality.—46° 46' south latitude, 45° 31' east longitude (near the Crozet Islands): 1,375 fathoms. H. M. S. Challenger.

australis = southern.

New name for Bathycrinus aldrichianus P. H. Carpenter, 1888 (not of Wyville Thomson, 1878).

Bathycrinus campbellianus P. H. Carpenter, 1884.

1884. P. H. Carpenter. Challenger Reports, XI, Zoology, p. 238, pl. viii, figs. 22, 23; pl. viii; wood-cut fig. 15, p. 239 (the latter the same one used by Wyville Thomson to illustrate his B. aldrichianus).

Lieut. Lord George Campbell, R. N.

This species was founded on the type specimen of Bathycrinus aldrichianus.

Bathycrinus caribbeus A. H. Clark, 1908.


Type-locality.—16° 54' north latitude, 63° 12' west longitude; 687 fathoms. U. S. S. Albatross.

caribbeus = Caribbean.

U. S. National Museum.

Bathycrinus complanatus A. H. Clark, 1907.


Type-locality.—40 miles S. S. W. ½ W. of Southeast Cape, Copper Island; 1,567 fathoms. U. S. S. Albatross.

complanatus = flattened.

U. S. National Museum.

Bathycrinus equatorialis A. H. Clark, 1908.

Type-locality.—$0^\circ 3.4'$ north latitude, $117^\circ 15.8'$ west longitude (between the Marquesas Islands and Central America); 2,320 fathoms. U. S. S. Albatross.


Bathycrinus gracilis Wyville Thomson, 1872.

1872. Wyville Thomson, Proc. Roy. Soc. Edinb., VII, p. 772. Type-locality.—$47^\circ 38'$ north latitude, $12^\circ 08'$ west longitude (Bay of Biscay); 2,435 fathoms. H. M. S. Porecupine.

gracilis = slender. British Museum.

Bathycrinus minimus Döderlein, 1907.

1907. Döderlein, Die gestielten Crinoiden der Siboga-Expedition, p. 8, pl. 1, fig. 1; pl. 11, figs. 1–1/f; pl. vi, fig. 5; fig. 1, p. 8.

Type-locality.—$0^\circ 34.6'$ north latitude, $119^\circ 8.5'$ east longitude (near Celebes, Straits of Macassar); 1,301 meters. Dutch S. S. Siboga.

minimus = smallest.

Bathycrinus nodipes Döderlein, 1907.

1907. Döderlein, Die gestielten Crinoiden der Siboga-Expedition, p. 8, pl. 1, figs. 2–4; pl. 11, figs. 1, 2; pl. 14, figs. 1–5; pl. v, figs. 1–4; pl. vi, figs. 1–3; full description, p. 9; first mentioned, p. 4.

Type-locality.—$0^\circ 34.6'$ north latitude, $119^\circ 8.5'$ east longitude (Straits of Macassar); 1,301 meters; or $4^\circ 24.3'$ south latitude, $129^\circ 49.3'$ east longitude (off Banda); 1,570 meters. Dutch S. S. Siboga.

nodus = a knot; pes = foot.

Bathycrinus pacificus A. H. Clark, 1907.


Type-locality.—Shio Misaki Light (south coast of Hondo, Japan), bearing N. $25^\circ$ E., 8.7 miles distant; 905 fathoms. U. S. S. Albatross.

pacificus, for the Pacific Ocean. U. S. National Museum.

Bathycrinus poculum Döderlein, 1907.

1907. Döderlein, Die gestielten Crinoiden der Siboga-Expedition, p. 8, pl. 1, fig. 4/f; pl. 11, figs. 2–2d; pl. vi, fig. 4; detailed description, p. 12.

Type-locality.—$1^\circ 24.3'$ south latitude, $129^\circ 49.3'$ east longitude (near Banda); 1,570 meters. Dutch S. S. Siboga.

poculum = a cup.

Bathycrinus serratus A. H. Clark, 1908.

Type-locality.—Off the coast of Virginia; 2,045 fathoms. U. S. S. Albatross.

Bathymetra A. H. Clark, 1908.

Bathymetra se'vrae=sevrae. TJ. S. National Museum.


Bathymetra carpenteri A. H. Clark, 1908.

Dr. P. Herbert Carpenter. British Museum.

Bathycrinus Verrill, 1885.

†Bourgueticrinus hotessieri (not of d’Orbigny) Pourtalès, 1868.
1868. Pourtalès, Bull. Mus. Comp. Zool., I, No. 7, p. 128. Pourtalès under this name referred to some specimens of the form now known by Sars’ name Rhizocrinus lofotensis from the Samboes and off Sand Key, considering them possibly the same as a fossil species from Guadeloupe.

†Cainocrinus Forbes, 1852.
1852. Forbes, Monogr. of the Echinod. of the British Tertiaries, p. 34. Type.—†Cainocrinus tintinnabulum Forbes (n. sp.). καϊνος=new + κρινον=lily.

Calamocrinus A. Agassiz, 1890.
1890. A. Agassiz, Neues Jahrb. für Mineral., I, p. 95; also Bull. Mus. Comp. Zool., XX, No. 6, p. 165. Type.—Calamocrinus diomedæ A. Agassiz (n. sp.). καλαμος=a reed or cane + κρινον=lily.

Calamocrinus diomedæ A. Agassiz, 1890.
Calometra A. H. Clark, 1907.
*Type.*—*Antedon callista* A. H. Clark, 1907.
καλός = handsome + metra.

Carpenterocrinus A. H. Clark, 1908.
*Type.*—*Pentacrinus mollis* P. H. Carpenter, 1884.
Dr. P. Herbert Carpenter.

Catoptometra A. H. Clark, 1908.
*Type.*—*Antedon hartlaubi* A. H. Clark, 1907.
κατοπτρός = conspicuous + metra.

Cenocrinus Wyville Thomson, 1864 (not *Cainocrinus* Forbes, 1852, which has the same derivation).
*Type.*—*Pentacrinites caput-medusae* Miller, 1821 = *Encrinus caput-medusae* Lamarck, 1816 = *Isis asteria* Linnaeus, 1766.
καινόν = “recent” + κρινόν = lily.

Charitometra A. H. Clark, 1907.
*Type.*—*Antedon incisa* P. H. Carpenter, 1888.
χαρις = beauty + metra.

Charitometra imbricata A. H. Clark, 1908.
imbricata = imbricating.

Charitometra lateralis A. H. Clark, 1908.
lateralis = lateral.

U. S. National Museum.
Cladactis Rafinesque, 1815.
A nomen nudum.
Possibly an ophiuroid; no type is mentioned.

Coccometra A. H. Clark, 1908.
Type.—Comatula hagenii Poupartes, 1869.
koko1soς = a berry, a kernel + metra.

Coccometra nigrolineata A. H. Clark, 1908.
Type-locality.—Porto Rico.
niger = black + lineata = lined.

Comaster L. Agassiz, 1836.
Type.—Comatula multiradiata Lamarck, 1816 = Asterias multiradiata Linnaeus, 1758.
coma = hair + aster = a star.

It has been stated by several authors, following Müller, 1841, that Comaster was based on Comatula multiradiata Goldfuss (not of Linnaeus nor of Lamarck) (= Alecto nova-guineae J. Müller), but this is a mistake. The type of the genus is the species cited above.

Comaster carpen teri A. H. Clark, 1908.
New name for Actinometra multifida P. H. Carpenter, 1888 (not Alecto multifida J. Müller, 1841).
Dr. P. H. Carpenter.

Comaster imbricata A. H. Clark, 1908.
Type-locality.—Sagami Bay, Japan; 50 fathoms. Mr. Alan Owston.
imbricata = imbricating.

Comatula Lamarck, 1816.
Type.—Comatula solaris Lamarck (n. sp.).
coma = a lock of hair + diminutive suffix.

It is a little difficult to understand just why Dr. P. H. Carpenter ignored this genus. In his treatment of the unstalked crinoids he used Antedon for the endocyclic forms, Actinometra for the exocyclic; but he used Comatula as a general term to include both. Antedon was proposed to cover a single species, the only one, apparently, known to de Fréminville (A. gorgonia = Asterias bifida Pennant); Comatula was proposed as a
term to include all the living free crinoids, and eight species are included by Lamarck under that heading, no particular one being selected as the type; his generic diagnosis, however, is quite explicit; it reads, "bouche inférieur, centrale, isolée, membranuse, tubuleuse, saillante." This obviously refers to the anal tube, taken by Lamarck for the mouth, and makes it plain that this diagnosis was drawn up from an exocyclic species; in other words, Comatula, as originally defined by Lamarck, is practically the same as Actinometra as rediagnosed by Doctor Carpenter. Subsequent authors have all either accepted Comatula for all free crinoids, or (following Carpenter) abandoned it altogether; the genus has never been revised. It becomes necessary, therefore, to decide upon a type, and we have no choice but to accept the first species, Comatula solaris, which species, moreover, accords perfectly with the generic diagnosis drawn up by Lamarck. Actinometra was founded by Müller in 1841, the type being Actinometra imperialis, a species described at the same time; but Actinometra imperialis is a synonym of Comatula solaris, as Müller himself discovered later, so Actinometra Müller, 1841, is a pure synonym of Comatula Lamarck, 1816, being based on the same species as type.

Comatula actinodes DuJardin and Hupe, 1862.
A nomen nudum.
ακτινοσθόδης=like rays.

Comatula adeona Lamarck, 1816.

Adeona=a genus of hydroids.

This species has never been properly described, and has never been figured, so that its true status and affinities remain uncertain. The multibrachiate "Comatula adeona" figured by de Blainville, is, of course, a case of misidentification. It is a copy of the figure illustrating the Comatula multiradiata of Audouin (not of Lamarck) from the Red Sea, upon which Müller’s name savignii is based.

Comatula annulata Risso, 1826.
Type-locality.—Nice.
annulata=banded.
Comatula (Alecto) articulata J. Müller, 1849. ("Valenciennes MS.")
Type-locality.—Moluccas. MM. Quoy and Gaimard.
articulata=jointed.

Comatula barbata Fleming, 1828.
Type-locality.—West coast of Scotland; Wales.
barbata=bearded.

Comatula bicolor Delle Chiaie, 1841.
1841. Delle Chiaie. Descrizione e notomia degli animali invertebrati della Sicilia citeriore, IV, p. 65, pl. clxxii, figs. 6, 7.
Type-locality.—Pozzuoli and Mondrazione, Sicily.
bicolor=two-colored.

Comatula bicolor Dujardin and Hupé, 1862 (not of Delle Chiaie, 1841).
A nomen nudum.
bicolor=two-colored.

Comatula (Actinometra) borneensis Grube, 1875.
Type-locality.—North Borneo.
borneensis=of Borneo. Type lost.

Comatula brachiolata Lamarck, 1816.
Type-locality.—Atlantic Ocean (probably erroneous).
brachiolata=with arms.

Comatula breviceirra P. H. Carpenter, 1879. ("Troschel MS.")
A nomen nudum.
brevis=short; cirra=“cirri.”

Comatula brevipinna, Poutealès, 1868.
Type-locality.—Off Havana, Cuba; 270 fathoms. U. S. S. Corwin.
breris=short; pinna=“pinnules.”

Comatula brownii.

Comatula carinata Lamarck, 1816.
Type-locality.—Mauritius. M. Mathier.

This is possibly the same species as that called by Doctor Leach Alecto carinata in the previous year; Leach's description is, however, worthless, and his type is lost, whereas, thanks to Dr. P. H. Carpenter, we know what Lamarck's species really is, as he examined the type. The species should, therefore, be referred to Lamarck, 1816.

Comatula celtica Barrett and McAndrew, 1858.
celticus=Celtic.

New name for Comatula woodwardii Barrett 1857 (not †Comatula woodwardii Forbes, 1852).

†Comatula claudiana.

Comatula coccodistoma Dujardin and Hupe, 1862.
A nomen nudum.
A nomen nudum.
kókkos=a kernel + δίστομα=with two openings.

†Comatula conoidea.

Comatula coralina Risso, 1826.
Type-locality.—Nice.
coralina=of coral.

Comatula cumingii J. Müller, 1849.
Type-locality.—Malacca. Mr. Hugh Cuming.
Mr. Hugh Cuming. Berlin Museum.

†Comatula depressa.

Comatula dibrachiata Dujardin and Hupe, 1862.
A nomen nudum.
dibrachiata=double-armed.

Comatula dividua Dujardin and Hupe, 1862.
A nomen nudum.
dividua=divided.
Comatula dubia **von Graff**, 1877.

1877. **von Graff**, *Das Genus Myzostoma*, pp. 15, 22, 72, 79.

*A nomen nudum.*

*dubia* = uncertain.

(See *Antedon dubia.*)

Comatula echinoptera **J. Müller**, 1840.


Syzygial interval only given; *not recognizable* (see *Alecto echinoptera*).

Comatula elongata **J. Müller**, 1841. ("Mus. Leyd. MS.")


A manuscript name adopted by Müller in his description of *Alecto elongata*.

Comatula eschrichtii **J. Müller**, 1840.


Syzygial interval only given; the species was fully described under the name of *Alecto eschrichtii* (*q. v.*) in the following year. The description here given must be considered unrecognizable.

†Comatula exilis.

Comatula fimbriata **Lamarck**, 1816.


*Type-locality.*—Australian seas. MM. Péron and le Sueur.

*fimbriata* = fringed. Paris Museum.

Comatula fimbriata **Miller**, 1821 (not *Comatula fimbriata Lamarck*, 1816).

1821. **Miller**, *A Natural History of the Crinoidea*, p. 132, and frontispiece.

*Type-locality.*—Milford Haven.

This species has been renamed *Comatula milleri*.

Comatula flagellata **J. Müller**, 1841. ("Mus. Leyd. MS.")


*flagellata* = whip-shaped.

A manuscript name adopted by Müller in his description of *Alecto flagellata*.

Comatula glacialis **Dujardin and Hupé**, 1862.


*A nomen nudum.*

*glacialis* = cold; icy.
Comatula (Alecto) hagenii Pourtalès, 1868.
_Type-locality._—Off Sand Key, Florida; 100 fathoms. U. S. S. Corwin.

Dr. H. A. Hagen. Museum of Comparative Zoology.

Comatula (Actinometra?) hamata Kuhl and van Hasselt, 1869.
_Type-locality._—Cape Bantam (=Cape Bantano).

hamata=bearded. Leyden Museum.

Comatula helianthus, new name for Actinometra elongata P. H. Carpenter, 1888, not Comatula elongata J. Müller, 1849.

"Haioz=the sun; ἀνθος=a flower.

Comatula holmesi Pourtalès, 1869.

Comatula indica Smith, 1879.
_Type-locality._—Rodriguez. Mr. H. H. Slater. indica=of India.

Comatula inserta Dujardin and Hupé, 1862.

Comatula jacquinotii J. Müller, 1846. ("Valenciennes MS.")
_Type-locality._—Ceram. M. Honoré Jacquinot.

Comatula japonica J. Müller, 1841. ("Mus. Leyd. MS.")

Comatula laevissima Grube, 1875.
_Type-locality._—North Borneo. laevissima=very insignificant. Breslau Museum.

†Comatula longimana.

Comatula macronema J. Müller, 1846. ("Valenciennes MS.")
Type-locality.—King George's Haven, New Holland. MM. Quoy and Gaimard.


Comatula mariae A. H. Clark, 1907.


Type-locality.—34° 16' 00'' north latitude, 130° 16' 00'' east longitude (near the Oki Islands, sea of Japan); 59 fathoms.

U. S. S. Albatross.


Comatula mediterranea Lamarck, 1816.


Type-locality.—Mediterranean. M. de Lalande.


†Comatula mediterraneaformis.

Comatula mertensi Grube, 1875.


Type-locality.—North Borneo. Dr. Carl H. Mertens.

Dr. Carl H. Mertens.

Comatula (Alecto) milberti J. Müller, 1846. ("Valenciennes MS.")


Type-locality.—"North America: type brought from New York," (probably, however, Indian Ocean; the species does not occur in the Atlantic).


Comatula milleri J. Müller, 1849.


Mr. J. S. Miller.

New name for Comatula fimbriata Miller, 1821, not Comatula fimbriata Lamarck, 1816.

Comatula moniliformis Dujardin and Hupé, 1862.


A nomen nudum.

monile=a necklace+formis=form.

Comatula monilis Dujardin and Hupé, 1862.


A nomen nudum.

monile=a necklace.

Comatula multistriata de Loriol, 1889.


Editorial error for Comatula multiradiata.
Comatula nigra von Graff, 1877. ("Semper MS.")
A nomen nudum.
nigra=black.
(See Actinometra nigra.)

Comatula novæ-guineæ J. Müller, 1841. ("Mus. Leyd. MS.")
A manuscript name adopted by Müller in his description of Alecto novæ-guineæ.

Comatula orientalis A. H. Clark, 1907.
orientalis=eastern.
New name for Actinometra simplex P. H. Carpenter, 1888, not Comatula simplex P. H. Carpenter, 1879 and 1881.

Comatula philiberti J. Müller, 1849. ("Valenciennes MS.")
Type-locality.—Java. M. Philibert.

Comatula picta Dujardin and Hupé, 1862.
A nomen nudum.
picta=painted.

† Comatula pinnata.

Comatula polyactinia Dujardin and Hupé, 1862.
A nomen nudum.
πολύς=many + ἀκτινόεις=emitting rays.

Comatula polyartha J. Müller, 1840.
Editorial error for Comatula polyartha.
† Comatula polydactyla.
† Comatula ransomi.

Comatula (Alecto) reynaudi J. Müller, 1846. ("Valenciennes MS.")
Type-locality.—Ceylon. M. Jean Ernest Reynaud.

Comatula rosacea Fleming, 1828.
Type-locality.—Pensance (Luid); Milford Haven.
rosacea=rosy.
This is the first post-Linnæan reference to the specific name rosecæae. It is antedated by bijīfida Pennant, 1777, gorgonia de Fréminville, 1811, mediterranea Lamarck, 1816 [pimbricida Mill., 1821, not available], annulata Risso, 1826, and coralina Risso, 1826.

Comatula rosea J. Müller, 1841. ("Mus. Vienn. MS.")

rosca=rosy.

A manuscript name adopted by Müller in his description of Alecto rosecæa.

Comatula rotalaria Lamarck, 1816.

Type-locality.—Australian Seas. MM. Péron and le Sueur.

rotalaria=eticular.

Comatula rotularia de Blainville, 1836.
1836. de Blainville Manuel d'Actinologie [1834], p. 249.

Editorial error for Comatula rotalaria.

Comatula scita Dujardin and Hupe, 1862.

A nomen nudum.

scita=beautiful, elegant.

Comatula serrata A. H. Clark, 1907.

Type-locality.—32° 33' 10" north latitude, 128° 32' 10" east longitude (southern part of the Sea of Japan); 95 fathoms. U. S. Albatross.

serrata=serrate.

This species belongs to the genus Comaster, and not to Comatula, as stated in Proc. U. S. Nat. Mus., XXXIII, p. 685.

Comatula simplex P. H. Carpenter, 1881.

A nomen nudum.


A nomen nudum.


Type-locality.—Australia. MM. Péron and le Sueur.

Comatula solaris Lamarck, 1816.


Type-locality.—Australian Seas. MM. Péron and le Sueur.

solaris = of the sun.

Comatula solaster A. H. Clark, 1907.


Type-locality.—31° 38' 15" north latitude, 130° 46' 50" east longitude (in Kagoshima Gulf); 43 fathoms. U. S. S. Albatross.

solaris = sun, solaster = star.

Comatula tenella. This is the type of the genus Saccocoma L. Agassiz, 1836, and is not congeneric with Asterias tenella Retzius.

Comatula timorensis J. Müller, 1841. ("Mus. Leyd. MS.")


A manuscript name adopted by Müller in his description of Alecto timorensis.

Comatula trichoptera J. Müller, 1846. ("Valenciennes MS.")


Type-locality.—King Georges Haven, New Holland. MM.

Quoy and Gaimard.

trichoptera = hair + πτερόν = wing.

Comatula triquetra von Graff, 1877. ("Lütken MS.")

1877. von Graff, Das Genus Myzostoma, pp. 12, 13, 14, 15, 16, 18, 22, 23, 72, 79.

A nomen nudum.

triqvetra = three-cornered.

Comatula wagneri.

Comatula woodwardii Forbes, 1852.

1852. Forbes, Monograph of the Echinoderms of the British Tertiaries, p. 19, pl. i, fig. 20.

Comatula woodwardii Barrett, 1857 (not of Forbes, 1852).


Type-locality.—Sound of Skye; 25 to 40 fathoms.

Mr. S. P. Woodward.

This species has been renamed Comatula celtica.

Comatulus Linville and Kelly, 1906.


Intended for Antedon.
Compsometra A. H. Clark, 1908.
Type.—Antedon loreni Bell. 1882 (=Antedon pumila Bell. 1884).

Cyllometra A. H. Clark, 1907.
Type.—Antedon manca P. H. Carpenter, 1888.

Cyllometra albopurpurea A. H. Clark, 1908.
Type-locality.—Entrance to Tokyo Gulf, Japan: 58 fathoms.
U. S. S. Albatross.

Cyllometra belli A. H. Clark, 1907.
This name was originally proposed as a substitute for Antedon loreni Bell, 1884, not Antedon loreni Bell, 1882; but Antedon loreni Bell, 1884 = Antedon insignis Bell, 1882; therefore Cyllometra belli is a pure synonym of Antedon insignis Bell, 1882. Professor F. Jeffrey Bell.

[Decacnimos; not binomial, although listed as such by Mr. C. D. Sherborn. See under Eucrinus.]

Decametrocrinus Minckert, 1905.
Type.—Promachocrinus abyssorum P. H. Carpenter, 1888.

Decametrocrinus borealis A. H. Clark, 1907.
Type-locality.—30° 22′ 00′′ north latitude, 129° 08′ 30′′ east longitude (Eastern Sea); 361 fathoms. U. S. S. Albatross.

No type is mentioned by the author, but two species, Promachocrinus abyssorum and Promachocrinus naresi, are assigned to it, of which the former agrees rather better with the generic diagnosis.

Decametrocrinus rugosus A. H. Clark, 1908.

Type-locality.—Off Bird Island, Hawaiian Islands; 762-1,000 fathoms. U. S. S. Albatross. 


Democrinus Perrier, 1883.

Type.—Democrinus parfaiti Perrier (n. sp.) [=Rhizocrinus rawsonii Pourtalès].

δέμω=to build+κρίνω=lily.

Democrinus parfaiti Perrier, 1883.

Type-locality.—Off the coast of Morocco, near Cape Blanche; 1,900 meters. French S. S. Travaillleur. 
M. T. Parfait, commander of the Travaillleur. Paris Museum.

(?) Diteropus Rafinesque, 1815.

A nomen nudum. 
Possibly an Ophiuroid; no type is mentioned.

†Encrinus Schulze, 1760; not binomial; see following.]

†Encrinus Andreae, 1763.

Type.—Encrinus coralloides (n. sp.), founded on Brückner Versuch einer Beschreibung historisch und natürlicher Merkwürdigkeiten der Landschaft Basel. Part 6, pl. figs. g, h, i, k, l, m (1748). 

έν=in+κρίνω=lily.

According to Bather, Encrinus dates from Schulze, Betrachtung der versteinerten Seeesterne und ihrer Theile, p. 27, No. 17 (1760); this work is, however, non-binomial, and can not, therefore, serve as the original reference for any names employed according to the present usages in nomenclature. Schulze uses the names in a purely historical sense, and takes all of them from previous authors, and he says of Encrinus, "Man findet gewisse Versteinerung, die, in Ansehung ihrer Gestalt, einige Gleichheit mit einer Lilie zu haben scheint; daher man dieselbe anfänglich für die Versteinerung dieser Blume gehalten, und sie die Lilienstein, Encrinum genommen hat," showing that he was merely repeating the name by which these fossils were known to pre-Linnaean authors. It should be noticed that Schulze makes no reference whatever to Linnaeus' work. While it would save 

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a vast amount of trouble if we could accept Schulze as the authority for such names as Encrinus, Astropecten, Palmipes, Pentagonaster, etc., it must be emphatically stated that such a course would be entirely unwarranted; it would be more sensible to date everything from Linck 1733, and other early authors than from a compiler who copied their names. Mr. Bather lays himself open to a charge of inconsistency; for, while, accepting Encrinus from Schulze in 1898, in 1899 we find him still using Antedon (de Fréminville 1811) and Actinometra (J. Müller 1841) instead of Decacrinus, Triscadecacrinus, and Polyactinis used by Schulze (taken from Linck and Seba) for these genera. Surely if one of Schulze's names be valid, all of them are.

Andreae, so far as the names given by himself go, was a binomialist in the Linnaean sense, although, like most of the early workers, he employed the polynomials of his predecessors. He gives many references to Linnaeus, showing that he was acquainted with his work, and he is accepted by the leading ornithologists as consistently binomial, his bird names, such as Fringilla gularis being accepted.

I have not been able to consult the Hannoverische Magazin, nor the work of Brückner. So far as I can judge, Encrinus coraloides appears to be the same as the Pentacrinites fossilis of Blumenbach 1804, in which case Pentacrinites becomes a pure synonym of Encrinus.

Encrinus australis Anonymous, 1845.
_Type-locality._—Newcastle, on the Hunter River, Australia. Rev. C. Pleydell.
australis = southern.

This cannot be a crinoid.

Encrinus caput-medusae Lamarck, 1816.
_Type-locality._—Martinique.
caput = head; _Medusa_ = Medusa, one of the Gorgons.
Encrinus caput-medusae Lamarck 1816 = Isis asteria Linnaeus, 1766.

Encrinus milleri Guilding, 1828 (not _Encrinites milleri_ von Schlotheim, 1822).
_Type-locality._—St. Vincent, West Indies.
Mr. J. S. Miller.

The species of Isoencrinus to which this name belongs can not be determined from the description.
Encrinus parrae Guérin, 1835.

1835. Guérin, Dict. d’Hist. Nat., III, p. 49, pl. 147, fig. 1. Type-locality.—Off Havana, Cuba.

Señor Antonio Parra.

This species is based on the "Palma animal" of Parra (Description de diferentes piezas de Historia Natural. Havana, 1787, p. 191, pl. lxx, facing p. 191). Parra’s plate (which is copied by Guérin), represents a remarkably fine specimen of the species subsequently called Pentacrinus mülleri by Örsted.

The short internodes, consisting of only three or four columnars, and the consequent crowding of the cirri are sufficient to identify the species beyond question. The Pentacrinus mülleri of Örsted, P. H. Carpenter, and other authors, must be known as Isocrinus parva.

Endiocrinus Bather, 1899.


Typographical error for Endiocrinus.

Endoxocrinus A. H. Clark, 1908.


Endoxocrinus granulatus A. H. Clark, 1908.


Erythrometra A. H. Clark, 1908.


Eudiocrinus P. H. Carpenter, 1882.


New name for Ophiocrinas Semper, 1868 (not Ophiocrinus Salter, 1856).

New name for Ophiocrinas Semper, 1868 (not Ophiocrinus Salter, 1856).

Eudiocrinus atlanticus Perrier, 1883.


atlanticus=of the Atlantic.

Eudiocrinus granulatus Bell, 1894.


Type-locality.—Macclesfield Bank; 34 to 40 fathoms. H. M. S. Egerton.

granulatus=granulated.

Eudiocrinus parva Guérin, 1835.

1835. Guérin, Dict. d’Hist. Nat., III, p. 49, pl. 147, fig. 1. Type-locality.—Off Havana, Cuba.

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Eudiocrinus hyselyi.

Eudiocrinus japonicus P. H. Carpenter, 1882.
*Type-locality.—37° 07' north latitude, 138° 00' east longitude (off southern Japan); 565 fathoms. H. M. S. Challenger. japonicus=Japanese.

Eudiocrinus semperi P. H. Carpenter, 1882.
*Type-locality.—34° 08' south latitude, 152° 00' east longitude (near Sydney, New South Wales); 950 fathoms. H. M. S. Challenger.
Prof. Carl Semper, of Wurzburg.

Eudiocrinus tuberculatus A. H. Clark, 1907.
*Type-locality.—Off Ukishima, Gulf of Tokyo; 169 fathoms.
U. S. S. Albatross.
tuberculatus=with tubercles.

Eudiocrinus varians P. H. Carpenter, 1882.
*Type-locality.—16° 42' north latitude, 119° 22' east longitude (off the west coast of Luzon, Philippines); 1,050 fathoms. H. M. S. Challenger.

Eudiocrinus variegatus A. H. Clark, 1908.
A nomen nudum.
*Type-locality.—34° 59' north latitude, 139° 34' east longitude (Sagami Bay, Japan); 60 fathoms. Mr. Alan Owston.

variegatus=variegated.

Euryale; see note under Ophiocrinus.

Ganymeda Gray, 1834.
*Type.—Ganymeda pulchella Gray (n. sp.).
Ganymeda, Ganymeda, or Hebe.

Ganymeda pulchella Gray, 1834.
*Type-locality.—Kent, England.
pulchella=pretty.

British Museum.
Ganymeda pulchella = detached centro-dorsal of Asterias bifida Pennant, Ganymeda therefore becoming a synonym of Antedon de Fréminville, with the same species as type. The specific name pulchella is not the same as the Antedon pulchella of Pourtalès, 1878; but, fortunately, a previous name (alata) is available for the latter.

Gephyrocrinus Koeiier and Bather, 1902.
Type.—Gephyrocrinus grimaldii Koehler and Bather (n. sp.). γεφυροω = to bridge over + κρινον = lily.

Gephyrocrinus grimaldii, Koeler and Bather, 1902.
Type-locality.—27° 41’ north latitude, 20° 14’ west longitude (Canary Islands); 1,786 meters. Yacht Princess Alice.
The Prince of Monaco.

Goldfussia Norman, 1891 (not of de Castelnau, 1843).
Type.—Comatula multiradiata Goldfuss (not Comatula multiradiata Lamarck = Asterias multiradiata Linnaeus) = Alecto nova-guineae J. Müller.
Georg August Goldfuss.
Canon Norman proposed the name Goldfussia as a substitute for Comaster J. Müller (not of L. Agassiz). Professor Agassiz’s type was the Comatula multiradiata of Lamarck, which is the same as the Asterias multiradiata of Linnaeus; but Professor Müller shifted this name to a specimen figured by Goldfuss, which represents a different species, and renamed Lamarck’s types multirada.

Gynameda Gray, 1848.

Gynameda pulchella Gray, 1848.

Hathrometra A. H. Clark, 1908.
Type.—Alectro dentata Say, 1825. ἄθροος = assembled in crowds + μετρα.
Heliometra A. H. Clark, 1907.
_Type._Alecto eschrichtii J. Müller, 1841.
"Hleioz = the sun + metra.

Heliometra glabra A. H. Clark, 1907.
Proposed as a new name for _Antedon australis_ P. H. Carpenter, 1888, preoccupied.
_glabra_ = smooth.

Heliometra juvenalis A. H. Clark, 1908.
_Type-locality._—Off Cape Raper, Davis Strait; 60 fathoms. Rev. A. M. Norman.
juvenalis = juvenile.
Museum of Comparative Zoology.

(?)_Heterias_ Rafinesque, 1815.
_A nomen nudum._
Possibly an asteroid; no type is mentioned.

_Hibernula_ Fleming, 1828.
_Type._—Pentacrinus europaeus J. V. Thompson, 1827.
_Hibernia_ = Ireland + diminutive suffix.
_Pentacrinus europaeus_ J. V. Thompson, 1827 = the larva of _Asterias bifida_ Pennant, 1777 = _Antedon gorgonia_ de Fréminville, 1811; _Hibernula_, therefore, is a pure synonym of _Antedon_.

_Himerometra_ A. H. Clark, 1907.
_Type._—Antedon crassipinna Hartlaub, 1890.
" Каϝπος = lovely + metra.

_Himerometra acuta_ A. H. Clark, 1908.
_Type-locality._—Fiji.
_acuta_ = sharp.
Museum of Comparative Zoology.

_Himerometra helianthus_ A. H. Clark, 1907.
_A nomen nudum._
"Haioz = the sun + ἄνθος = flower.
This refers, however, to the following; mistakes of this kind are quite inexcusable, and very annoying.
Himerometra heliaster A. H. Clark, 1908.


Himerometra persica A. H. Clark, 1908.


Himerometra subcarinata A. H. Clark, 1908.


Holopus d'Orbigny, 1837.

1837. d'Orbigny, Magas. de Zool., 7me année, classe X, p. 1. Type.—Holopus rangii d'Orbigny (n. sp.). 

Holopus rangii d'Orbigny, 1837.

1837. d'Orbigny, Magas. de Zool., 7me année, classe X, p. 6, pl. III. Type-locality.—Off Martinique. M. Sander Rang.

Hybernula de Blainville, 1836.


Hyocrinus Wyville Thomson, 1877.


Type.—Hyocrinus bethellianus Wyville Thomson (n. sp.). θυς = a hog; ραβν = lily; named for Hog Island, one of the Crozets, near which the genus was found.

Hyocrinus bethellianus Wyville Thomson, 1877.

Type-locality.—16° 16' south latitude, 48° 27' east longitude (30 miles west of Hog Island, Crozet group); 1,600 fathoms, H. M. S. Challenger.

Lieut. George R. Bethell, R. N. British Museum.

This has been misspelled *bethelianus* by Springer.

**Hypalocrinus A. H. Clark, 1908.**

1908. A. H. Clark, Proc. Biol. Soc. Washington, XXI, p. 152. *Type.—Pentacrinus naresianus* P. H. Carpenter, 1882. "\( \text{ι} \tau \omicron \omicron \omicron = \text{under} + \alpha \lambda \omicron \zeta \) = at sea + \( \kappa \pi \iota \omicron \omicron = \text{lily.}"

**Hypalometra A. H. Clark, 1908.**

1908. A. H. Clark, Proc. Biol. Soc. Washington, XXI, p. 133. *Type.—Antedon defecta* P. H. Carpenter, 1888. "\( \text{ι} \tau \omicron \omicron \omicron = \text{under} + \alpha \lambda \omicron \zeta = \text{the sea} + \text{meta.}"

**Hypomene Wachsmuth and Springer, 1879.**


Editorial error for *Hyponome*.

**Hyponome Lovén, 1868.**

1868. Lovén, Forhandl. Skand. Naturf. Christiania, X, p. liv. *Type.—Hyponome sarsii* Lovén (n. sp.). "\( \text{i} \nu \pi \omicron \omicron \omicron \omicron \omicron \iota \) = an underground passage.

**Hyponome sarsii Lovén, 1868.**


*Hyponome sarsii* is the detached visceral mass of some species of Antedonidae, possibly *Zygometra microdiscens* Bell; but as the characters given are non-diagnostic when referred to any of the Antedonidae with plated disks, the generic name can never become available.

**Ilyocrinus Danielssen and Koren, 1877.**

1877. Danielssen and Koren, Nyt Magasin for Naturvidenskaberne, XXIII, 3de Hefte, p. 45. *Type.—Ilyocrinus carpenterii* Danielssen and Koren (n. sp.). "\( \text{i} \nu \nu \nu \text{m} \nu \text{d} + \kappa \pi \iota \omicron \omicron \nu \omicron \omicr..."
Ilyocrinus Perrier, 1885.


"lily".

Perrier intended to write *Ilycrinus* and to refer the species to the genus *Ilyocrinus* of Danielssen and Korens; but the specimen he had lacked the very character on which *Ilycrinus* was separated from *Bathyocrinus*, besides presenting (according to Professor Perrier) some very remarkable features; so, as science only concerns itself with what authors do, not what they intend, it becomes necessary to accept *Ilyocrinus* as a generic term distinct from *Ilyocrinus*, based on characters quite foreign to the latter genus as diagnosed by its authors.

Ilyocrinus recuperatus Perrier, 1885.


This species is figured by Perrier in 1886 in "Explorations Sous-Marines," p. 273, fig. 193, under the name of *Ilyocrinus recuperatus*.

Iridometra A. H. Clark, 1908.


"the rainbow + metra."

Iridometra crispa A. H. Clark, 1908.


"curled."

Isis Linnaeus, 1758.


"Isis, an Egyptian goddess."

Isis aster Cuvier, 1830.


Isis asteria Linnaeus, 1766.


"an old name for detached pentacrinoid columnnars."
Isocrinus L. Agassiz, 1836.

Type.—Isocrinus pendulus von Meyer, 1837.

\[ \text{Isocrinus is equivalent to Pentacrinus as used by Dr. P. H. Carpenter and most other writers on recent crinoids, as was ably pointed out by Mr. F. A. Bather (Natural Science, XII, April 1898, p. 245). He credits } \text{Isocrinus to von Meyer, 1837 (see beyond); but in the previous year Professor Agassiz described the genus, naming } \text{Isocrinus pendulus von Meyer as the type. Clearly, he had no intention of anticipating von Meyer, but the fact remains that he did, so we have no alternative and must accept the genus from him.} \]

† Isocrinus pendulus von Meyer, 1837.
A nomen nudum.

Isocrinus sibogae Döderlein, 1907.
1907. Döderlein, Die gestieten Crinoiden der Siboga-Expedition, p. 18, pl. ix, fig. 1; pl. xiii, fig. 12; first mentioned, p. 2.

Type-locality.—10° 30' south latitude, 123° 40' east longitude (near Timor); 520 meters. Dutch S. S. Siboga.

Isometra A. H. Clark, 1908.

Type.—Antedon lineatus P. H. Carpenter, 1888 (not Antedon lineatus Pomel, 1887).

Kallispongia Wright, 1877.

Type.—Kallispongia archeri Wright (n. sp.).

Kallispongia archeri Wright, 1877.

Type-locality.—Australia.
This is the stalked larva of some free crinoid.

Leptometa A. H. Clark, 1908.

Type.—Alecto phalangium J. Müller, 1841.

Leptometra A. H. Clark, 1908.
Metacrinus P. H. Carpenter, 1882.

Type.—Metacrinus wyvillii P. H. Carpenter, 1884.

The view that Metacrinus was not described until 1884 is quite untenable, as in the article on West Indian stalked crinoids to which reference is made above a fairly complete diagnosis is given, and the most important differences between Metacrinus and Isocrinus ("Pentacrinus") are made clear.

Metacrinus has never had any species selected as the type; Doctor Carpenter records, however, that it was upon the proof of the plate representing his Metacrinus wyvillii that the name was found in Sir Wyville’s handwriting. It has seemed best, therefore, to select this species as the type, particularly as it is a very typical form. It is also appropriate to have as the type of this interesting genus a species named for the able naturalist who first discovered it.

Metacrinus acutus Döderlein, 1907.
1907. Döderlein, Die gestielten Crinoiden der Siboga-Expedition, p. 34, pl. x, figs. 1–16; pl. xi, figs. 6–8; pl. xii, figs. 6–13; pl. xiv, figs. 3, 11, 12; pl. xv; pl. xix, fig. 1; fig. 7b, p. 21; full description, p. 35; first mentioned, p. 20 (IBB discussed).

Type-locality.—Off the Ki Islands; 204 to 310 meters. Dutch S. S. Siboga.

acutus=sharp.

Metacrinus angulatus P. H. Carpenter, 1884.

Type-locality.—5° 49' 15" south latitude, 132° 14' 15" east longitude (Arafura Sea, off the Ki Islands); 140 fathoms. H. M. S. Challenger.

angulatus=provided with angles.

British Museum.

Metacrinus cingulatus P. H. Carpenter, 1884.
1884. P. H. Carpenter, Challenger Reports, XI, Zoology, p. 344, pl. xi; pl. xli, figs. 1–4; detailed description, p. 347; first mentioned, p. 17.

Type-locality.—5° 49' 15" south latitude, 132° 14' 15" east longitude (off the Ki Islands); 140 fathoms. H. M. S. Challenger.

cingulatus=girdled.

British Museum.
Metacrinus costatus P. H. Carpenter, 1884.
1884. P. H. Carpenter, Challenger Reports, XI, Zoology, p. 344, pl. xlvii, fig. 13; pl. xlix; detailed description, p. 360; first mentioned, p. 17.

Type-locality.—4° 33' north latitude, 127° 06' east longitude (off the Meangis Islands); 500 fathoms. H. M. S. Challenger.

Costatus = ribbed.

Metacrinus interruptus P. H. Carpenter, 1884.

Type-locality.—10° 14' north latitude, 123° 54' east longitude; 95 fathoms. H. M. S. Challenger.

Interruptus = interrupted.

Metacrinus moseleyi P. H. Carpenter, 1884.

Type-locality.—4° 33' north latitude, 127° 06' east longitude (off the Meangis Islands); 500 fathoms. H. M. S. Challenger.

Prof. H. N. Moseley.

Metacrinus murrayi P. H. Carpenter, 1884.
1884. P. H. Carpenter, Challenger Reports, XI, Zoology, p. 344, pl. xli figs. 12-17; pl. xlii; detailed description, p. 349; first mentioned, p. 17.

Type-locality.—Western Pacific. H. M. S. Challenger.

Sir John Murray.

Metacrinus nobilis P. H. Carpenter, 1884.
1884. P. H. Carpenter, Challenger Reports, XI, Zoology, p. 344, pl. xlii figs. 5-11; pl. xiii; detailed description, p. 351; first mentioned, p. 17.

Type-locality.—5° 49' 15'' south latitude, 132° 14' 15'' east longitude (off the Ki Islands); 140 fathoms. H. M. S. Challenger.

Nobilis = remarkable.

Metacrinus nobilis var. timorensis Döderlein, 1907.
1907. Döderlein. Die gestielten Crinoiden der Siboga-Expedition, p. 45, pl. xiii, fig. 8; pl. xxi, fig. 1.

Type-locality.—10° 39' south latitude, 123° 40' east longitude (near Timor); 520 meters. Dutch S. S. Siboga.

Timorensis = of Timor.

Metacrinus nobilis var. typica Döderlein, 1907.
1907. Döderlein. Die gestielten Crinoiden der Siboga-Expedition, p. 43.
Type-locality.—5° 49' 15" south latitude, 132° 14' 15" east longitude (near the Ki Islands); 140 fathoms. H. M. S. Challenger.
typica=" typical."

Metacrinus nodosus P. H. Carpenter, 1884.
Type-locality.—29° 45' south latitude, 178° 11' west longitude (near the Kermadec Islands); 630 fathoms. H. M. S. Challenger.
nodosus=knotty.

Metacrinus rotundus P. H. Carpenter, 1884.
Type-locality.—Sagami Bay, Japan; 70 fathoms. Dr. Ludwig Döderlein.

rotundus=rounded.

This species must, of course, be dated from the first reference where the specific characters are given. Doctor Carpenter inserted it in the key to the species of Metacrinus, published in the Challenger report a year before his formal description appeared. As its specific characters are here not only given in considerable detail, but its relation to the other species in the genus is made clear, we can not but accept this as the description of the species. It has been suggested, on good grounds (Sperry, Proc. Mich. Acad. Sci., 1902 [1904], p. 195), that this species is identical with M. interruptus. Those who adopt this view must use the name rotundus, this having priority of place over interruptus, which therefore becomes a synonym.

Metacrinus serratus Döderlein, 1907.
1907. Döderlein. Die gestielten Crinoiden der Siboga-Expedition. p. 34, pl. xi, fig. 5; pl. xii, figs. 3–5; pl. xiv, fig. 10; pl. xvii, fig. 2; full description, p. 37; first mentioned, p. 23.
Type-locality.—5° 43.5' north latitude, 119° 40' east longitude (Sulu Archipelago); 522 meters. Dutch S. S. Siboga.
serratus=serrate.

Metacrinus stewarti P. H. Carpenter, 1884.
Type-locality.—? Singapore. (See remarks under *Metacrinus superbus*.) Prof. Charles Stewart.

Prof. Charles Stewart.

*Metacrinus suluensis* Döderlein, 1907.

1907. Döderlein, Die gestielten Crinoiden der Siboga-Expedition, p. 33, pl. xli, fig. 10; pl. xiii, fig. 6; pl. xvii, fig. 1; detailed description, p. 47; first mentioned, p. 25.

Type-locality.—5° 48.7' north latitude, 119° 49.6' east longitude (Sulu Archipelago); 564 meters. Dutch S. S. Siboga.

*suluensis* = of Sulu.

*Metacrinus superbus* P. H. Carpenter, 1884.


Type-locality.—? Singapore. Prof. Charles Stewart.

*superbus* = magnificent.

The types of this and the preceding species were brought into Singapore by a cable-repair ship, presumably from somewhere in the vicinity: but it is quite possible that they may have been obtained at some distance from that port. This species, at least, is abundant off southwestern Japan; and, in view of the fact that some important cables pass under the sea at this point, it is not improbable that the first specimen was obtained somewhere in this region.

*Metacrinus superbus* var. typica Döderlein, 1907.

1907. Döderlein, Die gestielten Crinoiden der Siboga-Expedition, p. 49.

Typica here is equivalent merely to saying that the specimen is "typical."

*Metacrinus tuberosus* P. H. Carpenter, 1884.


Type-locality.—5° 49' south latitude, 132° 14' east longitude (near the Ki Islands); 140 fathoms. H. M. S. *Challenger*.

*tuberosus* = with tubercles. British Museum.

*Metacrinus varians* P. H. Carpenter, 1884.

1884. P. H. Carpenter, *Challenger* Reports, XI, Zoology, p. 344, pl. xliv, pl. xlvii, figs. 6–12; detailed description, p. 353; first mentioned, p. 17.

Type-locality.—4° 33' north latitude, 127° 06' east longitude (off the Meangis Islands); 500 fathoms. H. M. S. *Challenger*.

*varians* = varying. British Museum.
Metacrinus wyvillii P. H. Carpenter, 1884.
1884. P. H. Carpenter, Challenger Reports, XI, Zoology, p. 344, pl. xlvii. figs. 1-5; pl. xlviii; detailed description, p. 358; first mentioned, p. 129.

Type-locality.—4° 33' north latitude, 127° 06' east longitude (off the Meangis Islands); 500 fathoms. H. M. S. Challenger. Sir C. Wyville Thomson. British Museum.

Nanometra A. H. Clark, 1907.

Ref. = dwarf + metra.

Nanometra minckerti A. H. Clark, 1907.

Proposed as a new name for Antedon minor A. H. Clark, 1907, preoccupied.

Mr. Wilhelm Minckert.

Neocrinus Wyville Thomson, 1864.

Ref. = Pentacrinus decorus Wyville Thomson (n. sp.).

Neocrinus Wyville Thomson, 1864.

Oligometra A. H. Clark, 1908.


Oligometra caribbea A. H. Clark, 1908.

A nomen nudum.


Type-locality.—Off Colon, Canal Zone; 34 fathoms. U. S. S. Albatross.

caribbea = Caribbean.

Ophiocrinus Semper, 1868 (not Ophiocrinus Salter, 1856).

Ref. = Ophiocrinus indivisus Semper (n. sp.).

This genus has been renamed Endioerinus.

Note.—Ophiura was used by Oken in 1815 for the Asterias multiradiata of Linnaeus (!), and at the same time he referred Asterias pectinata to Euryale (!!). As these two generic names
are never used again, and as no new crinoid species were described under them, it is not considered necessary to do more than call attention to them here.

†Ophiocrinus hyselyi.

Ophiocrinus indivisus Semper, 1868.
Type-locality.—Pandanon, near Bohol, Philippines: 30 fathoms. Prof. Carl Semper.
indivisus = undivided (in reference to the arms).

†Pentacrinites Blumenbach, 1804.
Type.—Pentacrinites fossilis Blumenbach (n. sp.) = Pentacrinites brithanicus von Schlotheim, 1820 = Pentacrinites (Penta-
crinus) briareus Miller, 1821 [= ? Eucrinus coralloides Andreae, 1763].

Pentacrinites, a common name for Pentacrinoid remains.
Although as early as 1864 Sir Wyville Thomson writes that Pentacrinites briareus seems to have a valid claim as the type of "Pentacrinus," this was ignored by P. H. Carpenter, who accepted Isis asteria Linnaeus as the type and always dated the genus from Miller, 1821, although he must have known it had been in more or less common use since the time of Agricola. Extracrinus Austin and Austin, 1845, has the same type as Pentacrinites Blumenbach, and is therefore a pure synonym of it. Pentacrinites is not congeneric with any recent crinoid, and therefore must be dropped so far as recent forms are concerned. Isocrinus L. Agassiz, 1836, is equivalent to "Pentacrinus," as used by P. H. Carpenter and most other authors, and must therefore be adopted for the recent species.

Mr. F. A. Bather, in his admirable essay on "Pentacrinus, a name and its history" (Natural Science, XII, April, 1898, p. 245), first made this point clear; but it seems necessary to call attention to it again, as a few writers still continue to use "Pentacrinus Miller, 1821," in spite of the facts as stated by him.

Pentacrinites Blumenbach, 1804, appears to be a synonym of Encrinus Andreae, 1763, with the same species as type, but I have been unable to consult the plate on which the type species of the latter is figured.

Pentacrinus alternicirra P. H. Carpenter, 1882.
Type-locality.—28° 33' south latitude, 177° 50' west longitude (near the Kermadec Islands); or 4° 33' north latitude, 127° 06' east longitude (off the Meangis Islands); 600 or 500 fathoms. H. M. S. Challenger.

*alternicirra* = with alternating cirri. British Museum.

This name is frequently given as "*alternicirrus*.

**Pentacrinus arndtii** Schultze, 1858.


A nomen nudum.

**Pentacrinus balfouri** Wyville Thomson MS.

Specimens of *Pentacrinus naresiannus* P. H. Carpenter, 1882, were distributed under this name, which was originally applied by Sir Wyville Thomson to the species. It has, of course, no standing whatever in zoological nomenclature, but is merely inserted for the benefit of those who have received specimens thus labeled.

**Pentacrinus blakei** P. H. Carpenter, 1882.


Type-locality.—Off Montserrat in 120 fathoms; or off Barbados in 200 fathoms. U. S. S. Blake.


This specific name was misspelled "blakii" by Bell (Zool. Record for 1882, Echinod., p. 10 [1883]).

**Pentacrinus europæus** J. V. Thompson, 1827.


Type-locality.—Cove of Cork, Ireland.

europæus = of Europe.

*Pentacrinus europæus* is the stalked larva of *Asterias bifida* Pennant, 1777.

**Pentacrinus guettardi** Schultze, 1858.


A nomen nudum.

**Pentacrinus maclearanus** Wyville Thomson, 1877.


Type-locality.—9° 05' north latitude, 34° 50' west longitude; 350 fathoms. H. M. S. Challenger.

Commander J. L. P. Maclear, R. N. British Museum.

This name was emended to *maclearianus* by Lockington in 1884 (Standard Natural History, I, p. 145).

Proc. N. M. vol. xxxiv—08——35
Pentacrinus mollis P. H. Carpenter, 1884.
1884. P. H. Carpenter, Challenger Reports. XI, Zoology, p. 338, pl. xxxiv, figs. 7-10; first mentioned, p. 44.
_Type-locality._—34° 7' north latitude, 138° 00' east longitude (off southern Japan); 565 fathoms.
mollis = soft.

British Museum.

Pentacrinus mülleri Örsted, 1856.
_Type-locality._—Near St. Thomas, Danish West Indies.
Prof. Johannes Müller.
This species was named _Encrinus parva_ by Guérin in 1835.

Pentacrinus naresianus P. H. Carpenter, 1882.
_Type-locality._—4° 33' north latitude, 127° 06' east longitude (off the Meangis Islands); 500 fathoms. H. M. S. Challenger.

Admiral Sir George Nares. R. N. British Museum.

Pentacrinus rawsoni Köehler, 1895.
Editorial error for _Rhizocrinus rawsonii._

Pentacrinus thomsoni Brehm, 1878.
Editorial error for _Pentacrinus wyville-thomsoni._

Pentacrinus wyville-thomsoni Wyville Thomson, 1872.
_A nomen nudum._
_A nomen nudum._
_Type-locality._—39° 42' north latitude, 9° 43' west longitude (off the coast of Portugal); 1,095 fathoms. H. M. S. Porcupine.

This has been misspelled _wyville-thompsoni_ by Filhol.

Pentacrinus (Neocrinus) decorus Wyville Thomson, 1864.
_Type-locality._—"Seas of the outer Antilles."
decorus = beautiful.

British Museum.
Pentametrocrinus A. H. Clark, 1908.
_Type._—Eudilocrinus japonicus P. H. Carpenter, 1882.

\[ \text{πέντε} = \text{five} + \text{μετρέω} = \text{to be surrounded (in passive)} + \text{κρίνω} = \text{lily.} \]

Pentametrocrinus diomedae A. H. Clark, 1908.
_A nomen nudum._

Pentarinus Greeff, 1876.
1876. Greeff, S.-B. Gesellsch. Marburg, 1876; No. 5 (May), p. 91.
_Type._—Antedon diomedea A. H. Clark, 1907.

Perometra A. H. Clark, 1907.
_Type._—Antedon diomedea A. H. Clark, 1907.

Phanogenia Lovén, 1866.
_Type._—Phanogenia _typica_ Lovén (n. sp.).

\[ \text{φανογένεω} = \text{born of a sea-god.} \]

Phanogenia _typica_ Lovén, 1866.
_Type._—New Harbour, near Singapore. Capt. A. Vestöö.

typica = typical.

Phrynocrinus A. H. Clark, 1907.
_Type._—Phrynocrinus _nudus_ A. H. Clark (n. sp.).

\[ \text{φύρνω} = \text{a toad} + \text{κρίνω} = \text{lily.} \]

Phrynocrinus _nudus_ A. H. Clark, 1907.
_Type._—9.6 miles S. 75° W. of Shio Misaki light (off the south coast of Nipon, Japan); 649 fathoms. U. S. S. _Albatross._
nudus = naked.

Phytocrinus de Blainville, 1830.
_Type._—Pentacrinus _europaeus_. J. V. Thompson, 1827.

\[ \text{φύτος} = \text{animal} + \text{κρίνω} = \text{lily.} \]
De Blainville took exception to Fleming’s name *Hibernula*, founded on the same type, believing that the names of all stalked crinoids should end in “—crinus,” and therefore proposed *Phyto-crinus* as a substitute.

**Pæcilometra** A. H. Clark, 1907.
*Type.—Antedon acola* P. H. Carpenter, 1888.
ποικίλος=variegated+metra.

[**Polyactinis:** _not binomial; see under Encriinus_.]

(?) **Polyactis** Rafinesque, 1815.
A nomen nudum.
Possibly an Asteroid or an Ophiuroid; no type is mentioned.

**Pontiometra** A. H. Clark, 1907.
*Type.—Antedon andersoni* P. H. Carpenter, 1889.
πόντιος=of the sea+metra.

**Promachocrinus** P. H. Carpenter, 1879.
*Type.—Promachocrinus kerguelensis* P. H. Carpenter, 1880.
πρόμαχος=a challenger+κέρυξ=lily.
This has been misspelled *Promachorus* by de Loriol.

**Promachocrinus abyssorum** P. H. Carpenter, 1888.
A nomen nudum.
*Type-locality.—46° 16’ south latitude, 48° 27’ east longitude, 1,600 fathoms: or 50° 01’ south latitude, 123° 04’ east longitude, 1,800 fathoms. H. M. S. Challenger. abyssorum=of the depths. British Museum.

**Promachocrinus kerguelensis** P. H. Carpenter, 1880.
*Type-locality.—Balfour Bay, Kerguelen: 20 to 60 fathoms. H. M. S. Challenger. kerguelensis=of Kerguelen. British Museum.

It seems best to date this species from 1880 when a figure of the centro-dorsal was published, as it happens that in this species the centro-dorsal is quite characteristic.
Promachocrinus kerguellenensis Perrier, 1886.
Editorial or typographical error.

Promachocrinus naresi P. H. Carpenter, 1884.
*Type-locality.*—1° 33' north latitude, 127° 06' east longitude (off the Meangis Islands); 500 fathoms. H. M. S. Challenger.
Admiral Sir George Nares, R. N. British Museum.

Promachocrinus naresii P. H. Carpenter, 1879.
A *nomcn nudum.* (See preceding; Doctor Carpenter in his later work emended all words ending in "ii" to "i.")

Promachocrinus vanhoffenianus Minckert, 1905.
*Type-locality.*—66° 02' 09" south latitude, 89° 38' 00" east longitude; 350-400 meters. German S. S. Gauss.
Prof. E. Vanhöffen.

Psathyrometra A. H. Clark, 1907.
*Type.*—*Antedon fragilis* A. H. Clark, 1907.
\(\phi\alpha\thetaυρος=\)brittle+metra.

Psathyrometra borealis A. H. Clark, 1908.
*Type-locality.*—East of Agattu Island, Aleutians; 1,046 fathoms. U. S. S. Albatross.

borealis=\(=\)northern. U. S. National Museum.

Psathyrometra congesta A. H. Clark, 1908.
*Type-locality.*—Off Kauai, Hawaiian Islands; 400-500 fathoms. U. S. S. Albatross.


Psathyrometra profundorum A. H. Clark, 1908.
*Type-locality.*—Off Moresby Island, Queen Charlotte group; 1,588 fathoms. U. S. S. Albatross.

profundorum=\(=\)of the depths. U. S. National Museum.

†Psaterocoma L. Agassiz, 1836.
*Type.*—†*Comatula pinnata* Goldfuss.
\(\pi\tau\varepsilon\rho\omicron=\)a feather+coma=hair.
Pterocrinus P. H. Carpenter, 1884.

_Type._—*Bathycriminus australis* A. H. Clark, 1907.

\[ \pi \tau \rho \omicron \sigma = \text{a feather} + \kappa \pi \omicron \nu \omicron = \text{lily.} \]

No generic diagnosis is given with this name; it was found in Sir Wyville Thomson's handwriting on a bottle containing specimens of the species given as the type. We have, therefore, a definite generic name, with a definite type, so the genus must be accepted if it should ever become necessary to separate *Bathycriminus gracilis* and *Bathycriminus australis* generically. The case is exactly parallel to that of *Querquesdula* Cones, where the generic name only was given with the type *Querquesdula eatoni*.

Ptilocrinus A. H. Clark, 1907.

_Type._—*Ptilocrinus pinnatus* A. H. Clark (n. sp.).

\[ \pi \tau \delta \omicron \nu = \text{feather} + \kappa \pi \omicron \nu \omicron = \text{lily.} \]

Ptilocrinus pinnatus A. H. Clark, 1907.

_Type-locality._—52° 39' 30'' north latitude, 130° 38' 00'' west longitude (Queen Charlotte Islands, British Columbia); 1,588 fathoms. *U. S. S. Albatross*.

\[ \pi \tau \eta \eta \nu \tau \zeta = \text{feathered.} \]

_Ptilometra* A. H. Clark, 1907.

_Type._—*Comatula macronema* J. Müller, 1846.

\[ \pi \tau \delta \omicron \nu \sigma = \text{feather} + \nu \omicron \nu \omicron \]

Rhizocrinus M. Sars, 1864.

_Type._—*Rhizocrinus lofotensis* M. Sars (n. sp.).

\[ \beta \iota \lambda \nu \kappa = \text{root} + \kappa \pi \omicron \nu \omicron = \text{lily.} \]

_Rhizocrinus chuni_ Döderlein, 1907.
1907. Döderlein. *Die gestielten Crinoiden der Siboga-expedition*, p. 14, pl. 1, fig. 5; pl. vi, fig. 6; fig. 6, p. 14.

_Type-locality._—Off Somaliland, East Africa; 1644 and 1668 meters. *German S. S. Valdivia*.

Professor Karl Chun.

_Rhizocrinus lofotensis* M. Sars, 1864.
Rhizocrinus rawsonii Pourelès, 1874.
_Type-locality._—Off Sandy Bay, Barbados; 80 to 120 fathoms.

U. S. S. Hassler.

Rhizocrinus verrilli A. H. Clark, 1908.
_Type-locality._—Off Marthas Vineyard, Massachusetts; 640 fathoms.


Rhizocrinus weberi Döderlein, 1907.
1907. Döderlein, Die gestielten Crinoiden der Siboga-expedition, p. 15, pl 1, figs. 6-11; pl. 11, figs. 3-5; pl. vi, figs. 7-11; pl. viii, figs. 1-4; pl viii, figs. 1-4; fig. 5 a, b, p. 14; first mentioned, p. 2.

_Type-locality._—Sulu Archipelago, near Ceram Laut, or near Timor; 112 to 2,050 meters. Dutch S. S. Siboga.

Dr. Max Weber.

Stylometra A. H. Clark, 1908.
_Type._—Antedon spinifera P. H. Carpenter, 1881.
στόλος = a pillar + metra.

Thalassometra A. H. Clark, 1907.
_Type._—Antedon villosa A. H. Clark, 1907.
θάλασσα = the sea + metra.

Thalassometra crassicirra A. H. Clark, 1908.

Thalassometra delicata A. H. Clark, 1908.
_Type-locality._—Off Laysan Island, Hawaiian Islands; 319 fathoms. U. S. S. Albatross.
Thalassometra fisheri A. H. Clark, 1908.

Thalassometra gigantea A. H. Clark, 1908.
gigantea = Gigantean.

Thalassometra komachi A. H. Clark, 1908.
Type-locality.—Misaki, Sagami Bay, Japan. Mr. Alan Owston. Komachi; a famous Japanese court beauty; also the vernacular name for a comatulid.

Thalassometra pergracilis A. H. Clark, 1907.
Proposed as a new name for Antedon gracilis P. H. Carpenter, 1888, not Solanocrinites (=Antedon, according to P. H. Carpenter) gracilis of Goldfuss. pergracilis = very slender.
This name was inadvertently given as Antedon pergracilis on the same page, in a footnote.

Thaumatocrinus P. H. Carpenter, 1883.
Type.—Thaumatocrinus renovatus P. H. Carpenter (n. sp.).
θαυματοκρινος = a marvel + κρινος = lily.

Thaumatocrinus renovatus P. H. Carpenter, 1883.
Type-locality.—50° 01′ south latitude, 123° 04′ east longitude; 1,800 fathoms. H. M. S. Challenger. renovatus = renewed.

British Museum.

Thaumatometra A. H. Clark, 1908.
Type.—Antedon ciliata A. H. Clark, 1907.
θαυματομετρα = a wonder + μετρα.

Thaumatometra comaster A. H. Clark, 1908.
A nomen nudum.
Type-locality.—In Yezo Straits, Japan; 300–533 fathoms. U. S. S. Albatross.
coma = hair + aster = a star.

U. S. National Museum.
Thaumatometra parva A. H. Clark, 1908.
A nomen nudum.

Type-locality.—Sagami Bay, Japan; 120–265 fathoms. U. S. S. Albatross.
parva = small.

Thysanometra A. H. Clark, 1907.
Type.— Antedon tenelloides A. H. Clark, 1907.

Trichometra A. H. Clark, 1908.
Type.— Trichometra aspera A. H. Clark, 1908.

Trichometra aspera A. H. Clark, 1908.
A nomen nudum.

Type-locality.— Off southern Georgia, U. S. A.; 270 fathoms. U. S. S. Albatross.
aspera = rough.

Trichometra vexator A. H. Clark, 1908.
A nomen nudum.

Type-locality.—South of Oahu, Hawaiian Islands; 323–299 fathoms. U. S. S. Albatross.

vexator = a troubler.

[Triscaedecacnimos; not binomial; see under Encrinus.]

Tropiometra A. H. Clark, 1907.
Type.—Comatula carinata Lamarck, 1816.

Zenometra A. H. Clark, 1907.
Type.— Antedon columnaris P. H. Carpenter, 1881.
ζέφος = strange + metra.
Zenometra pyramidalis A. H. Clark, 1908.
*Type-locality.*—Off Savannah, Georgia; 410 fathoms.  U. S. S. *Albatross.*


Zenometra triserialis A. H. Clark, 1908.
*Type-locality.*—Southeast of Oahu, Hawaiian Islands; 192–352 fathoms.  U. S. S. *Albatross.*


Zygometra A. H. Clark, 1907.
*Type.*—*Antedon microdiscus* Bell, 1884.

*Zygometra* =a yoke+metra.

Zygometra kœhleri A. H. Clark, 1907.
*Type-locality.*—Sagami Bay, Japan; 63–100 fathoms.  U. S. S. *Albatross.*


REFERENCES.


By Charles C. Nutting,
Professor of Zoology, State University of Iowa, Iowa City.

INTRODUCTION.

The Hawaiian region appears to be a virgin field, so far as Alcyonaria are concerned, as the writer has been unable to find a single reference, in the rather extensive literature consulted, indicating that any alcyonarians whatever have been reported from this region.

This fact, together with the extraordinary isolation of these islands from any large land mass, makes the material discussed in the following report of unusual interest, both from the number of new forms included and from the standpoint of zoögeography.

Considering the length of time since the discovery of the Hawaiian Islands, and the number of European and American residents and visitors, it is somewhat surprising that nothing has heretofore been reported regarding the very rich alcyonarian fauna. This is doubtless due, in part, to the fact that this group of animals has but little recognized economic importance, and more particularly to the almost total lack of dredging operations in this region. A few hauls, it is true, were taken by the Challenger in the vicinity of the Hawaiian group, but there is no mention of any Alcyonaria being secured.

Of the 68 species brought to light by the cruise of the U. S. Bureau of Fisheries steamer Albatross in 1902, 39 are new and 29 have been reported from other localities, giving a proportion of 57 per cent of new species. Of the three orders of Alcyonaria discussed, the first, the Alcyonacea is most meagerly represented by 5 species. The second order, the Pennatulacea, is well represented by 16 species, while the remaining 47 species belong, as would be expected, to the great and widely distributed order Gorgonacea.

The paucity of Alcyonacea was to be expected from the fact that this order is largely arctic in its distribution, although certain special groups are very abundant in the Australian region. It is interesting
to note in this connection the strong infusion of arctic forms found in reporting on the hydroida of the Hawaiian region is not to be found in the alcyonarian fauna. The Pennatulacea is a group mainly found in deep water in all seas, and its occurrence in this collection was to be expected, although the number of new species is rather larger than might have been anticipated. The most notable fact in regard to the Gorgonacea is the entire absence of representatives of the great family Gorgonidae, the scarcity of the Briareidae, and the surprisingly rich representation of the Primnoidae, and particularly of the Chrysogorgidae, which leads the list of families with 17 species, exactly one-fourth of all the species found, 9 of which are new.

In order to show the general facies of the alcyonarian fauna of the Hawaiian region the following synopsis is presented:

SYSTEMATIC SYNOPSIS OF THE HAWAIIAN ALCYONARIA.

Order ALCYONACEA.

Family Cornularidae.

Clavularia spiculicola, new species.
Clavularia corrugata, new species.

Family Alcyoniidae.

Anthomastus steenstrupi Wright and Studer.

Family Nephthyidiae.

Spongodes alexandrei, new species.
Siphonogorgia collaris, new species.

Order PENNATULACEA.

Family Pennatulidae.

Pennatula sanguinea, new species.
Pennatula flavus, new species.
Pennatula pallida, new species.
Pennatula pearceyi Kölliker.
Haliseiphrum abies Kölliker.

Family Echinoptilidae.

Echinoptilum macintoshi Hubrecht.

Family Anthoptilidae.

Anthoptilum murayi Kölliker.

Family Kophoeelemononidæ.

Calihelemonon symmetricum, new species.

Family Umbellulidæ.

Umbellula carpenteri Kölliker.
Umbellula jordani, new species.
Umbellula gilberti, new species.
Umbellula, species.

Family Protocaullidæ.

Protocallum mollæ Kölliker.

Family Protoptilidæ.

Protoptilum wrighti, new species.
Trichoptilum attenuatum, new species.
Chadiscus studeri, new species.

Order Gorgonacea.

Family Briareidæ.

Paragorgia nodosa Koren and Danielsen.

Family Sclerogorgidæ.

Keroeides gracilis Whitelegge.

Family Isidæ.

Ceratoisis flabellum, new species.
Ceratoisis paniespinosa Wright and Studer.
Ceratoisis grandis, new species.
Lepidisis longiflora Verrill.
Acanella charcha (Pourtales).

Family Primnoidæ.

Amphiaphis biseriatus, new species.
Amphiaphis regularis Wright and Studer.
Caligorgia gilberti, new species.
Stenella helminthophora, new species.
Stachyodes angularis, new species.
Stachyodes regularis Wright and Studer.
Stachyodes dichotoma Versluys.
Stachyodes boweri, new species.
Calyptrophora japonica Gray.
Calyptrophora hyptill Percival Wright.
Calyptrophora versluysi, new species.
Family Muriceidae.

Acanthogorgia armata Verrill.
Paramuricea aquatorialis Wright and Studer.
Paramuricea hawaiensis, new species.
Antomuricea tenispina, new species.
Clamatissa alba, new species.
Clamatissa tenue, new species.
Clamatissa verrilli Wright and Studer.
Mucella grandiflora, new species.
Echinomuricea brunnca, new species.
Cyclomuricea flavellata, new species.
Mucicella tencri Ridley.

Family Chrysogorgiidae.

Lepidogorgia gibbosa, new species.
Lepidogorgia spiralis, new species.
Chrysogorgia arborescens, new species.
Chrysogorgia delicata, new species.
Chrysogorgia elegans (Verrill).
Chrysogorgia flexilis (Wright and Studer).
Chrysogorgia lata Versluys.
Chrysogorgia spiculosa (Verrill).
Chrysogorgia carrata Versluys.
Chrysogorgia flavescens, new species.
Chrysogorgia geniculata (Wright and Studer).
Chrysogorgia stellata, new species.
Metallogorgia melanotrichos (Wright and Studer).
Metallogorgia squarrosa (Wright and Studer).
Iridogorgia bella, new species.
Iridogorgia superba, new species.
Pleuropogorgia militaris, new species.

Family Gorgonellidae.

Verracella bicolor, new species.

The synopsis given above shows that the 68 species of alyconarians now known from the Hawaiian Islands are distributed among 17 families and 38 genera.

**Distribution.**

Our knowledge of the Aleyonaria as a whole is far too incomplete to warrant us in being dogmatic in our conclusions regarding their general distribution, either geographic or bathymetric. When we consider how little of the ocean bottom has been explored with any thoroughness, and the vast extent of practically unknown regions, and the host of species yet to be discovered, it becomes evident that our conclusions are tentative at best, and very likely to be rendered valueless by further exploration and study. The ocean floor has been but scratched here and there by the dredge and trawl, and the absence of species from our collections will by no means warrant us in saying that they are really absent from the regions explored.
There remains, however, a positive value to the record of species actually secured, and the correlation of the work of students in different groups is now yielding results of recognized importance.

**Geographical and bathymetrical distribution of Hawaiian Alcyonaria.**

<table>
<thead>
<tr>
<th>Name</th>
<th>China and Japan</th>
<th>Pacific</th>
<th>Atlantic</th>
<th>Bathymetric (in fathoms)</th>
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<tr>
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<td>East Indies</td>
<td>South Pacific</td>
<td>North Atlantic and West Indies</td>
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<td><em>Cereularia spiculigera</em></td>
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<td><em>Cereularia corrigata</em></td>
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<td><em>Spongodes alexandri</em></td>
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<td><em>Stegophoria gigalina</em></td>
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<td><em>Pennatula angulata</em></td>
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<td>+</td>
<td>+</td>
</tr>
<tr>
<td><em>Chrysoalosia laevigata</em></td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td><em>Chrysoalosia globosa</em></td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td><em>Chrysoalosia curvata</em></td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td><em>Chrysoalosia flexuosa</em></td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td><em>Chrysoalosia plicata</em></td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td><em>Chrysoalosia delicata</em></td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td><em>Metallotopogorgia melanodactyla</em></td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td><em>Echinogorgia leucadea</em></td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td><em>Iridogorgia bella</em></td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td><em>Iridogorgia superba</em></td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td><em>Pleurgorugia millotis</em></td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td><em>Verrucella bicolor</em></td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
</tbody>
</table>

* The asterisk indicates a new species.
It will be seen that of the 29 species heretofore described and not confined to the Hawaiian region, 10 occur in China or Japan, 9 in the East Indies, 7 in the North Atlantic and West Indies, and 5 in the South Atlantic. Sixteen species are found in the western part of the Pacific, showing that about 55 per cent of the species not peculiar to the Hawaiian Islands are Asiatic in their relations. The 7 species identical with Atlantic forms offer an interesting problem which may find its solution in the equatorial current which is supposed to have formerly swept through the Central American region and onward across the Pacific.

It is highly interesting to find that the Pacific coast of America is represented by but a single species, *Anthoptilum murrayi*, secured by the Bureau of Fisheries steamer *Albatross* from Erben Bank, off the California coast, and also in the Hawaiian region. This species, however, was previously reported by Kölliker as secured by the *Challenger* off the coast of Halifax, in 1,250 fathoms, and by Verrill as taken by the *Albatross* in 1883, and the *Fish Hawk* in 640–1,362 fathoms. It occurred at a depth of 545 fathoms on Erben Bank. It is essentially a deep-water form and therefore apt to be distributed widely.

Mr. W. K. Fisher, in his excellent paper on the Starfishes of the Hawaiian Islands, remarks on the lack of relation between the faunas of our western coasts and that of Hawai'i. In the preparation of a report which the writer hopes to publish in the near future the alcyonarian fauna of the Californian coast has been studied with some care, with the result that not more than one or two species are found to be common to the two regions.

Of the 68 species now known from the Hawaiian region, 39 are, so far as known, confined to that region, and the remainder show the relationship of the fauna to be strongly Asiatic, but with 12 species identical with Atlantic forms, and almost no connection with the fauna of the eastern coast of the Pacific.

**Record of dredging stations at which Alcyonaria were secured during the Hawaiian cruise of the *Albatross* in 1902.**

<table>
<thead>
<tr>
<th>Station number</th>
<th>Position</th>
<th>Depth in fathoms</th>
<th>Kind of bottom</th>
<th>Species of Alcyonaria</th>
</tr>
</thead>
<tbody>
<tr>
<td>3793</td>
<td>Erben Bank; lat. N. 32° 32' 55'; long. W. 132° 34' 10&quot;.</td>
<td>412-545</td>
<td>Black manganese sand; foraminifera; rock.</td>
<td><em>Anthoptilum murrayi</em>.</td>
</tr>
<tr>
<td>3824</td>
<td>South coast of Molokai Island.</td>
<td>222-248</td>
<td>Coral rock; broken shell.</td>
<td><em>Pemunata pearcyi</em>.</td>
</tr>
</tbody>
</table>

Record of dredging stations at which Alcyonaria were secured during the Hawaiian cruise of the Albatross in 1902—Continued.

<table>
<thead>
<tr>
<th>Station number</th>
<th>Position</th>
<th>Depth in fathoms</th>
<th>Kind of bottom</th>
<th>Species of Alcyonaria</th>
</tr>
</thead>
<tbody>
<tr>
<td>3542</td>
<td>South coast of Molokai Island</td>
<td>435-506</td>
<td>Fine brown sand; mud; rock.</td>
<td>Trichopodium attenuatum.</td>
</tr>
<tr>
<td>3553</td>
<td>do</td>
<td>113-134</td>
<td>Coarse sand; shell.</td>
<td>Keroeides gracilis.</td>
</tr>
<tr>
<td>3554</td>
<td>Channel between Molokai and Maui islands</td>
<td>130-134</td>
<td>Sand; shell; rock.</td>
<td>Maricella tenera.</td>
</tr>
<tr>
<td>3556</td>
<td>do</td>
<td>127</td>
<td>Fine sand; yellow mud.</td>
<td>Echinopodium macintoshi.</td>
</tr>
<tr>
<td>3590</td>
<td>do</td>
<td>138-140</td>
<td></td>
<td>Pennatula flavo.</td>
</tr>
<tr>
<td>3592</td>
<td>do</td>
<td>168-177</td>
<td>Coarse sand; shell; rock.</td>
<td>Keroeides gracilis.</td>
</tr>
<tr>
<td>3593</td>
<td>do</td>
<td>127-154</td>
<td>Broken coral; coarse gravel; rock.</td>
<td>Para-</td>
</tr>
<tr>
<td>3594</td>
<td>do</td>
<td>163-198</td>
<td>Fine volcanic sand; shell.</td>
<td>Alcyonaria sequatralis.</td>
</tr>
<tr>
<td>3595</td>
<td>do</td>
<td>256-283</td>
<td>Fine volcanic sand; rock.</td>
<td>Clementissia tenera.</td>
</tr>
<tr>
<td>3596</td>
<td>do</td>
<td>283-294</td>
<td>Gray mud; fine sand.</td>
<td>Echinomuricea brunnnea.</td>
</tr>
<tr>
<td>3599</td>
<td>South of Lanai Island</td>
<td>234-1,084</td>
<td>Globigerina ooe; Sand; coral rock</td>
<td>Echinomuricea brunnnea.</td>
</tr>
<tr>
<td>3592</td>
<td>Channel between Maui and Molokai islands</td>
<td>136</td>
<td>Glo-</td>
<td>Pennatula lata.</td>
</tr>
<tr>
<td>3587</td>
<td>do</td>
<td>227-284</td>
<td>G lobigerina ooe;</td>
<td>Pennatula pallida.</td>
</tr>
<tr>
<td>3594</td>
<td>do</td>
<td>284-290</td>
<td>G lobigerina mad; Sand; pebbles.</td>
<td>Calibelebnum symmetrical.</td>
</tr>
<tr>
<td>3592</td>
<td>do</td>
<td>136-148</td>
<td>258-264</td>
<td>Brown globigerina mad; fine sand.</td>
</tr>
<tr>
<td>3598</td>
<td>Channel between Maui and Molokai islands</td>
<td>301-311</td>
<td>Globigerina mad; Sand; broken shell.</td>
<td>algia flexila.</td>
</tr>
<tr>
<td>3601</td>
<td>do</td>
<td>295</td>
<td>Brown mud; shell; rock.</td>
<td>Chryso-</td>
</tr>
<tr>
<td>3604</td>
<td>North coast of Molokai Island</td>
<td>304-315</td>
<td>Fine white sand; mud.</td>
<td>algia flexila.</td>
</tr>
<tr>
<td>3607</td>
<td>South coast of Oahu Island</td>
<td>304-308</td>
<td>...do...</td>
<td>Pennatula saquinosa.</td>
</tr>
<tr>
<td>3608</td>
<td>do</td>
<td>308-322</td>
<td>...do...</td>
<td>Pennatula saquinosa.</td>
</tr>
<tr>
<td>3609</td>
<td>do</td>
<td>311-337</td>
<td>Fine gray sand; mud.</td>
<td>Calibelebnum symmetrical.</td>
</tr>
<tr>
<td>3611</td>
<td>do</td>
<td>334-337</td>
<td>...do...</td>
<td>Chryso-</td>
</tr>
<tr>
<td>3614</td>
<td>do</td>
<td>281-292</td>
<td>Gray sand; mud.</td>
<td>algia flexila.</td>
</tr>
<tr>
<td>3617</td>
<td>do</td>
<td>294-349</td>
<td>...do...</td>
<td>Pennatula saquinosa.</td>
</tr>
<tr>
<td>3619</td>
<td>do</td>
<td>229-257</td>
<td>Gray sand.</td>
<td>Chryso-</td>
</tr>
<tr>
<td>3625</td>
<td>do</td>
<td>269-283</td>
<td>Fine gray sand; mud; rock.</td>
<td>algia flexila.</td>
</tr>
<tr>
<td>3633</td>
<td>Near Laysan Island</td>
<td>57-79</td>
<td>White sand; broken shell; coralline.</td>
<td>Pennatula saquinosa.</td>
</tr>
<tr>
<td>3635</td>
<td>do</td>
<td>173-229</td>
<td>Coarse coral sand; shell; coral rock.</td>
<td>Chryso-</td>
</tr>
<tr>
<td>3637</td>
<td>French Frigate Shoal</td>
<td>315-347</td>
<td>Fine white sand.</td>
<td>algia flexila.</td>
</tr>
<tr>
<td>3654</td>
<td>do</td>
<td>327-414</td>
<td>Fine coral sand; globigerina ooe.</td>
<td>Siphonogorgia collaris.</td>
</tr>
<tr>
<td>3679</td>
<td>Near Bird Island</td>
<td>222-287</td>
<td>Fine white shell; foraminifera; rock.</td>
<td>Pennatula saquinosa.</td>
</tr>
<tr>
<td>3682</td>
<td>Near Kaui Island</td>
<td>40-233</td>
<td>Coarse broken coral; sand; shell.</td>
<td>Chryso-</td>
</tr>
<tr>
<td>3685</td>
<td>do</td>
<td>430-477</td>
<td>Gray sand; foraminifera; shelf deposit.</td>
<td>algia flexila.</td>
</tr>
<tr>
<td>3680</td>
<td>do</td>
<td>385-500</td>
<td>Coral sand; rock.</td>
<td>Pennatula saquinosa.</td>
</tr>
<tr>
<td>3690</td>
<td>do</td>
<td>326-296</td>
<td>Gray sand; foraminifera; rocks.</td>
<td>Chryso-</td>
</tr>
<tr>
<td>3692</td>
<td>do</td>
<td>328</td>
<td>Fine gray sand; mud.</td>
<td>algia flexila.</td>
</tr>
<tr>
<td>3694</td>
<td>do</td>
<td>310-382</td>
<td>Fine gray sand; foraminifera.</td>
<td>Calibelebnum symmetrical.</td>
</tr>
</tbody>
</table>

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<table>
<thead>
<tr>
<th>Station number</th>
<th>Position</th>
<th>Depth in fathoms</th>
<th>Kind of bottom</th>
<th>Species of Alcyonaria</th>
</tr>
</thead>
<tbody>
<tr>
<td>3967</td>
<td>Near Kauai Island</td>
<td>418-429</td>
<td>Fine gray sand; brown mud</td>
<td>Umbellularia jordani, Calyptropha orayilii, Calyptropha versylvii, Metallogorgia squarrosa, Ceratopsis flabellum</td>
</tr>
<tr>
<td>3968</td>
<td>do</td>
<td>228-235</td>
<td>Coarse brown coral sand; shell; rock</td>
<td>Cladiscus studei, Metallogorgia squarrosa</td>
</tr>
<tr>
<td>4002</td>
<td>do</td>
<td>53-230</td>
<td>Fine coral sand; glogigerina ooze, glogigerina brown mud; glogigerina gray sand</td>
<td>Calyptropha japonica, Calyptropha versylvii, Stephanocoenia dichotoma</td>
</tr>
<tr>
<td>4003</td>
<td>do</td>
<td>490-751</td>
<td>Fine sand; brown mud; glogigerina gray sand</td>
<td>Metallogorgia squarrosa, M. melanostrichos, Calyptelmonym symmetricum, Metallogorgia melanostrichos</td>
</tr>
<tr>
<td>4007</td>
<td>Between Honolulu and Kauai Island</td>
<td>308-557</td>
<td>Foraminifera</td>
<td>Iridogorgia bella, Calyptropha orayilii, Stephanocoenia dichotoma, Paragorgia nodosa, Protocaulon nolte</td>
</tr>
<tr>
<td>4013</td>
<td>Near Kauai Island</td>
<td>399-419</td>
<td>Fine gray sand; foraminifera</td>
<td>Calyptelmonym symmetricum, Ambulipodium murrayi, Ceratopsis flabellum</td>
</tr>
<tr>
<td>4016</td>
<td>do</td>
<td>305-318</td>
<td>Black sand</td>
<td>Umbellularia carpenleri</td>
</tr>
<tr>
<td>4017</td>
<td>do</td>
<td>365</td>
<td>Gray sand</td>
<td>Clavularia corripata, Chryserogorgia arborescens, Verrucella bicornis</td>
</tr>
<tr>
<td>4018</td>
<td>do</td>
<td>724-804</td>
<td>Foraminifera; sand; nauphagene fragum</td>
<td>Pennatula flava, Echinomurica brunnea</td>
</tr>
<tr>
<td>4019</td>
<td>do</td>
<td>409-550</td>
<td>Gray sand; foraminifera; rock</td>
<td>Pennatula pellida, Calyptelmonym symmetricum</td>
</tr>
<tr>
<td>4030</td>
<td>do</td>
<td>423-438</td>
<td>Fine coral sand; foraminifera; rock</td>
<td>Calyptelmonym symmetricum, Pennatula pellida</td>
</tr>
<tr>
<td>4031</td>
<td>West coast of Hawaii Island</td>
<td>4067-4092</td>
<td>Fine dark gray sand; foraminifera</td>
<td>Pennatula pellida, Pleurogorgia militaris</td>
</tr>
<tr>
<td>4039</td>
<td>do</td>
<td>670-697</td>
<td>Gray mud</td>
<td>Pennatula pellida, Calyptelmonym symmetricum, Protocaulon nolte</td>
</tr>
<tr>
<td>4040</td>
<td>do</td>
<td>235-246</td>
<td>Foraminifera; gray sand; broken shell; rock</td>
<td>Pennatula pellida, Calyptelmonym symmetricum</td>
</tr>
<tr>
<td>4058</td>
<td>Northeast coast of Hawaii Island</td>
<td>190-195</td>
<td>Rocky</td>
<td>Pennatula pellida, Pleurogorgia militaris</td>
</tr>
<tr>
<td>4060</td>
<td>do</td>
<td>730-913</td>
<td>Fine gray volcanic sand; foraminifera; rock</td>
<td>Pennatula pellida, Calyptelmonym symmetricum, Protocaulon nolte</td>
</tr>
<tr>
<td>4065</td>
<td>Channel between Hawaii and Maui islands</td>
<td>391-500</td>
<td>Foraminifera; sand; rock</td>
<td>Pennatula pellida, Calyptelmonym symmetricum</td>
</tr>
<tr>
<td>4072</td>
<td>Northeast and north coast of Maui Island</td>
<td>36-59</td>
<td>Coarse coral sand; foraminifera</td>
<td>Pennatula pellida, Calyptelmonym symmetricum</td>
</tr>
<tr>
<td>4079</td>
<td>do</td>
<td>143-178</td>
<td>Gray sand; foraminifera</td>
<td>Pennatula pellida, Calyptelmonym symmetricum</td>
</tr>
<tr>
<td>4081</td>
<td>do</td>
<td>202-229</td>
<td>do</td>
<td>Pennatula pellida, Calyptelmonym symmetricum</td>
</tr>
<tr>
<td>4082</td>
<td>do</td>
<td>220-238</td>
<td>Gray sand</td>
<td>Pennatula pellida, Calyptelmonym symmetricum</td>
</tr>
<tr>
<td>4086</td>
<td>do</td>
<td>283-298</td>
<td>Sand; shell</td>
<td>Pennatula pellida, Calyptelmonym symmetricum</td>
</tr>
<tr>
<td>4088</td>
<td>Northeast approach to channel between Maui and Molokai islands</td>
<td>297-299</td>
<td>Fine gray sand</td>
<td>Pennatula pellida</td>
</tr>
<tr>
<td>4090</td>
<td>do</td>
<td>304-308</td>
<td>do</td>
<td>Pennatula pellida, Calyptelmonym symmetricum, Protocaulon nolte</td>
</tr>
<tr>
<td>4093</td>
<td>do</td>
<td>1,171-1,572</td>
<td>Fine gray sand; foraminifera; rock</td>
<td>Pennatula pellida, Pleurogorgia militaris</td>
</tr>
<tr>
<td>4096</td>
<td>do</td>
<td>272-286</td>
<td>Fine gray sand</td>
<td>Pennatula pellida, Calyptelmonym symmetricum, Protocaulon nolte</td>
</tr>
<tr>
<td>4097</td>
<td>do</td>
<td>286</td>
<td>do</td>
<td>Pennatula pellida, Calyptelmonym symmetricum, Protocaulon nolte</td>
</tr>
<tr>
<td>4098</td>
<td>do</td>
<td>90-132</td>
<td>Coral sand; foraminifera; rock</td>
<td>Pennatula pellida, Calyptelmonym symmetricum, Protocaulon nolte</td>
</tr>
<tr>
<td>4100</td>
<td>Channel between Maui and Molokai islands</td>
<td>130-151</td>
<td>Coral sand; shell; foraminifera</td>
<td>Pennatula pellida, Calyptelmonym symmetricum, Protocaulon nolte</td>
</tr>
<tr>
<td>4101</td>
<td>do</td>
<td>122-143</td>
<td>do</td>
<td>Pennatula pellida, Calyptelmonym symmetricum, Protocaulon nolte</td>
</tr>
<tr>
<td>4102</td>
<td>do</td>
<td>122-132</td>
<td>Foraminifera; fine gray sand</td>
<td>Pennatula pellida, Calyptelmonym symmetricum, Protocaulon nolte</td>
</tr>
<tr>
<td>4103</td>
<td>do</td>
<td>132-141</td>
<td>Fine gray sand</td>
<td>Pennatula pellida, Calyptelmonym symmetricum, Protocaulon nolte</td>
</tr>
<tr>
<td>4104</td>
<td>do</td>
<td>123-141</td>
<td>Fine gray sand; foraminifera</td>
<td>Pennatula pellida, Calyptelmonym symmetricum, Protocaulon nolte</td>
</tr>
<tr>
<td>4105</td>
<td>Channel between Molokai and Oahu islands</td>
<td>314-335</td>
<td>Fine coral sand; foraminifera</td>
<td>Pennatula pellida, Calyptelmonym symmetricum, Protocaulon nolte</td>
</tr>
<tr>
<td>4107</td>
<td>do</td>
<td>350-355</td>
<td>Coral sand; foraminifera</td>
<td>Pennatula pellida, Calyptelmonym symmetricum, Protocaulon nolte</td>
</tr>
<tr>
<td>4108</td>
<td>do</td>
<td>411-442</td>
<td>do</td>
<td>Pennatula pellida, Calyptelmonym symmetricum, Protocaulon nolte</td>
</tr>
<tr>
<td>4114</td>
<td>Northwest coast of Oahu Island</td>
<td>174-195</td>
<td>do</td>
<td>Pennatula pellida, Calyptelmonym symmetricum, Protocaulon nolte</td>
</tr>
<tr>
<td>4116</td>
<td>do</td>
<td>241-282</td>
<td>do</td>
<td>Pennatula pellida, Calyptelmonym symmetricum, Protocaulon nolte</td>
</tr>
<tr>
<td>4117</td>
<td>do</td>
<td>253-265</td>
<td>do</td>
<td>Pennatula pellida, Calyptelmonym symmetricum, Protocaulon nolte</td>
</tr>
</tbody>
</table>
Record of dredging stations at which Alcyonaria were secured during the Hawaiian cruise of the Albatross in 1902—Continued.

<table>
<thead>
<tr>
<th>Station number</th>
<th>Position</th>
<th>Depth in fathoms</th>
<th>Kind of bottom</th>
<th>Species of Alcyonaria</th>
</tr>
</thead>
<tbody>
<tr>
<td>418</td>
<td>Northwest coast of Oahu islands.</td>
<td>233-322</td>
<td>Coral sand; foraminifera; rock.</td>
<td>Calibelemnon symmetricum.</td>
</tr>
<tr>
<td>419</td>
<td>do</td>
<td>54-167</td>
<td>Coral sand; foraminifera.</td>
<td>Calibelemnon symmetricum.</td>
</tr>
<tr>
<td>421</td>
<td>do</td>
<td>216-251</td>
<td>do</td>
<td>Lepidissia longifis; Acanella curvata;</td>
</tr>
<tr>
<td>425</td>
<td>Channel between Oahu and Kauai islands.</td>
<td>963-1,124</td>
<td>Brown mud; foraminifera; rock.</td>
<td>Umbellula carpenteri; Chrysothamnus curvatus;</td>
</tr>
<tr>
<td>426</td>
<td>do</td>
<td>743-1,378</td>
<td>Gray sand; foraminifera.</td>
<td>Calibelemnon symmetricum; Calyphorgia gilberti;</td>
</tr>
<tr>
<td>430</td>
<td>Near Kauai Island.</td>
<td>283-309</td>
<td>Fine gray sand.</td>
<td>Calibelemnon symmetricum; Calyphorgia gilberti;</td>
</tr>
<tr>
<td>431</td>
<td>do</td>
<td>257-309</td>
<td>Fine gray sand; mud.</td>
<td>Calyphorgia gilberti.</td>
</tr>
<tr>
<td>432</td>
<td>do</td>
<td>257-312</td>
<td>Fine coral; volcanic sand.</td>
<td>Calyphorgia gilberti.</td>
</tr>
<tr>
<td>433</td>
<td>do</td>
<td>225-324</td>
<td>do</td>
<td>Chrysothamnus elongata.</td>
</tr>
<tr>
<td>436</td>
<td>do</td>
<td>411-676</td>
<td>Coral; volcanic sand; foraminifera; rock.</td>
<td>Umbellula carpenteri; Chrysothamnus symplocos.</td>
</tr>
<tr>
<td>439</td>
<td>do</td>
<td>339-512</td>
<td>Fine gray sand; rock.</td>
<td>Stockyodes boveri; Chrysothamnus curvatus;</td>
</tr>
<tr>
<td>451</td>
<td>Near Bird Island.</td>
<td>313-800</td>
<td>Fine coral sand; foraminifera; stones.</td>
<td>Antithamnobia armata;</td>
</tr>
<tr>
<td>453</td>
<td>do</td>
<td>902-1,069</td>
<td>Coral sand.</td>
<td>Stichodactyla helicophora; Ceramia alba;</td>
</tr>
<tr>
<td>456</td>
<td>do</td>
<td>280-588</td>
<td>White mud; foraminifera; rock.</td>
<td>Cyclomuricea fimbriata; Chrysothamnus delicata.</td>
</tr>
<tr>
<td>457</td>
<td>do</td>
<td>762-1,000</td>
<td>do</td>
<td>Ceratoides grandis, Stichyodes boveri;</td>
</tr>
<tr>
<td>461</td>
<td>do</td>
<td>36-143</td>
<td>Coral; coralline.</td>
<td>Calibelemnon symmetricum.</td>
</tr>
<tr>
<td>466</td>
<td>do</td>
<td>205-590</td>
<td>Coral sand; foraminifera; rock.</td>
<td>Antithamnobia tenuispina;</td>
</tr>
<tr>
<td>474</td>
<td>Near Niihau Island.</td>
<td>755-865</td>
<td>Gray sand; mud; globo-alumina; rock.</td>
<td>Anathamnobia armata;</td>
</tr>
<tr>
<td>476</td>
<td>do</td>
<td>537-672</td>
<td>Gray sand; rock; foraminifera.</td>
<td>Stockyodes dichotoma.</td>
</tr>
<tr>
<td>478</td>
<td>do</td>
<td>319-378</td>
<td>Coral sand; rock; pebbles.</td>
<td>Umbellula gilberti.</td>
</tr>
<tr>
<td>479</td>
<td>do</td>
<td>378-146</td>
<td>Coral sand; rock; pebbles.</td>
<td>Umbellula jordani.</td>
</tr>
<tr>
<td>482</td>
<td>Near Kauai Island.</td>
<td>671-657</td>
<td>Manganese sand; globo-alumina.</td>
<td>Paramuricea hawaiensis;</td>
</tr>
<tr>
<td>483</td>
<td>do</td>
<td>367-1,067</td>
<td>Fine gray sand; globo-alumina.</td>
<td>Umbellula carpenteri.</td>
</tr>
<tr>
<td>485</td>
<td>do</td>
<td>1,000-1,314</td>
<td>Gray sand; mud; foraminifera.</td>
<td></td>
</tr>
<tr>
<td>486</td>
<td>do</td>
<td>508-682</td>
<td>Gray sand; foraminifera.</td>
<td></td>
</tr>
<tr>
<td>487</td>
<td>do</td>
<td>508-703</td>
<td>do</td>
<td></td>
</tr>
</tbody>
</table>

An analysis of the foregoing table shows that Alcyonaria were dredged at 112 stations out of the 403 dredging stations recorded for the Hawaiian cruise. It should be remembered, however, that the bottom was of such nature, being in a notably volcanic region, that a large percentage of the hauls were unsuccessful.

In all its long history the Albatross has never lost and ruined so much dredging gear in any one cruise as she did in the Hawaiian region. It is altogether likely that nearly half of all the successful hauls yielded alcyonarians, showing an exceedingly rich bottom for these forms. There are 161 lots of Alcyonaria in the collection, a "lot" being all of the specimens of a single species secured at a given station.

Two or more species were secured at 32 of the stations; three or more at 11 stations. Four species were secured at Station 3397, near
the island of Kauai, and at Station 4101, in the channel between Maui and Molokai islands.

The best hauls yielded five species each, one being at Station 3859, near Kauai, and the other being Station 3989, between Molokai and Maui.

The richest alcyonarian fauna appears to be off the island of Kauai and in the channel between Molokai and Maui and its northeast approach. There are doubtless other localities just as rich where the roughness of the bottom prevented successful hauls and a satisfactory exploration. It appears certain, from the quantity and variety of material secured, that the Hawaiian region is one of the best localities in the world for alcyonarian life. The fact that no species have heretofore been reported is doubtless due to the apparent lack of Alcyonaria in very shallow water. There would therefore be no likelihood of these forms being collected by the natives or other shore collectors.

There were only eight hauls where a depth of over 1,000 fathoms was reached, the deepest being at Station 4093, where a depth of 1,572 fathoms was recorded, and a single specimen of Pleurogorgia militaris, new species, was secured. But two successful hauls from which alcyonarians were obtained, each yielding a single species, were made in less than 100 fathoms.

SYSTEMATIC DISCUSSION OF HAWAIIAN ALCYONARIA.

With the exceptions about to be noted, the writer has followed in general the classification of the Alcyonaria adopted by Wright and Studer in their report on the Alecyonaria of the Challenger expedition.  

In the treatment of the Pennatulacea the writer has practically adopted the classification as revised by Kölliker in his report on the Challenger collections of this group.  

With the families Chrysogorgidae and Primnoidea: the superb monographs on these groups by Versluys have furnished the basis of the classification used. No better work has been done on the Alcyonaria than is embodied in these reports, and the present writer wishes here to acknowledge the very great assistance he has derived from the careful and masterly work of Versluys. The Chrysogorgidae appears to be an unusually difficult group to handle in a satisfactory manner, and the division of

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a Report on the Alcyonaria collected by H. M. S. Challenger during the years 1873-1876. By Prof. E. Percival Wright and Prof. Th. Studer. 1889.

b Report on the Pennatulida dredged by H. M. S. Challenger during the years 1873-1876, 1880.

the genus *Chrysogorgia* into subgenera along the lines suggested by Versluys simplifies the problem greatly, although, as is usually the case in large and widely distributed groups, there is more or less intergradation between the subgenera, and these intergradations will doubtless increase with our increasing knowledge.

In the definitions of groups the writer has endeavored to give diagnoses rather than description; to preserve the essential characters while avoiding the confusing details that often obscure definition.

**Order ALCYONACEA** Verrill.

Polyps single or in colonies without an axis cylinder.

**Family CORNULARIDÆ** Verrill.

Polyps united by stolon-like processes, sometimes forming encrusting or lobular masses from which the individual polyps arise. Sometimes the polyps bear lateral buds.

**Genus CLAVULARIA** Quoy and Gaimard (modified).

Spicules present. Colonies consisting of band-like stolons from which the polyps arise singly, or of branched forms arising from a stolon-like or encrusting base.

The genus as here defined includes the genera *Clavularia* and *Telesto* of authors, which were differentiated on the basis of the two modes of growth above indicated. One of the new species described below shows that these two modes are united in a single species. The diagnostic feature by which these genera have been separated is not of generic, or even specific, rank, and the genera are therefore united in the one genus *Clavularia*.

**CLAVULARIA SPICULICOLA**, new species.

Plate XLI, fig. 1; plate XLVII, fig. 1.

Colony in the form of a creeping stolon which often surrounds a long sponge spicule for its entire length, so that the spicule forms a sort of false axis.

At other times the stolon is band-like, covering but one side of the spicule. The calyces vary greatly in their distance from each other, there being no regularity whatever in their disposition, but they are generally quite distant from each other, the distance perhaps averaging about 5 mm.

Other colonies exhibit an altogether different habit, taking on the typical mode of growth of the genus *Telesto*, forming branching colonies, of which the branches arise as buds from the body of the original or axial polyp. Branches of a second order also occur, and
in some cases the mode of growth of the genera *Cornularia* and *Telesto* are combined in the same specimen, the colony starting in the primitive way on a sponge spicule and giving off branches which themselves branch like *Telesto* colonies. Several cases were found in which a number of the sponge spicules 7 or 8 inches long are involved in one mass by anastomoses of the branching polyps. The branching forms attain a height of 50 to 100 mm.

The calyces vary enormously in size, some being 10 mm. in height and 1 mm. in diamenter, while others are less than 2 mm. high. Their diameter is fairly constant.

The calyceal walls are marked by eight longitudinal costae and terminate distally in an eight-rayed rosette. The polyps are completely retractile.

The spicules are stout warty spindles and clubs, the verrucae being very thickly crowded.

The color is light brown, sometimes yellowish.

*Type.*—Cat. No. 22574 U.S.N.M., Albatross Station 3910, north coast of Molokai, 337 fathoms.

*Distribution.*—Between the islands of Molokai and Maui; Station 3865, 265–283 fathoms (Cat. No. 22572, U.S.N.M.) ; Station 3883, 277–284 fathoms.

North coast of Molokai: Station 3910, 311–337 fathoms (Cat. No. 22574, U.S.N.M.) ; Station 3911, 224–337 fathoms (Cat. No. 22571, U.S.N.M.) ; Station 3914, 289–292 fathoms (Cat. No. 25351, U.S.N.M.).

**CLAVULARIA CORRUGATA**, new species.

Plate XLI, fig. 2.

* The usually somewhat distant polyps are connected by band-like solenia that in places expand into lobular masses from which one or two polyps spring. Polyps cylindrical, 2 to 4 mm. high, slightly expanded basally, walls strongly grooved longitudinally, there being eight grooves and corresponding costae. The distal part of the walls is transversely corrugated, so that the corrugations and grooves together cut up the surface into a regular series of squarish nodules. Distal end forming an eight-rayed rosette over the retracted tentacles.

*Spicules.*—Stout warty spindles, shorter in proportion to length than in other species of the genus, packing the walls of the solenia and polyps. In the polyp walls they have no regular disposition, but seem to be crossed in almost every direction. They seem to be absent from the tentacles.

*Color.*—Very light brown, almost white in alcohol.
This species is smaller in size than any other of the genus except *C. australicus* and *C. frigida*. It differs from either of these in the character of the spicules and in the rugosity of the polyps.

*Type.*—Cat. No. 22594, U.S.N.M., *Albatross* station 4065, between Hawaii and Maui islands, 491-500 fathoms.

**Family ALCYONIDÆ Verrill (emended).**

Colonial forms with the proximal portion of the stem usually devoid of polyps. Cœnenchyma thick. Spicules abundant. Polyps retractile.

**Genus ANTHOMASTUS Verrill.**


*Anthomastus steenstrupi* Wright and Studer.

*Anthomastus steenstrupi* Wright and Studer. Report on the *Alycyonaria* collected by H. M. S. Challenger during the years 1873-1876, 1889, p. 243.

A colony of this species was taken from a depth of 122-143 fathoms off the north coast of the island of Maui, Station 4101. The specimen agrees well with the description of the original which was secured off the coast of Japan from a depth of 565 fathoms.

**Family NEPHTHYIDÆ Verrill.**

Branched colonial forms, much like the *Alycyonidae* except that the tentacles do not retract within the body cavity of their polyps, but simply fold over the oral disk in retraction.

**Genus SPONGODES Verrill.**

Walls between the canals of the stem with few or no spicules. Polyp-heads with large conspicuous fusiform spicules, bundles of which overarch the heads themselves. Cortex with large and abundant spicules.

*Spongodes alexanderi*, new species.

Plate XLI, fig. 3; plate XLVII, fig. 2.

Colony attaining a height of about 64 mm. Stem without polyps for about 25 mm. above the constricted base. A large branch (broken) arises about 30 mm. above the base, and near the top the colony is broken up into five rather slender, finger-like branches. The polyps are single, and scattered over the upper part of the stem and branches, but tend to form small terminal clusters of closely aggregated but fairly distinct polyps.
Spicules.—Long, very large, warty spindles, longitudinally placed in the walls of the stem, branches and calyces. The latter are quite large, and distinctly overtop the polyps, the spicules arising in two or more bundles on the outer side of the calyx wall. There is a strongly marked collar of spicules below the tentacle bases. Above the collar are large spicules sometimes arranged en chevron, sometimes without apparent regularity, that form a pseudo operculum. The tentacles bear on their dorsal surface a double row of small transverse spicules. Largest spicules in calyx wall 2½ mm. long.

Color.—Very pale, almost white in alcohol. There is no reddish tinge whatever.

Distribution.—North coast of the island of Maui; Station 4101, 122-143 fathoms (type, Cat. No. 25361, U.S.N.M.); Station 4098, 95-152 fathoms (Cat. No. 22544, U.S.N.M.).

This species belongs to the "Divaricata" group of Spongodes. In one specimen from Station 4098 the spicules of the pseudo operculum are bright crimson in color, but there appears to be no other important difference between this specimen and the others.

The species is named after Mr. A. B. Alexander, Fisheries Expert on the Albatross during the Hawaiian cruise.

Genus Siphonogorgia Kölliker.

Walls between stem canals with numerous spicules. Colony branched, externally resembling a gorgonian. Coenenchyma abundant in walls of canals and filled with large spicules. Tentacles retractile.

Siphonogorgia Collaris, new species.

Plate XLI, fig. 4.

Only a fragment of this species was secured, consisting of the terminal portion of a thick branch, 6 mm. wide by 13 mm. long. The canals are numerous and irregular, with long spindle-shaped spicules and also minute spindles in their walls. The polyps are thickly clustered over the entire surface, reminding one of the end of a branch of Acropora muricata forma prolifica.

The calyces are prominent, 3½ mm. high by 1½ mm. in diameter at the middle, tubular, narrowing gradually at the distal end. The whole surface is packed with quite large, stout, warty spicules arranged longitudinally both in the coenenchyma and calyceal walls. In the latter there is a distinct circle of rather slender but large spicules, below which the spicules are stouter and sometimes resemble imbricating scales.

The polyps have a thick collar of curved transverse spicules which is much wider and more conspicuous than usual. Above the collar and
at the base of each tentacle there are a few spicules arranged \textit{en chevron}, and then a few longer and more slender spicules which are outside of the latter, and curved to meet each other so that their distal ends are parallel to the axis of the tentacle; the whole forming a rather high conical operculum. All of the spicules are covered densely with minute verrucæ so small as to appear as mere granules.

\textit{Color}.—Coral red.

\textit{Type}.—Cat. No. 25318, U.S.N.M., Albatross Station 3935, off Laysan Island, 59–79 fathoms.

This species differs from \textit{S. köllikeri} in having much more exserted and more crowded calyces.

\textbf{Order PENNATULACEA.}

Colonial forms not permanently attached to the bottom or to other objects. Stem with an axial cavity which is often longitudinally subdivided by thin partitions and contains an axis cylinder. Spicules needle-like or bar-like, never warty. Both polyps and siphonozooids are generally present.

\textbf{Family PENNATULIDAE} Kölliker.

Axis and pinnae present, the latter large, and without calcareous-ray-like bodies. Colony feather-shaped.

\textbf{Genus PENNATULA} Linnaeus (part).

The leaves or pinnae have spicules scattered over their entire surface.

\textbf{PENNATULA SANGUINEA}, new species.

Plate XLI, figs. 7 and 8.

Colony about 100 mm. long. Stem slightly expanded or swollen at base, 28 mm. long. Rachis 63 mm. long. Leaves about eighteen on each side, increasing in length from below upward to near the distal end, and then diminishing rapidly. Longest leaf about 32 mm. in length, with six polyps; an elongated triangle in shape with a maximum breadth of 3½ mm. Calyces rather prominent, cylindrical, obliquely placed so as to point toward distal end of leaf; height, on the longest side, 2½ mm.; diameter, 1½ mm.; margin with eight prominent, acute teeth composed of numerous spicules.

\textit{Spicules}.—Needle-shaped, crowding the entire surface of leaves and calyces, crisscrossed in every direction. Those in calyces longitudinally arranged in distal part and crisscrossed in proximal portion. Polyps without tentacular spicules.
Zooids.—Ventral zooids forming short rows leading inward and downward from the bases of the leaves. There is a more conspicuous row of five or six zooids on the rachis just back of the base of each leaf. Each zooid is surrounded by a circlet of perpendicularly placed spicules. Ova are seen near the bases of the leaves in the downward continuations of the polyp cavities.

Color.—Bright scarlet. Polyps white (perhaps yellow in life).

Type.—Cat. No. 22597, U.S.N.M., Albatross Station 4116, between Oahu and Molokai, 241–282 fathoms.

Distribution.—South coast of Oahu: Station 3907, 304–315 fathoms; Station 3908, 304–308 fathoms (Cat. No. 25414); Station 3910, 311–337 fathoms (Cat. No. 25329, U.S.N.M.); Station 3917, 295–330 fathoms (Cat. No. 22582, U.S.N.M.); Station 3919, 220–257 fathoms (Cat. No. 22599, U.S.N.M.).

Between Oahu and Molokai: Station 4114, 154–195 fathoms; Station 4116, 241–282 fathoms (Cat. No. 22597, U.S.N.M.); Station 4117, 253–283 fathoms (Cat. No. 22600, U.S.N.M.).

One of the prettiest and most abundant pennatulids in the collection.

PENNATULA FLAVA, new species.

Plate XLI, figs. 5 and 6.

Length of a large specimen 200 mm. Stem, to first leaf with normal polyps, 100 mm. The stem has a small basal bulb and an elongated swollen portion commencing about 25 mm. above the proximal end, and gradually diminishing until the ordinary caliber is attained below the first leaves; varying, however, considerably in different specimens. Leaves not so closely approximated as is usual in the genus, those with normal polyps being about twenty-five in number on each side; the larger ones being 20 mm. long by $3\frac{1}{2}$ mm. broad. They are an elongated triangle in shape.

Polyps six to nine in number, decreasing toward proximal leaves, the last having but a single polyp. Calyces cylindrical, in a single row, directed toward the distal ends of the leaves, increasing in length from the proximal to the distal end of the leaf; average length of longest side, 2 mm.; margin with eight acute, elongated points.

Spicules of the usual needle shape, bright yellow in color, usually of smaller size but abundant on the stem and rachis; almost absent on leaves except at their extreme bases, and on the polyp band; there being a few, however, on the general surface of the leaves. Those on the calyx walls larger, arranged in eight longitudinal rows, the upper ends of the rows projecting into the eight marginal points.

Below the true leaves there is a long series of rudimentary leaves which dwindle away into mere spiny points. This series reaches to within 47 mm. of the basal end of the stem in a specimen 8 inches long.
Zooids.—Much less numerous than is usual in this genus. There is a row of eight to twelve on ventral side at junction of each leaf with the rachis, each zooid being surrounded by a circlet of spicules converging at their distal ends.

Color.—Bright yellow throughout.

Type.—Cat. No. 22579, U.S.N.M., Albatross station 4101, between Molokai and Manu, 122-143 fathoms.

Distribution.—Between Molokai and Manu: Station 3859, 138-140 fathoms (Cat. No. 22576, U.S.N.M.).

Between Manu and Molokai: Station 3864, 163-198 fathoms; Station 4102, 122-132 fathoms (Cat. No. 22578, U.S.N.M.).

Off Laysan Island: Station 3957, 173-220 fathoms (Cat. No. 22581, U.S.N.M.).

Northwest coast of the Island of Hawaii: Station 4079, 143-178 fathoms (Cat. No. 22577, U.S.N.M.).

The specimen from Station 3864 was 10½ inches long.

**Pennatula Pallida**, new species.

Plate XI, figs. 9 and 10.

Largest specimen 175 mm. long; stem to first rudimentary leaf 28 mm.; rachis, including portion bearing the rudimentary leaves, 112 mm. long. The stem is swollen at the base, with another bulging portion about 25 mm. above the end bulb.

Functional leaves nineteen on each side, long, much narrower proportionally than in other species, 11 mm. long, 4 mm. broad at base, recurved.

Polyps usually four to each leaf, short, the calyces inclined toward the distal ends of the leaves so much that the outer side of one is adnate to the inner side of the next one nearly to the margin of the former; margin flaring, with about eight acute spines. Calyces 2 mm. long on inner side, and 2 mm. broad.

Spicules.—The spicules of this species are large and conspicuous, of the usual needle-shaped type, crowded over the entire surface of rachis, stem, leaves, and calyces, their points often projecting, giving a harsh, hirsute appearance under a low magnification, except on the lower part of stem, which is comparatively smooth. The spicules are crisscrossed in every direction on leaves and lower part of calyces, but on the upper parts of the calyx walls they are vertical, and arranged in eight rib-like bands which project upward into the eight marginal teeth. The tentacles are without spicules.

Zooids.—A row of about a dozen zooids joins the adjacent leaf bases on the ventral side of the rachis. There are other but shorter rows on the latero-dorsal ridge, which is plainly marked in this species. The hirsute appearance of the rachis, already referred to, makes it difficult to count the zooids with certainty.
Color.—Very pale light brown or buffy. Pallid, almost white.

Type.—Cat. No. 22547, U.S.N.M., Albatross Station 4097, between Maui and Molokai, 286 fathoms.

The largest specimen has no locality label.

Distribution.—Between Molokai and Maui: Station 3865, 256–283 fathoms (Cat. No. 22552, U.S.N.M.); Station 3866, 283–284 fathoms (Cat. No. 22549, U.S.N.M.).

Between Maui and Molokai: Station 3884, 284–290 fathoms (Cat. No. 25365, U.S.N.M.); Station 4082, 220–238 fathoms; Station 4088, 297–306 fathoms (Cat. No. 22554, U.S.N.M.); Station 4096, 272–286 fathoms (Cat. No. 22548, U.S.N.M.); Station 4097, 286 fathoms (Cat. No. 22547, U.S.N.M.).


? Pennatula pearceyi Kölliker.

Pennatula pearceyi Kölliker, Report on the Pennatulida dredged by H. M. S. Challenger during the years 1873–1876, 1880, p. 4.

A specimen secured at Station 3824 (Cat. No. 25365, U.S.N.M.), south coast of Oahu, appears to belong to this species, although it is considerably longer and more slender than the type as described by Kölliker. The specimen is much mutilated, and is referred to this species with much doubt.

The original specimen was taken by the Challenger south of the coast of Japan at a depth of 565 fathoms.

Genus Halisceptrum Herklots.

Pennatulide in which the leaves are without spicules.

Halisceptrum abies Kölliker.


An incomplete specimen, which, like the one described by Kölliker from the Copenhagen Museum, is without stem and undeveloped leaves, was secured at Station 4101, north coast of Maui, depth 122–143 fathoms. (Cat. No. 22588, U.S.N.M.)

This specimen agrees well with the original describer’s exceedingly brief description, except that the calyces are more exerted. The specimen appears to have been broken off from the stem some time before it was captured. Indeed the proximal end is rounded, as if it were possible that it never had a true stem.

The original specimen came from Japan.
Small, pen.

Gen.

ECHI

Echinoptilum mucin

Specimens of this tross at Station No. 22564, V Maui, 123-
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**NO. 1624. DESCRIPTIONS OF HAWAIIAN ALCYONARIA—NUTTING. 563**

Color.—Stem and rachis creamy white, polyp bodies purplish brown banded with yellowish white.

Type.—Cat. No. 22534, U.S.N.M., Albatross Station 3909, north coast of Molokai, 308-322 fathoms.

Distribution.—South coast of Molokai: Station 3828, 281-319 fathoms (Cat. No. 22531, U.S.N.M.); Station 3836, 238-255 fathoms (Cat. No. 22537, U.S.N.M.).

Between Molokai and Maui: Station 3868, 294-684 fathoms (Cat. No. 22522, U.S.N.M.); Station 4096, 272-286 fathoms (Cat. No. 22525, U.S.N.M.); Station 3898, 258-284 fathoms (Cat. No. 22538, U.S.N.M.).

North coast of Molokai: Station 3909, 308-322 fathoms (Cat. No. 22534, U.S.N.M.); Station 3910, 311-337 fathoms; Station 3911, 334-337 fathoms (Cat. No. 22532, U.S.N.M.); Station 3919, 220-257 fathoms (Cat. No. 22530, U.S.N.M.).

Off Kauai: Station 3994, 330-382 fathoms (Cat. No. 22529, U.S.N.M.); Station 4017, 305 fathoms (Cat. No. 22541, U.S.N.M.); Station 4130, 283-309 fathoms (Cat. No. 22526, U.S.N.M.); Station 4131, 257-312 fathoms (Cat. No. 22542, U.S.N.M.).

South coast of Oahu: Station 4039, 670-697 fathoms. (Cat. No. 22539, U.S.N.M.)

Between Molokai and Oahu: Station 4105, 314-335 fathoms (Cat. No. 22528, U.S.N.M.); Station 4118, 322 fathoms (Cat. No. 22535 U.S.N.M.).

Northwest coast of Oahu: Station 4117, 253-283 fathoms (Cat. No. 22536, U.S.N.M.); Station 4119, 84-167 fathoms (Cat. No. 22533, U.S.N.M.).


North coast of Maui: Station 4086, 283-308 fathoms. (Cat. No. 22523, U.S.N.M.)

Off Bird Island: Station 4176, 537-672 fathoms.

This species is the most abundant one in the collection.

Family UMBELLULIDÆ Kölliker.

Polyps very large, without calyces, and borne in a cluster at the end of an exceedingly long stem.

Genus UMBELLULA Lamarck.

Being the only genus in the family, it has the same diagnostic characters.
UMBELLULA CARPENTERI KÖLLIKER.

*UMBELLULA carpenteri* KÖLLIKER. Report on the Pennatulida dredged by H. M. S. Challenger during the years 1873–1876, 1880, p. 23.

A number of specimens collected during the Hawaiian cruise at the following stations are referable to this species:

*Distribution.*—Northeast coast of Hawaii: Station 4060, 759–913 fathoms. (Cat. No. 25343, U.S.N.M.)

Between Oahu and Kauai: Station 4125, 963–1124 fathoms. (Cat. No. 25344, U.S.N.M.)

Off Kauai: Station 4139, 512–339 fathoms (Cat. No. 25342, U.S.N.M.); Station 4187, 508–703 fathoms (Cat. No. 25345, U.S.N.M.).

The type specimen was secured by the *Challenger* in the North Pacific, south of Yeddo, from a depth of 565 fathoms.

UMBELLULA JORDANI, new species.

Plate XLII, fig. 3.

Total length of large specimen about 400 mm.; polyps to tentacle bases 17 mm.; tentacles, not fully expanded, 11 mm. There is an end bulb at proximal end of the stem which is continuous with a swelling which is distinctly quadrangular in section. Otherwise the stem is quite slender, quadrangular in section, gradually merging at its distal end into the short rachis.

Polyps nine, in largest specimen, eight being arranged around a central ninth, the whole head showing little trace of bilateral symmetry in this specimen, although it is distinct in other and smaller ones. Polyp bodies smooth, not strongly corrugated as in *U. huxleyi*, which appears to be the most nearly related known species.

*Zooids.*—Rather large, not very much crowded on terminal swelling, where they tend to assume a linear arrangement, the lines being continuous with the patches of zooids between the polyp bases. These patches are drawn into a long angle below. A few zooids are seen among the polyps on the dorsal side, and also on the lower swelling and end bulb. They are not so large as those of *U. huxleyi*.

Spicules apparently wanting.

*Color.*—In alcohol, stem nearly white; polyps umber brown, except where the surface is abraded. In the latter case the color is bluish white.

This species resembles *U. huxleyi* in color, and *U. magniflora* in arrangement of zooids, but does not have the conspicuous terminal flattened swelling of the latter.

Named in honor of President David Starr Jordan, of Stanford University.

*Type.*—Cat. No. 25319, U.S.N.M., Albatross Station 3985, off Kauai, 430–777 fathoms.
Distribution.—Off Kauai: Station 3985, 430–477 fathoms (Cat. No. 25319, U.S.N.M.); Station 3989, 385–500 fathoms (Cat. No. 25322, U.S.N.M.); Station 3997, 418–429 fathoms (Cat. No. 25321, U.S.N.M.); Station 4185, 1,000–1,314 fathoms (Cat. No. 25320, U.S.N.M.).

UMBELLULA GILBERTI, new species.

Plate XLII, fig. 4.

Total length of stem 185 mm.; end bulb and lower swelling together 30 mm.; polyp body to tentacle base 8 mm.; tentacles 20 mm.

Stem slender, with end bulb and swelling better differentiated than in the last species, the latter quadrangular in section. Symmetry radial.

Polyps, in best specimens, five in number; bodies smooth, longitudinally ribbed by the mesenteries showing through. Tentacles much longer in proportion than in *U. jordani*.

Zooids very few in number, in groups of five or six between the bases of the polyps, apparently without tentacles. A few are seen sparsely distributed on terminal swelling. They are apparently absent from specimen from Station 4183.

*Color.*—Stem very light brown; end bulb and swelling more decided sienna brown; polyps umber brown, the ribs lighter.

Named for Prof. Charles H. Gilbert, of Stanford University.

*Type.*—Cat. No. 22586, U.S.N.M., Albatross Station 4183, off Kauai, 957–1,067 fathoms.

Off Bird Island: Station 3979, 222–387 fathoms.

UMBELLULA, species.

Plate XLII, fig. 9.

A fragmentary specimen was secured at Station 4126, between Oahu and Kauai, which had but two polyps and a very short portion of the stem below the rachis.

This specimen is not sufficiently well preserved for specific description, but the following points were made out:

The two polyps are nearly opposite, with bodies about 13 mm. long and tentacles 23 mm. The body is much corrugated transversely and has eight longitudinal ribs.

Rachis broad and club-shaped.

Spicules very numerous, small, needle-shaped, crowded throughout the entire surface of rachis, polyps and tentacles.

Zooids not easily distinguishable, but apparently rather sparsely distributed on surface of rachis and basal parts of polyps.

This is the only *Umbellula* in the collection that has evident spicules on the rachis and polyps.

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Family PROTOCAULIDÆ Kölliker.

Polyps on both sides of rachis in a single series, or in indistinct rows. Polyps small and without calyces.

Genus PROTOCAULON Kölliker.

Polyps alternate, sessile. Spicules absent.

PROTOCAULON MOLLE Kölliker.


A small specimen in poor condition answers well to the description and figure of this species given in the original description.

Distribution.—West coast of Hawaii: Station 4036, 692 fathoms (Cat. No. 22543, U.S.N.M.). The type specimen was secured by the Challenger northeast of New Zealand at a depth of 700 fathoms.

Family PROTOPTILIDÆ Kölliker.

Rachis long and slender, bearing sessile polyps in a single series of indistinct rows on opposite sides. Calyces present.

Genus PROTOPTILUM Kölliker.

Zooids growing all around the rachis, leaving only the median ventral line uncovered.

PROTOPTILUM WRIGHTI, new species.

Plate XLII, fig. 7.

Length of colony 65 mm.; of stem to rudimentary polyps 21 mm. Stem rather slender, without appreciable bulb, but hooked at proximal end, and with a slight swelling above the hook. Rachis larger, increasing in size to the distal end.

Polyps usually in two rows, one on each side, but with an occasional one placed on the stem more toward the central line than the others. In general the polyps are alternately disposed, placed rather on the dorsal than the ventral side. They differ greatly in size, the smaller (younger?) ones being nearer the mid-dorsal line than the others, thus giving in places an appearance of an arrangement in rows of two. There are many rudimentary polyps on the lower part of the rachis. Calyces almost entirely immersed, their inner margins being not at all exserted; margins without distinct teeth, although the needle-like spicules sometimes give an appearance of serration.
Calyces very small, not more than $1\frac{1}{2}$ mm. high. Polyps retractile, without spicules.

Spicules needle-like, abundant, disposed longitudinally, or nearly so, throughout the colony.

Zooids large, arranged on each side of a bare mid-ventral band. They are very sparsely distributed on lateral and dorsal surfaces. Each zooid is surrounded by a tuft of converging spicules.

*Color.*—Deep rose red on rachis and calyces. Stem light yellow. The polyps were probably bright yellow in life, but are a yellowish white in alcohol.

*Type.*—Northeast approach to channel between the islands of Maui and Molokai: Station 4096, 272-286 fathoms (Cat. No. 22585, U.S.N.M.)

Named for Prof. E. P. Wright.

**Genus TRICHOPTILUM** Kölliker.

Polyps alternately arranged; margins of calyces with eight spines; spicules numerous in calyces and tentacles; zooids dorsal.

**TRICHOPTILUM ATTENUATUM**, new species.

Plate XLII, fig. 8.

Colony exceedingly long and slender. Entire length 325 mm.; stem, from base to first rudimentary polyps, 112 mm. There is a slightly swollen end bulb, and a less pronounced gentle swelling about 37 mm. above it. Average diameter of stem about $1\frac{1}{2}$ mm. The stem is quadrangular in section.

Polyps arranged somewhat irregularly in two dorso-lateral rows, sometimes opposite and sometimes alternate, large and small individuals being interspersed.

The individual polyps are large and conspicuous, with exceedingly elongated calyces which attain a length of 6 mm. and a diameter of $1\frac{1}{2}$ mm. The basal part of the body is sharply differentiated from the distal, the former being transversely wrinkled and having the needle-like spicules crisscrossed, having a length of about $3\frac{1}{2}$ mm., and appearing somewhat like a short branch with which the second part or true calyx is continuous. This second part is somewhat swollen in the middle and bears eight narrow longitudinal bands of spicules continuing upward above the margin into eight sharp teeth. The tentacles are without spicules, and are arranged in a cylindrical vertical bundle in contraction.

Spicules, needle-like, abundant in rachis and calyces.

Zooids in short rows of two or three on dorsal surface, running obliquely inward from below the bases of the calyces.

*Color.*—The stem and rachis is white, polyps umber-brown.
Type.—Cat. No. 25352, U.S.N.M.; Albatross Station 3842, south coast of Molokai, 495–506 fathoms. Numerous specimens.

The polyps of this species are very easily detached, and but few remain in place on the specimens secured, most of them having fallen to the bottom of the jar.

Genus CLADISCUS Koren and Danielssen.

Spicules absent or sparsely distributed; calyces present, but indicated only by the eight shallow lobes around the margin.

CLADISCUS STUDERI, new species.

Plate XLII, figs. 5, 6.

Colony attaining a height of 150 mm.; end bulb not well developed; stem with a stiff axis which is quadrangular in section, and measures 41 mm. to the lowest rudimentary polyps.

Calyces long, cylindrical, crowded on ventral and lateral surfaces so densely that no distinct arrangement in series can be discerned; differing greatly in size, those of different sizes being intermingled, except on basal part of rachis where they are all small; the longest about 6 mm. in height. The calycine walls are so thin and so nearly devoid of spicules that the polyps appear to be without calyces at first view, and the walls are semitransparent, showing eight longitudinal bands corresponding to the mesenteries inside. The margin is ornamented by eight pointed angular flaps that are sometimes everted. The polyps are retractile and have long tentacles.

Spicules are not entirely wanting, as in other species of the genus, but are very sparsely distributed, being found mainly in the eight longitudinal bands on the polyp walls, where they are needle-like and colorless. On superficial examination the spicules appear to be entirely absent.

Zooids are scattered in small groups of four or five between the bases of the polyps on the dorsal surface of the rachis. The ventral surface has a broad band entirely devoid of polyps and zooids.

Color.—Very pale brown in the two specimens secured.

Type.—Cat. No. 25347, U.S.N.M., Albatross Station 4002, off Kauai Island, 53–230 fathoms.

Koren and Danielssen say that Cladiscus loveni and C. gracilis have well marked calyces, although Kölliker overlooked the fact. C. loveni is said to be entirely without spicules.

The crowding of the polyps destroys the bilateral symmetry characteristic of the family, the only indication of such symmetry being in the bare ventral band.
Order GORGONACEA.

Fixed colonial forms with a distinct axis cylinder composed of calcareous or chitinous material.

Section SCLERAXONIA.

Axis composed of calcareous spicules, which are either free or fused into a solid mass.

Family BRIAREIDÆ Wright and Studer.

Axis cylinder composed of closely packed but distinct spicules.

Genus PARAGORGIA Milne-Edwards.

**PARAGORGIA NODOSA** Koren and Danielssen.


A careful comparison of the single specimen secured by the *Albatross* shows that it agrees with the original description in every essential particular except in the matter of color, which is bright coral red with a white axis in the Hawaiian specimen. The color of the type specimen was yellowish red.

The colony bears a striking superficial resemblance to *Corallium*, and was mistaken for that when first seen.

**Distribution.**—Off the Island of Kauai: Station 4030, 423-438 fathoms (Cat. No. 25357, U.S.N.M.). The original specimen was taken from the North Atlantic, off the coast of Norway.

Family SCLEROGORGIDÆ Wright and Studer.

Axis cylinder unjointed, composed of a horny substance and agglutinated calcareous spicules that are easily separated. Polyps completely retractile.

Genus KEROEIDES Wright and Studer.

Calyces in the form of warty verrucæ, in two lateral rows. Spicules of axis smooth, spindle-shaped.

**KEROEIDES GRACILIS** Whitelegge.


Quite characteristic specimens of this species were found in the Hawaiian material.
Distribution.—South coast of Molokai: Station 3838, 92-212 fathoms; Station 3853, 115-134 fathoms (Cat. No. 22563, U.S.N.M.); Station 3859, 138-140 fathoms.

Section HOLAXONIA.

Colony with an axis consisting of amorphous horny or calcareous material, or both, and not pierced by longitudinal canals, excepting a central one.

Family ISIDÆ Gray (modified by Wright and Studer).

Axis cylinder composed of alternating horny and calcareous joints, the latter not of fused spicules, but amorphous.

Genus CERATOISIS Percival Wright.

Branches, when present, arising from the calcareous joints of the axis cylinder. Polyps nonretractile, a circle of diverging spicules around the oral region. Spicules smooth.

CERATOISIS FLABELLUM, new species.

Plate XLIII, fig. 1; plate XLVII, fig. 3.

All of the specimens were secured in a fragmentary condition. The largest piece is about 275 mm. long; calcareous nodes 17 to 27 mm. long, horny nodes 1½ mm. long. The branches arise from the calcareous joints, on opposite sides of the stem; irregularly disposed but all in the same plane. Polyps on front and sides of stem and branches, unequally distributed, often denser on one side than on the other, standing at various angles with stem; about 4 mm. high, 2 mm. broad, cylindrical. The tentacles are folded loosely over the oral disk.

Spicules very long needles, attaining a length in some instances of 5 mm.; vertical in walls of calyces, on the distal portion of which they project upward as sharp points between the tentacle bases. The proximal part of calyx wall is overlaid with similar long needle-shaped spicules, often more or less obliquely disposed. Similar spicules are sparsely disposed in the cortex, where they are longitudinally disposed, and sometimes branched at one end, the two or three branches being parallel to the axis of the spicule.

The main stem and larger branches appear to be somewhat flattened. The polyps are distributed on all sides of smaller terminal branches, but are usually thicker on the edges.

Color.—Ivory white, the nodes purplish brown.

Type.—Cat. No. 25390, U.S.N.M., Albatross Station, unknown, Hawaiian Islands.
Distribution.—Off the coast of Kauai: Station 3998, 228–235 fathoms (Cat. No. 25391, U.S.N.M.).


The largest specimen, taken as a type for the above description, was without a locality label.

**Ceratoisis paucispinosa** Wright and Studer.

*Ceratoisis paucispinosa* Wright and Studer. Report on the Alcyonaria collected by H. M. S. Challenger during the years 1873–1876, 1889, p. 28.

A fragmentary specimen with but four joints and the polyps much decomposed agrees fairly well with the original description of this species.

Distribution.—North coast of Molokai: Station 3904, 295 fathoms (Cat. No. 22584, U.S.N.M.).

The type specimen was taken by the *Challenger* off the coast of Japan, 345 fathoms.

**Ceratoisis grandis**, new species.

Plate XLIII, fig. 2; plate XLIX, fig. 3.

Two fragments of the denuded axis measure, together, 437 mm., the indications being that the entire specimen was much longer. Calcareous internodes excessively elongated, none being certainly complete; measurements, 140 mm., 118 mm., 105 mm., and 70 mm. (the latter evidently broken). These internodes vary from 8 mm. to 2 1/2 mm. in diameter. There are but two horny internodes present, measuring 4 mm. and 2 1/2 mm. in length, the longer one being between the stouter calcareous internodes, and these latter are also the longest. All of the calcareous internodes have a distinct central canal.

The polyps were all detached from the axis, but were wrapped in a cloth with it. They are typical of the genus *Bathygorgia* of Wright and Studer, which is here included with *Ceratoisis*. Polyps large, slender-bodied, arising from a basal expansion and ending in an expanded distal part bearing the tentacles; length, 4 1/2 to 8 mm.; diameter below distal expansion 1 mm., across distal part 2 1/2 mm.; tentacles not fully retracted, but coiled over the mouth.

Spicules long, slender, sometimes slightly forked, rarely cruciform, often bar-like, sometimes approaching the needle-like form; apparently absent from the skin-like coenenchyma peeled from the axis; but slender spicules are present in the basal expansions of the polyps. Very large spicules surround the polyps, arranged vertically in the calyx walls, although they are often inclined to be more or less diagonal; strong spicules projecting up from the tentacle bases, and large...
bar-like ones placed haphazard, as it were, on the tentacle bases, giving an exceedingly unkempt appearance. Small bar-like spicules are placed transversely on the distal parts of the tentacles.

**Color.**—Polyps straw yellow, stem ivory white, horny internodes very dark brown.

**Type.**—Cat. No. 22559, U.S.N.M., Albatross Station 4174, off Bird Island, 735–865 fathoms.

**Genus** LEPIDISIS Verrill.

Axis with long tubular calcareous joints, alternating with short horny ones from which the branches arise. An external layer of small scale-like spicules is found covering the large fusiform spicules.

**LEPIDISIS LONGIFLORA** Verrill.


A specimen taken by the *Albatross*, northwest coast of Oahu, at Station 4121, 316–251 fathoms (Cat. No. 25358, U.S.N.M.), agrees with the original description of this species.

The type and other specimens studied by Verrill were taken from four stations in the West Indies, at depths of from 461 to 805 fathoms.

**Genus** ACANELLA Gray (emended by Verrill).

Branches arising from the short horny internodes of the axis cylinder, spicules numerous in tentacles. No external layer of scale-like spicules.

**ACANELLA EBURNEA** (Porltales).


A specimen which I refer with doubt to this species was secured at Station 4121, northwest coast of Oahu, 216–251 fathoms. It is much broken, but was probably about 18 inches high. Branching very irregular, with a tendency to the formation of whorls. The polyp spicules were smaller than described by Verrill, but otherwise much the same.

The specimens studied by Pourtalès and Verrill were taken from five stations in the West Indies, at depths of from 288 to 955 fathoms.

**Family** PRIMNOIDÆ Valenciennes (emended by Verrill).

Colonial forms with calcareous roots. Axis cylinder calcareous or horny, but never with alternating calcareous and horny joints. Calyces prominent, almost always with an operculum composed of eight scale-like spicules, and movable. Polyps often in whorls. Spicules usually scale-like.
Subfamily PRIMNOINÆ Versluys.

O perculum present. Scales large, not more than eight rows on polyp body, each row that is complete containing at least five scales.

Genus AMPHILAPHIS Wright and Studer.

Colony flabellate; calyces club-shaped, arranged in pairs on basal parts of branches, and irregularly distributed on distal parts.

AMPHILAPHIS BISERIALIS, new species.

Plate XLIII, fig. 3; plate XLVII, fig. 4.

The single fragment secured was 65 mm. high, and consisted of a stem or branch giving off alternate branches at intervals of about 18 mm.

The polyps are small, 1 ½ mm. long, club-shaped, nearly straight, and form an acute angle with the stem or branch. They are strictly opposite on the main stem, and nearly always on the branches; but on the distal ends of the latter they are sometimes in whorls of three. The calyx walls are covered with large imbricating squamous spicules in about five whorls, and usually four longitudinal rows. Scales often ctenate on the distal edges and also often show undulating edges; surfaces often sculptured with radiating lines or furrows. Operculum nearly concealed, in side view, by the last whorl of body spicules, composed of broadly triangular scales, ribbed and fluted. Sometimes the alternate opercular scales are elevated and depressed, giving the appearance of two whorls of four each.

Spicules on stem and branches broad, scale-like, lamelliform, and much larger than in Caligorgia gilberti, which otherwise resembles this species. They are usually rounded, oval or ovate in outline.

Color light buffy throughout.

Type.—Cat. No. 22583, U.S.N.M., Albatross, station 3982, off Kauai, 40-233 fathoms.

Although this species does not quite agree with the definition of the genus Amphilaphis, it seems to me to belong here, the opposite disposition of the polyps making it necessary to remove it from P lumarella, to which it is closely allied.

The sculpturing of the scales seems to indicate a close affinity with Caligorgia, from which it is separated by the fact that the polyps are not appressed to the cortex, as in that genus.

AMPHILAPHIS REGULARIS Wright and Studer.

Amphilaphis regularis Wright and Studer. Report on the Alcyonaria collected by H. M. S. Challenger during the years 1873-1876, 1889, p. 71.

A single specimen in the Hawaiian collection is referred to this species.

Specimens were secured by the Challenger in the South Atlantic, near Tristan da Cunha, at a depth of 75 fathoms; and off Nightingale Island, 100–150 fathoms.

Genus CALIGORGIA Gray (emended by Studer).

Calyces bilateral, appressed to the cortex. Spicules scale-like, often with conspicuous sculpturing in the form of radiating ridges and ctenate edges.

CALIGORGIA GILBERTI, new species.

Plate XI, III, fig. 4; plate XLVII, fig. 6.

Colony (incomplete) about 325 mm. high. Main stem wavy in outline, giving off alternate branches which themselves often resemble the main stem and which give off alternate branchlets at intervals of about 18 mm. The whole colony is flabellate in form.

Calyces arranged in whorls of five (rarely four) to seven, rather closely approximated, club-shaped, with their inner sides appressed to the cortex. Height, 1½ mm.

Spicules on calyx walls squamiform, numerous, with imbricating edges, distal edge often ctenate. The rows of scales are in annular whorls, and the more distal ones are often sculptured with radiating lines ending in the points which form the ctenate distal edges of the scales. Opercular scales eight, broad, flat, curved, the ventral ones not being notably smaller than the dorsal.

The distal ends of the polyps are bent strongly toward the cortex, so as to face the stem or branch.

Color.—Light yellow in alcohol. The fresh specimens were a bright corn yellow.

Named for Prof. Charles H. Gilbert, of Stanford University.

Type.—Cat. No. 25364, U.S.N.M., Albatross Station 4130, off Kanai, 283–309 fathoms.

Distribution.—Off Kanai: Station 3992, 528 fathoms (Cat. No. 25363, U.S.N.M.); Station 4130, 283–309 fathoms (Cat. Nos. 25364 and 25388, U.S.N.M.); Station 4132, 257–312 fathoms (Cat. No. 22592, U.S.N.M.); Station 4134, 225–324 fathoms. Off Hawaii: Station 4041, 382–253 fathoms.

Genus STENELLA Gray.

Polyps in whorls, with their calyces rigidly extending at right angles from branches. Body scales very large, in less than five rows, and very distinct from the opercular scales.
STENELLA HELMINTHOPHORA, new species.

Plate XLIV, figs. 6-9; plate XLVII, fig. 5.

Specimens much broken up. Colony evidently large, one stem being 13 mm. in diameter and densely calcareous. Branching not easily made out owing to the greatly broken condition of the specimens. Main branches irregularly distributed, branchlets dichotomously divided, with a tendency for the twigs to lie in the same plane.

Polyps irregularly distributed on main stem and branches, and in irregular whorls of four on the terminal twigs, length about 4 mm., shape cylindrical with a greatly expanded distal end, which flares like the mouth of a trumpet. The calyces project rigidly from the stem at right angles.

Spicules very large and squamiform, concave on cortex, with convexity resting on stem or branch, less concave on calyx where the scales are in about four whorls with three or four to a whorl. First whorl longest, often consisting of but two scales; third whorl shortest; the first, second, and third whorls forming a cylinder, but with their distal edges often elevated and more or less frilled. The distal whorl is much expanded at its margin, forming a cup composed of four scales (two larger and two smaller) inclosing the operculum. The operculum is composed of eight scales, each of which has a lamelliform raised edge, giving the appearance of eight vertical concentric plates. The operculum extends considerably beyond the calyx wall.

The spicules of the cortex are scale-like, fluted, often convex, with the convexity attached to the stem or branch.

Nearly all of the specimens were infested with an annelid, which had, by its presence, modified the first whorl of body scales so that they formed a sort of a tunnel, running along the branches, in which the annelid lived. These modified scales are enormously enlarged, two rows of them arching over and meeting each other above, forming an arcade. These arcades cover the greater part of one side of the branches in many specimens, and it is scarcely to be wondered at that Wright and Studer took this arcade or tunnel to be a normal structure.\(^a\)

In several specimens small simple-armed basket fish were excessively numerous, and these, too, seemed to have modified in some degree the cortex scales.

This species differs from _Stenella spinosa_ in color of stem, and in having much more slender polyps; and from _S. johnstoni_ in the number of whorls of spicules, and in the operculum.

\(^a\) Report on the Alcyonaria collected by H. M. S. Challenger during the years 1873-1876, p. 53. Here the authors regard this structure as a generic character of the genus _Calypterina_, an error that has already been corrected by Studer. (See Alcyonaires provenant des campagnes de l'Hirondelle, 1886-1888, 1901, p. 40.)
Type.—Cat. No. 25385, U.S.N.M., between Molokai and Maui: Station 3973, 32–37 fathoms.

Distribution.—Between Molokai and Maui: Station 3868, 294–685 fathoms (Cat. No. 25317 and 25385, U.S.N.M.); Station 3973, 32–37 fathoms (Cat. No. 25385, U.S.N.M.); Station 3974, 21–28 fathoms.

The bathymetric distribution of this species is greater than of any other in the collection.

Subfamily CALYPTROPHORINÆ Versluys.

Spicules of calyx body reduced to two or three pairs of large scales. Operculum conspicuous, turned toward base of branch, and in contact with the branch when the polyp is retracted.

Genus STACHYODES Wright and Studer.

Calyx body armed with three pairs of large scale-like spicules; basal scales usually not entirely encircling the body.

STACHYODES ANGULARIS, new species.

Plate XI11, fig. 7; plate XLI111, fig. 1.

But a few fragments were secured, the largest being a branch about 125 mm. long, giving off regularly disposed unilateral branchlets, six in number, all in one plane.

Calyces arranged in verticils of four or five, which are closely approximated, but leave a part of the stem appearing between them. The calyces in this species appear to face upward, instead of downward as in the preceding species.

The calyx is composed of a series of three annular spicules, the proximal one being a short inconspicuous collar, incomplete on its inner side. The second has outer profile straight, outer side ending in two blunt lateral spines and very much longer than the inner side. The third or distal annular spicule is turned so as to form an acute angle with the second, its outer profile is straight, its lower edge is overlapped by the second, and its distal end is terminated by a round smooth margin.

Opercular scales thin and delicate, longer than in other species in the collection, and form a rather delicate turret or cone.

The spicules of the cortex are thin, lamelliform, and much smaller than those forming the calyces.

Color, in alcohol, white throughout: axis, where denuded, with a golden gloss.

Type.—Cat. No. 25346, U.S.N.M. The specimens of this species, in two bottles, had no locality label.
STACHYODES REGULARIS Wright and Studer.

A specimen of this species was dredged at Station 3879, south of Lanai Island, 923-1,081 fathoms. The original specimens were secured by the Challenger in the South Atlantic, near Tristan da Cunha, 75-150 fathoms.

STACHYODES DICHTOMA Versluys.


Several specimens referred to this species were secured by the Bureau of Fisheries steamer Albatross. Each specimen had coiled around its branches a simple-armed basket fish, probably belonging to the genus Ophiocreas. One specimen was 14 inches high.

Distribution.—Off Kauai: Station 3989, 388-500 fathoms (Cat. No. 22561, U.S.N.M.); Station 4013, 399-419 fathoms; Station 4030, 423-438 fathoms (Cat. No. 25376, U.S.N.M.); Station 4182, 671-957 fathoms (Cat. No. 25375, U.S.N.M.).

The species were secured by the Siboga Expedition in the Celebes Sea, off Menado, 1,264-1,165 meters; Kei Island, 204 meters; Arafura Sea, 984 meters.

STACHYODES BOWERSI, new species.

STACHYODES BOWERSI, new species. Plate XLIII, figs. 5, 6; plate XLVIII, fig. 2.

Colony about 220 mm. high. Basal portion white, solidly calcareous except at the center of axis; eight erect branches are given off immediately above the base, all of which shortly divide into three erect branchlets, some of which continue without further division, but most of which again branch dichotomously. All of the branches are erect and approximately parallel.

The calyces are in whorls of four, and face downward, each calyx bearing a series of whorls of broad scale-like spicules, two to a whorl, each whorl being strongly frilled and dentate on its outer (lower) margin, each being costate in a longitudinal direction, and each whorl overlapping its successor. One scale of each pair also overlaps its fellow laterally. The first, or upper whorl, is much broader in its dorsal part, narrows beneath into a mere collar or rim, and distally expands into a broadly frilled margin with four to seven jagged uneven teeth.

The second (middle) whorl is incomplete on its inner side, and its outer side is shorter than that of the first whorl; it ends in a frilled expanded margin in which the teeth are less prominent than in the first whorl. The third (distal or lower) whorl is the largest, and the margin is conspicuously frilled and dentate, or rather lobular, the teeth being less pointed than in the first whorl.
The operculum consists of eight delicate lamellar spicules which overlap laterally in regular order, reminding one of the blades of a turbine wheel; scales all of nearly the same size.

The height of the polyp, measuring directly and not around the curve, is 6 mm., and its diameter is about \( \frac{2}{3} \) mm.

The cortex spicules are long, delicate, flattened scales.

Color of stem and branches pale yellow, polyps pure white (in alcohol).

This species differs from Stachyodes clarata Versluys in having all three whorls of body scales about equally expanded and fluted.

Named in honor of George M. Bowers, the U. S. Commissioner of Fisheries.

*Type.*—Cat. No. 25377, U.S.N.M., Albatross Station 4153, near Bird Island, 962-1,039 fathoms.

*Additional locality.*—Off Niihau: Station 4174, 735-865 fathoms.

**Genus CALYPTROPHORA** Wright and Studer (emended by Versluys).

Calyx body with but two pairs of very large scale-like spicules, both of which usually, but not always, entirely encircle the polyp.

**CALYPTROPHORA JAPONICA** Gray.


Several specimens of this highly variable form were secured, most of which seemed to belong to *C. japonica* No. 3 of Versluys.\(^a\)

*Distribution.*—Between Maui and Molokai: Station 3882, 136 fathoms (Cat. No. 25369, U.S.N.M.).

Between Honolulu and Kauai: Station 4007, 508-557 fathoms (Cat. No. 25370, U.S.N.M.).

Between Molokai and Oahu: Station 4108, 411-442 fathoms.

This species was secured by the *Challenger* off the Fiji Islands, depth 610 fathoms; also by the *Siboga* expedition at several localities in the East Indies at depths varying from 12 to 1,264 meters.

The type is said to have come from the Japan Sea.

**CALYPTROPHORA WYVILLI** Percival Wright.

*Calyptrophora wyvilli* Percival Wright, Narrative, Challenger Expedition, 1885, p. 690.

A very fine colony of this species was secured at Station 3997, off Kanai, 418-429 fathoms; also at Station 4019, off Kanai, 409 fathoms. Secured by the *Siboga* expedition from the Celebes Sea at a depth of 1,080-1,264 meters.

The *Challenger* secured the type from the West Pacific at a depth of 600 fathoms.

\(^a\) Die Gorgoniden der *Siboga*-Expedition, II, Die Primnoidu', 1906, p. 118.
Calyptrophora versluysi, new species.

Plate XLIII, fig. 8.

Colony incomplete, about 250 mm. high, flabellate in general form, dividing near the base into four main branches, two of which remain undivided, and the others again divide each into four branches, one of which on each side gives off branchlets from its inner side only, the others being undivided or dichotomously branched.

Calycies arranged in whorls of four, except at the extreme bases of main branches, where there are six in a whorl, their opercula turned basally. The whorls are about 6 mm. apart from base to base.

Buccal pair of scales large, their distal ends with three to seven (usually four) large, jagged, irregular teeth, forming a complete ring. Basal scales with four (sometimes two) long slender spines, the four seeming to arise from the splitting of the original two. The spines vary greatly in younger specimens, the distal border of the buccal scales being merely scalloped, and there are but two spines to each basal scale.

Opercular scales eight, the abaxial and outer lateral being much longer and more flattened than the other four, which they overlap and almost conceal.

A pair of very small, almost linear, cortex scales abut against and overlap the basal scales on their proximal sides.

The cortex scales are thin, elongated, and irregular in form.

Color.—General color white, the axis appearing gray as seen through the cortex scales. The bare axis is a very dark brown, with a coppery luster.

This species is named in honor of J. Versluys, jr., the author of the report on the Gorgonacea of the Siboga expedition.

Type.—Cat. No. 25382, U.S.N.M. Albatross Station 4007, between Honolulu and Kauai, 508-557 fathoms.

Additional locality.—Off Kauai: Station 3997, 429 fathoms.

Family MURICEIDÆ Verrill.

Axis horny. Polyp without a true operculum, with a collarette of transverse spicules immediately below the tentacle bases. A pseudo-operculum is formed by the spicules on the tentacles, when the latter are folded. Oesophageal part of body wall without spicules, and retractile within the basal portion, which has spicules.

Genus ACANTHOGORGIA Gray (emended by Verrill).

Calycies elongated, cylindrical, expanded distally. Body spicules in eight longitudinal rows arranged en chevron, margins armed with eight bundles of sharp projecting spines.
ACANTHOGORGIA ARMATA Verrill.


It appears to me to be likely that the Acanthogorgia spinosa of Hiles is a synonym of this species. The specimens in the Hawaiian collection vary considerably among themselves.

Distribution.—Between Molokai and Oahu: Station 4107, 350-355 fathoms (Cat. No. 22556, U.S.N.M.).

Off Bird Island: Station 4156, 286-568 fathoms (Cat. No. 25381, U.S.N.M.).

Vicinity of Niihau Island: Station 4179, 378-126 fathoms (Cat. No. 22557, U.S.N.M.).

The original description was based on specimens taken from off the New England coast, from depths of 304 to 524 fathoms.

Genus PARAMURICEA Kölliker (emended by Verrill).

Bases of contracted tentacles bearing spicules arranged en chevron, forming an eight-rayed pseudo-operculum. Spicules of calyx walls forming eight longitudinal bands.

PARAMURICEA EQUATORIALIS Wright and Studer.

Paramuricea equatorialis Wright and Studer, Report on the Alcyonaria collected by H. M. S. Challenger during the years 1873-1876, 1889, p. 100.

A specimen from Station 3859 (Cat. No. 25366, U.S.N.M.) agrees with the original description and figures except that the spicules are not so decidedly curved in our specimen, and do not show such decided "stachenplatten." The calyces are exceedingly varied in form, from a truncated cone to a short cylinder.

The figures in the Challenger report do not agree with the description in the text as to the proportion of height to diameter of the polyps.

The type specimens were taken by the Challenger near St. Pauls Rock, South Atlantic, from a depth of 80 fathoms.

PARAMURICEA HAWAIIENSIS, new species.

Plate XLIV, fig. 1; plate XLVIII, fig. 3.

Colony large, robust, flabellate in outline, incomplete, 200 mm. in height. Main stem about 8 mm. in diameter, irregularly bent, giving off irregularly spaced lateral branches which resemble the main stem; branches showing a tendency to branch on one side only, but in some cases the distal branchlets are alternate; branch terminations abruptly enlarged and usually bearing a group of two to four laterally placed polyps.

*Zoological Results of the Willey Expedition, Pt. 2, p. 113.*
Polyps irregularly but sparsely scattered over main stem and larger branches, more approximate on distal parts, where they often become quite regularly alternate; those on the same side being about 3 mm. apart. They project at a right angle from the branches and are 2 to 3 mm. high to the end of the operculum, varying from a rough cylinder to the frustrum of a cone in shape; average diameter below collar about 2 mm.

Spicules warty spindles, large and stout, often forked or branched, arranged in circles at bases of the calyces, and vertically placed in the calyceal walls without forming eight longitudinal costae that are as distinctly marked as in other species of this genus. At the margin a few not very prominent points arise. The collar is quite well marked, and is composed of rather slender spindles with inconspicuous verrucae or none. The opercular spicules are slender, curved, warty spindles, covering the dorsal side of the tentacles in longitudinal bundles of four to eight. Spicules of the cœnenchyma rough, coarse spindles arranged longitudinally, in a general way, but often more or less irregular in disposition.

Color of main stem and branches dark golden brown. The rest of the colony is grayish brown.

_Type._—Cat. No. 25353, U.S.N.M., _Albatross_ station 4186, off Kauai, 508-682 fathoms.

**Genus ANTHOMURICEA** Wright and Studer.

Calyces cylindrical, projecting perpendicular to the axis. Spindle-shaped spicules arranged _en chevron_ both on body walls and on proximal parts of tentacles.

**ANTHOMURICEA TENUISPINA,** new species.

Plate XLIV, fig. 2; plate XLVIII, fig. 5.

Colony flabellate in form, attaining a height of about 375 mm., growing from a basal disk-shaped concave flap of leathery consistency. Stem 7 mm. thick, almost straight proximately and sinuous distally, giving off large and small branches on opposite sides; branches subdividing several times, sometimes giving off regularly opposite twigs, and at others showing no regularity whatever.

Polyps scattered sparsely on the main stem and branches; more crowded distally. On the branchlets they are arranged in irregular whorls of three or four, and are only about 2 or 3 mm. apart. The twigs end in a broad lobular expansion on which is placed a group of three to five polyps.
Calyces low truncated cones. The polyp is greatly constricted just below the collar, and above it the tentacles arise in a perpendicular group, the outline of the mass of tentacles being a truncated oval when viewed laterally. Height of polyp and calyx about 2 mm.

Spicules, small warty spindles disposed transversely around the bases of the calyces, and in eight double rows arranged en chevron in their walls. Those of the collar are more slender and curved at the ends; while those of the tentacles are much smaller, more slender, arranged en chevron basally, but distally they are disposed in numerous more nearly parallel longitudinal rows. The spicules of the cortex are sometimes scale-like, but are usually stout warty spindles, sometimes very irregular in their disposition, at others longitudinally disposed.

Color.—Stem and branches, where bare, a dark rich brown; polyps a much lighter yellowish brown. When dried, the spicules of the cortex give the colony a silvery appearance.

This is one of the largest and handsomest species in the collection.


Genus CLEMATISSA Wright and Studer.

Termination of branch always formed by a polyp. Calyces bluntly conical, arranged in short spirals. Spicules exceedingly varied in shape, those in calyx walls arranged irregularly, those on tentacle bases en chevron.

CLEMATISSA ALBA, new species.

Plate XLIV, fig. 4; plate XLVIII, fig. 4.

Colony incomplete, about 22 mm. high, consisting of a sinuous stem giving off two large unequal branches about 50 mm. apart. The branches and main stem are equal in diameter and similar in appearance, each ending in an irregular cluster of polyps. The calyces are disposed in an irregular spiral, project at a right angle from the stem and branches, although their distal ends may be inclined either toward the distal or proximal end of the colony; unusually large in size, cylindrical, sometimes attaining a height of 5½ mm. to the top of the operculum, and a diameter of 3 mm. across the top of the calyceal wall. The tentacular part of the polyp is abruptly constricted from the body, and is quite high; the basal half of the tentacles being held vertically, and the distal half bent abruptly over the oral disc.

The spicules are warty spindles, sometimes flattened and branched. Those of the calyx walls are proportionally small and inclined in all
sometimes
edges
Station
Station
the
calyx,
toward
other,
mainder
bases,
l^osed
coenenchyma
times
corals.
Color.—The axis, cortex, and calyces are all creamy white in color
(in alcohol), so that the colony bears a striking resemblance to a
coral.

Type.—Cat. No. 25378, U.S.N.M., Albatross Station 4157, off Bird
Island, 762-1,000 fathoms.

CLEMATISSA TENUÉ, new species.

Plate XLIV, fig. 3; plate XLIX, fig. 2.

Colony straggling in habit, attaining a height of 150 mm., some-
times unbranched and at others very sparsely branched. In one
specimen there are two very short branches very distant from each
other, and in others there are several long, straggling, irregularly dis-
posed branches.

Calyces arranged in rather irregular spirals which grow closer
toward the distal ends of the branches. Branches terminating in a
polyp. The calyces are very low dome-shaped, spreading at their
bases, which are often contingent.

Pólyps, when expanded, arising abruptly from the summit of the
calyx, where they assume the form of a miniature acorn; sometimes
the polyp is greatly elongated and the tentacles are extended and not
folded over the mouth as usual, but generally the attitude is the char-
acteristic one of the family. The expanded polyp shows eight longi-
tudinal bands of warty spicules.

Spicules usually small, exceedingly varied in shape. Those of the
cenenchyma are almost scale-like in appearance, and their outer edges
seem to overlap the inner edges of those in the next row; edges jagged
and irregular. The spicules of the calyx walls are similar to those
just described. The collaret is evident, the spicules at the bases of
the tentacles are warty spindles arranged en chevron, and the re-
mainder of the tentacular spicules are longitudinally arranged. There
are many warty spindles in the cortex, often with projections on one
side, sometimes curved or branched.

Color.—Gray.

Type.—Cat. No. 22569, U.S.N.M., Albatross Station, 4102, between
Molokai and Maui. 122-132 fathoms.

Distribution.—Between Maui and Molokai: Station 3856, 127 fath-
ombs (Cat. No. 22566, U.S.N.M.); Station 3857, 127-128 fathoms (Cat.
No. 22570, U.S.N.M.); Station 3858, 128-138 fathoms; Station 3859,
138–140 fathoms (Cat. No. 22567, U.S.N.M.); Station 3862, 108–127 fathoms (Cat. No. 22565, U.S.N.M.); Station 3864, 163–198 fathoms; Station 4102, 122–132 fathoms (Cat. No. 22569, U.S.N.M.).

Clematiissa verrilli Wright and Studer.

*Clematiissa verrilli* Wright, Report on the Alcyonaria collected by H. M. S. Challenger during the years 1873–1876, 1889, p. 107.

A fragmentary specimen taken off the north coast of Maui, at Station 4098, 95–152 fathoms (Cat. No. 22593, U.S.N.M.), is referred to this species.

The type was secured by the *Challenger* off Tristan da Cunha Island, from a depth of 360 fathoms.

Genus *Mellella* Gray.

*Mellella grandiflora*, new species.

Plate XLIV, fig. 5; plate XLVIII, fig. 6.

Colony unbranched; calyces on all sides of stem, closely set; polyps retractile, in retraction leaving an oblong concavity at the summit of the calyx.

*Mellella grandiflora*, new species.

Plate XLIV, fig. 5; plate XLVIII, fig. 6.

Colony an unbranched stem arising from a disk-like leathery base, attaining a height of 256 mm. and a diameter of 3½ mm. The stem is slightly expanded at the distal end, making it somewhat club-shaped.

Polyps very large, rather thickly emplanted on the sides, and more closely on the front and back of stem. Calyces in form of truncated cones 3½ mm. high and 5½ mm. broad at base, elliptical in section. The polyp is often considerably exserted above the calyx, so that the height of polyp and calyx together may be 7 mm.

Spicules large warty, sometimes forked, disposed irregularly around the base of the cone, with a tendency toward a circular arrangement. They form eight vertical bands on the calyx walls; those of each band being en chevron basally and more nearly vertical distally, their ends projecting above the margins of the walls.

The esophageal region of the polyp is much more extensive than usual in this family, and is surrounded by a number of rugosities consisting of transversely disposed spicules, the upper rugosity forming the collar. Above this arise the tentacular spicules, disposed en chevron basally and in several longitudinal rows distally. The tentacles are erect and not distinctly folded over the mouth.

Color of axis very dark brown, in places, with greenish golden iridescence; polyps very light brownish yellow, in alcohol.

*Type.*—Cat. No. 22590, U.S.N.M., *Albatross* Station 3992, off Kauai, 528 fathoms.
Genus ECHINOMURICEA Verrill.

Calyces short, cylindrical, conical or truncated; tentacular opercula horizontal; spicules long flat needles, with branched ends.

ECHINOMURICEA BRUNNEA, new species.

Plate XLV, fig. 1; plate XLIX, fig. 4.

Colony incomplete, flabellate in form, attaining a height of about 75 mm., consisting of a central stem which branches in a straggling manner.

Calyces usually borne on opposite sides of stem and branches, but in places on all sides, low, dome-shaped, and about 2 mm. high by 2½ mm. broad at base.

Polyps completely retractile, so that there is not even a distinct opening at the top of the calyx.

Spicules small, of exceedingly varied form, many being spindle shaped with both ends branched and forked, some being star shaped, and some resembling the paxillae of starfish in miniature. They cover the surface of calyces and cortex, looking much like grains of sand under the dissecting lens. There is a circlet of pointed spicules around the top of the calyx at the margin of inversion, and there are a few large warty spindle-shaped spicules arranged en chevron on basal part of tentacles and longitudinally on distal part.

Color.—A uniform sandy brown.

Type.—Cat. No. 25325, U.S.N.M., Station 4079, between Hawaii and Maui, 143-178 fathoms.

Distribution.—South coast of Molokai: Station 3838, 92-212 fathoms (Cat. No. 22596, U.S.N.M.).

Between Molokai and Maui: Station 3859, 138-140 fathoms; Station 3863, 154 fathoms (Cat. No. 25420, U.S.N.M.); Station 3885, 136-148 fathoms (Cat. No. 25327, U.S.N.M.); Station 4100, 130-151 fathoms (Cat. No. 25328, U.S.N.M.).

Between Hawaii and Maui: Station 4079, 143-178 fathoms (Cat. No. 25325, U.S.N.M.).

This species bears much superficial resemblance to the Gorgonidae, but is distinctly amuriceid, and appears to belong to this genus, as is shown by the arrangement of spicules in the polyps.

Genus CYCLOMURICEA, new genus.

Colony flabellata; calyces short, stout, columnar, their walls with spicules transverse to the axis of the calyx and forming annular rings around it. Spicules warty spindles.

Type.—Cyclomuricea flabellata.
CYCLOMURICEA FLABELLATA, new species.

Plate XLI, figs. 2 and 3; plate XLIX, fig. 1.

Colony (fragmentary) 65 mm. high, flabellate in general form. Main stem giving off irregularly spaced branches from opposite sides, and then dividing into two branches about 25 mm. from the base; these latter branches giving off branchlets from one side only; the branchlets again dividing, in some cases giving off terminal twigs from both sides.

Polyps irregularly distributed on opposite sides of main stem, but becoming more closely approximated on the smaller branches and twigs, where the distance between adjacent polyps is about 1 mm. The calyces are inclined distally and bend slightly at the ends. They are short, stout, columnar, about 1 mm. high, and their diameter is about equal to their height. The cesophageal region is not well differentiated.

Spicules, warty spindles, many of them rather slender, sometimes forked, but usually fairly symmetrical. Those in the calyx walls are transversely disposed, this disposition making it hard to differentiate the collar from the rest of the polyp, the spicules having the same form and disposition. The tentacular spicules are of the same warty form; several at bases of the tentacles converging distally en chevron, but longitudinally arranged on the rest of the tentacle.

Color.—Axis dark brown; polyps lighter brown, in alcohol.

Type.—Cat. No. 25331, U.S.N.M., Albatross Station 4161, off Bird Island, 39-183 fathoms.

Genus MURICELLA Verrill.

Coenenchyma thin; calyces short, subconical; spicules warty spindles.

MURICELLA TENERA Ridley.

Muricella tenera Ridley, Zoological Collections of H. M. S. Alert, 1884, p. 335.

The specimens secured by the Albatross agree better with the descriptions of those secured by the Challenger than with the original descriptions of Ridley, especially regarding the disposition of the spicules on the calyx walls. The calyces are exceedingly variable in size.

Distribution.—South coast of Molokai: Station 3854, 130-134 fathoms (Cat. No. 25373, U.S.N.M.).

Type—Locality.—Port Molle, Queensland.

The Challenger specimens were secured off the Ki Islands, Papua.
Family CHRYSOGORGIDAE Verrill.

Coenenchyma thin, polyps large, usually distant, in a single row and nonretractile; base of attachment calcareous. Calyces not evident as separate from the polyp walls, to the shape of which they strictly conform; no operculum nor collaret. Axis, when denuded, generally with a brilliant metallic lustre.

Subfamily LEPIDOGORGINÆ.

Colony simple, unbranched, slender; polyps in a single row.

Genus LEPIDOGORGIA Verrill.

The characters of the genus are the same as those of the subfamily.

LEPIDOGORGIA GIBBOSA, new species.

Plate XLV, fig. 6; plate XLIX, fig. 5.

The unbranched stems arise singly or in tufts from a fibrous mass of rootlets which is small in comparison to the size of the stems; height 150-200 mm.

Stem flexible, slender, covered with a thin coenenchyma; bearing equidistant and unilateral polyps inclined toward the distal end.

Polyps 27 mm. apart, emplanted along the whole length of the stem; rather short, arising from a distinct swelling, which is larger than the polyp body itself and embraces the stem. The polyp body is sharply distinguished from this swelling, very short, being but about 1 mm. in height to tentacles; tentacles very long and thread-like, nonretractile, with long filamentous fringes. The tentacles are very difficult to measure, on account of their being loosely coiled, but they are at least twice as long as the polyp body.

The spicules are small, rod-like, sometimes cruciform, rather sparsely distributed, longitudinally placed on polyp body, thickly distributed on the basal swelling and the cortex, apparently absent in the tentacles. Those of the cortex are scale-like and lobed in various ways. All spicules are without pronounced verrucae.

Siphonozooids are present in this species, between the basal swellings.

Color.—Light buffy yellow, the bared stems showing a dull golden iridescence.

Type.—Cat. No. 25330, U.S.N.M., Albatross Station 3990, off Kauai, 296-326 fathoms.

Additional locality.—Off Kauai: Station 3989, 165-469 fathoms (Cat. No. 25372, U.S.N.M.). Numerous specimens.

*The arrangement of subfamilies, genera, and subgenera here adopted is substantially that of Versluys in his excellent monograph of the Chrysogorgide of the Siboga expedition.*
LEPIDOGORGIA SPIRALIS, new species.

Plate XLV, fig. 5.

Colonies unbranched, attaining a height of 4 feet 6 inches (135 cm.). Stem bending on its ascent in the form of a helix, exceedingly slender and growing more so distally, until it is not much larger than a coarse hair. Root absent.

Polyps uniserial, small, short, inclined toward distal end of stem, placed at intervals of about 3 1/2 mm.; basal portion of polyp consisting of a long swelling embracing the stem, from the distal and lateral angle of which the polyp proper arises. Length of polyp, from tentacle bases to branch, 1 1/2 mm.; diameter about 1 mm.

There appear to be no spicules whatever in this species.

Color.—Straw yellow, in alcohol, axis with indistinct violet and purple reflections.

The spiral coiling of the stem may possibly be due to the manner in which it was packed in a can for transportation; but the "set" appears to be natural.

The entire absence of spicules appears to be a feature not before met with in this family. The presence or absence of spicules does not seem to be a good character for even generic definition in this order.

Type.—Cat. No. 25355, U.S.N.M., Albatross Station 4103, between Maui and Molokai, 132-141 fathoms.

Subfamily CHRYSOGORGINÆ.

Colonies branched; the branches simple or branched, branches often spirally arranged; cortex thin; tentacles capable of but partial retraction; spicules sparsely distributed.

Genus CHRYSOGORGIA Verrill.

Branches geniculate, giving off branchlets, all of which are from the same side of the branch. Stem sympodial, the branches being given off in a spiral. Tentacles never truly retractile.

"Group A," Versluys.

Polyps with spicules in body and tentacles that are shorter or longer bar- or needle-shaped, with rounded or pointed ends, and with surfaces covered with nodules; "schuppen" or scales are also present. Exceptionally the body spicules are slender, but usually longer than broad, sometimes with very few nodules, and all lying lengthwise in the distal part of the body.

CHRYSOGORGIA ARBORESCENS, new species.

Plate XLV, figs. 4 and 8; plate XLIX, fig. 6.

Height of incomplete colony 162 mm. The main stem divides into two equal main branches about 25 mm. from the bottom; branch
origins two-fifths, right-handed. The distance between branch origins is about 3 mm., and the slightly ascending branches subdivide about four times. Normal polyps ordinarily one to each node, but two to a node on distal parts; small, rather slender, 1/2 to 2 mm. high. Besides these there are a number of large abnormal polyps infested with parasitic crustacea. These polyps are in some cases as much as 12 mm. high by 2 mm. in diameter.

Spicules, usually bar-like, arranged longitudinally on body walls and in tentacles. Not seldom irregular, branched forms are seen. The spicules in the modified polyps are larger than elsewhere, and tend to be more irregular. Here also they are arranged longitudinally in the body walls.

Color of main stem light drab, main branches light yellow, polyps almost white. It is probable that the branches and polyps are bright yellow in life.

The stem has a dull greenish iridescence, where denuded, and this becomes lighter green where the axis of the branches is seen.

Type.—Cat. No. 25354, U.S.N.M., Albatross Station 3973, near French Frigate Shoal, 395–397 fathoms.

Additional locality.—Between Hawaii and Maui: Station 4065, 491–500 fathoms.

CHRYSOGORGIA DELICATA, new species.

Plate XLV, fig. 7.

Colony, incomplete, about 50 mm. in height, with exceedingly delicate stem and branches, the latter with but one or two bifurcations. Spiral left-handed, one-third to a whorl; distance between branch origins 4 mm.

Polyps about 2 1/2 mm. high, quite distant from each other, a single one to a node, except where there are two on a distal node, much decomposed and hard to study in the specimens secured.

Spicules squamiform, but so varied in form and size as to be almost beyond description. They are rather large, with many lobular processes from their edges, and are imbricating and interlocked in an exceedingly complex manner. They often have forked, lobular ends, resembling those of C. axillaris. Their general trend seems to be longitudinal in polyp walls, although there is a tendency to become transverse on the polyp bases. Tentacular spicules curved, placed transversely.

*These terms are used by Vershys. "Branch origins two-fifths" means that starting with a given branch origin, and following the origins of successive branches upward, the sixth branch origin will be directly above the first, and that the spiral traced through the branch origins will have passed meanwhile twice around the stem. "Right-handed" means that the spiral passes upward in an opposite direction to that taken by the hands of a watch.
Color.—Almost white throughout. Where the axis is bare it shows a violet iridescence.

The species is not far from "Chryso gorgia sp.?" Versluys, with which it agrees in the details of the polyp spicules.

Type.—Cat. No. 25332, U.S.N.M., Albatross Station 4166, near Bird Island, 293–800 fathoms.

CHRYSO GORGIA ELEGANS (Verrill).

Plate L, fig. 1.


Several specimens referable to this species were secured.

Distribution.—Between Molokai and Maui: Station 3866, 283–284 fathoms (Cat. No. 25339, U.S.N.M.).

North coast of Molokai: Station 3911, 334–337 fathoms; Station 3917, 294–330 fathoms (Cat. No. 25338, U.S.N.M.).

The material studied by Verrill was secured off Granada, 291 fathoms, and off Barbados, 237–347 fathoms.

CHRYSO GORGIA FLEXILIS (Wright and Studer).

Plate XLVI, fig. 1; plate L, fig. 6.

Dasysorgia flexilis Wright and Studer, Report on the Alcyonaria collected by H. M. S. Challenger during the years 1873–1876, 1889, p. 10.

Several fine colonies of this species were secured during the Hawaiian cruise.

Distribution.—Between Molokai and Maui: Station 3868, 294–684 fathoms. (Cat. No. 25340 U.S.N.M.)

Between Maui and Molokai: Station 3901, 280–311 fathoms (Cat. No. 25341, U.S.N.M.).

North coast of Molokai: Station 3925, 299–323 fathoms.

The specimen from Station 3868 differs from the others in having more slender polyps, and in having a brighter golden iridescence to the distal parts of the denuded stem and branches.

This species was collected by the Challenger off the coast of Chiloe, at a depth of 120 fathoms.

CHRYSO GORGIA LATA Versluys.

Plate XLVI, fig. 2; plate L, fig. 3.

Chryso gorgia lata Versluys, Die Gorgoniden der Siboga-Expedition, I. Die Chryso gorgiidae, 1902, p. 33.

A beautiful colony, about 2 feet in height, was secured at Station 4137, off Kauai, 411–476 fathoms.

Other localities. Station 3989, off Kauai, 385–500 fathoms, and Station 4187, off Kauai, 508–793 fathoms. (Cat. No. 25387, U.S.N.M.)

Die Gorgoniden der Siboga Expedition, I. Die Chryso gorgiidae, 1902, p. 78.
The type was secured by the *Siboga* expedition in the Celebes Sea at a depth of 1,901 meters.

**ChrysoGorgia SpiculoLosa** (Verrill).


A single specimen, collected off Bird Island, at Station 4151, 313–800 fathoms (Cat. No. 25356, U.S.N.M.), agrees better with the description in the *Challenger* report (p. 91) than it does with Verrill’s original description.

The material studied by Verrill was secured at five West Indian stations, from depths varying from 334 to 573 fathoms. The *Challenger* secured this species off Pernambuco, from a depth of 350 fathoms.

“Group B, Squamosæ Aberrantes,” Versluys.

Polyps with very thin squamous spicules only in the body. Tentacular spicules very thick and irregular scales, sometimes terete spicules.

**ChrysoGorgia Curvata** Versluys.

Plate XLV, fig. 9.


An incomplete colony from near Bird Island, Station 4153, 962–1,059 fathoms (Cat. No. 25371, U.S.N.M.), shows the characteristics of this species very well, although it differs from the type in having longer internodes, and the tentacular spicules do not show such jagged ends as are figured by Versluys. It is doubtless the same species, however.

**Distribution.**—The type was secured by the *Siboga* expedition between Halmahera and Gebe, from a depth of 1,089 meters.

**ChrysoGorgia Flavezecens**, new species.

Plate L, fig. 5.

The fragments of a large colony indicate an original height of about 16 inches (40 cm.). Stem smooth, straight, and unbranched for about 250 mm., distinctly geniculate at branch origins. Branch origins one-third, left-handed, rather distant for this genus, being about 12 mm. apart. Branches dividing four or five times. Polyps, one to each internode of branches, rather distant, about 2½ mm. high, with bulging basal and constricted middle portions, projecting at nearly a right angle from the branches.

Zooids are present on the branches.

Spicules squamiform, with lobulated edges, transverse on body wall and on the outer surfaces of the tentacles, forming an imбри-
cating armor. This imbrication is formed by the lobulated upper edges of the scales overlapping the smoother edges of those just above. The spicules of the cortex are larger lobulated scales, longitudinally disposed. Occasional cruciform scales are seen.

Color.—Buffy yellow, with a bright golden iridescence where the cortex is removed from the axis.

Type.—Cat. No. 25379, U.S.N.M., Albatross Station 4125, between Oahu and Kauai, 963 fathoms.

Additional locality.—South of Lanai: Station 3879, 923–1,081 fathoms.

The specimens from Station 3879 are mere fragments, and have larger terminal polyps than the type. The single specimen which forms the type is so fragmentary that I do not feel justified in dissecting the stem to find whether it is monopodial or not. From its mode of growth, and long, smooth, straight basal part of the stem, I suspect that it may belong to the next genus, *Metallogorgia*.

**CHRYSOGORGIA GENICULATA** (Wright and Studer.)

Plate I., fig. 4.

*Dasygorgia geniculata* Wright and Studer. Report on the Alcyonaria collected by H. M. S. Challenger during the years 1873–1876, 1889, p. 17.

This species shows the highly modified polyps referred to on page 589 that seem to be the result of the presence of parasitic crustacea in the polyp cavities.

Some of these polyps are 7 mm. long, while the normal polyps are but a little less than 2 mm. long.

The station number of this specimen is lost. (Cat. No. 25360, U.S.N.M.) The types were taken by the *Challenger* off the Philippines from a depth of 80 to 102 fathoms, and off the Japanese coast. The species was also secured by the *Siboga* expedition, off Kei Island from a depth of 148 to 621 meters.

**CHRYSOGORGIA STELLATA**, new species.

Plate XLVI, fig. 3; plate I., fig. 3.

Colony profusely branched, flabellate in general form, 150 mm. high by 125 mm. in spread. Root, a round, flat white calcareous plate. Main stem stout, beginning to branch 6 mm. from the root; first three branches tending to form a spiral 5½ mm. apart; then a large, much divided branch is given off; then a smaller branch; and then the stem divides into a bushy tuft of large branches, each being erect and much divided, there being from seven to ten divisions of each.

Polyps usually two to each node on distal parts, and one to each node on proximal parts of branches, inclined toward distal parts of
DESCRIPTIONS OF HAWAIIAN AlCYONARIA—NUTTING. 593

branches; 4 mm. high, 2½ mm. broad across crown of spines. Basal part of polyps rather broad, the calyces expanding above into eight broad conspicuous spines composed of spicules longitudinally arranged, and pointing radially outward and upward, so that the whole affair has a pronounced stellate outline when viewed from above.

Spicules usually smooth, without verrucae, but often with lobular processes. On the bases of the polyps they are obliquely arranged; higher up they are transverse, there being two horizontal series between the ridges under the tentacle bases, forming a concave surface to which the spicules conform. Just above and inside of each of the spines referred to above, a band of imbricating squamiform spicules in several indefinite rows passes along the dorsal surface of each infolded tentacle. The cortex contains an outer layer of long terete spicules, and an inner layer of smaller, scale-like forms.

The color of the entire colony is a brilliant golden yellow when fresh. The exposed surface of the axis shows a particularly brilliant golden luster, like highly burnished gold.

Type.—Cat. No. 25380, U.S.N.M., Albatross Station 3826, south coast of Molokai, 371 fathoms.

Additional locality.—Between Molokai and Oahu: Station 4107, 355 fathoms.

This species is near Chrysogorgia octagonus Versluys but the branching is much more profuse, the angles at tentacle bases are acute, and the arrangement of body spicules different.

Genus METALLOGORGIA Versluys.

Branches irregular, distant or absent in proximal part of the colony; on distal part they form a pannicle. Stem monopodial.

METALLOGORGIA MELANOTRICHOS (Wright and Studer).

Plate LI, fig. 5.

Dasyfjorfila melanotrichos WRIGHT and STUDER, Report on the Alcyonaria collected by H. M. S. Challenger during the years 1873-1876, 1889, p. 15.

Several fine specimens of this species were secured during the Hawaiian cruise. One of these from Station 4018 had a smooth unbranched stem 32 inches (80 cm.) long, surmounted by a graceful pannicle or crown of branches.

Distribution.—Off Kauai Island: Station 4018, 724-804 fathoms.
Near Kauai Island: Station 4016, 305-318 fathoms (Cat. No. 25367, U.S.N.M.).

Off Bird Island: Station 4157, 100-762 fathoms (Cat. No. 25384, U.S.N.M.).

# Die Gorgoniden der Siboga-Expedition, I, Die Chrysogorgiide, 1902, p. 65.
The type was secured by the Challenger off Ascension Island, 425 fathoms.
The Siboga expedition secured the species from Ternate and south of Timor at depths of 765 to 1,994 meters.

**METALLOGORGIA SQUAROSA** (Wright and Studer).


A number of colonies which agree almost exactly with the original description of this species were collected during the Hawaiian cruise. The mode of growth is the characteristic one for this genus, to which I therefore refer the species.

**Distribution.**—South coast of Molokai: Station 3828, 281-319 fathoms (Cat. No. 25335, U.S.N.M.).

Off Kauai: Station 3992, 528 fathoms (Cat. No. 25349, U.S.N.M.); Station 3997, 418-429 fathoms (Cat. No. 25350, U.S.N.M.); Station 4003, 406-751 fathoms (Cat. No. 25336, U.S.N.M.); Station 4016, 305-318 fathoms.

Between Molokai and Oahu: Station 4107, 350-355 fathoms.

The type was secured by the *Challenger* south of the Philippine Islands, depth 500 fathoms.

**Genus IRIDOGORGIA** Verrill.

Axis growing in the form of an upright spiral. Branches simple, long, slender, arranged on one side of the heliciform stem; their bases therefore being inserted in a helix.

**IRIDOGORGIA BELLA,** new species.

*Plate XLVI, fig. 4; plate L, fig. 1.*

The incomplete stem is 325 mm. in actual length, but coiled in such a close helix that the actual height of the colony is only 93 mm. Stem thick and wire-like in structure, very different from the preceding species, bearing a series of closely approximated simple branches on one side, the outer. Branches 4 mm. apart, equally spaced, gracefully curved, about 112 mm. in length. They were almost all stripped from the stem, but apparently they all belonged to the same specimen; only five of them remained normally attached.

Polyps uniserial, 7 mm. apart, each arising from a long swelling which embraces the branch, cylindrical, inclined toward the distal end of the branch, proximal end smaller than the distal, about $2\frac{1}{2}$ mm. high. The tentacles are matted together over the tops of the
IRIDOGORGIA branches height, inch. length height, -

NO. polyps body tion branches, each branch branched. Where branches.

Zooids are rather sparsely scattered over the upper sides of the branches.

_Type._—Cat. No. 25359. U.S.N.M., Albatross Station 4019, near Kauai Islands, 405-550 fathoms. The close helix into which the stem is coiled, together with the very stiff and wiry texture, are the chief diagnostic features of this species.

**IRIDOGORGIA SUPERBA, new species.**

Plate XLVI, fig. 5; plate L, fig. 2.

Two pieces of an incomplete specimen measured, together, 5 feet \(\frac{1}{2}\) inch. Main stem stout, brittle, straight on all but distal portion where it becomes wavy; its whole length marked by the regular branch origins arranged in a spiral, or helix. In the proximal part each turn of the helix, measured vertically, is 17 mm., in the distal part it is 24 mm. The adjacent branch origins are 2 to 3 mm. apart. There are a few scattered polyps on the stem. The branches are slender, unbranched and gracefully curved, 125 to 175 mm. in length.

Polyps unilateral in arrangement, on the upper sides of the branches, 5 to 6 mm. apart, arising from a long swelling basal portion which is parallel to the axis of the stem. Above this swelling the body is short and stout, bearing very long, nonretractile tentacles. Length of basal swelling, \(\frac{2}{3}\) mm.; height, 1 mm. Diameter of body above basal swelling, \(\frac{1}{2}\) mm.; height, 1 mm.; length of longest tentacle (in alcohol), 6 mm.

Zooids are distributed in groups along the branches, sometimes being aggregated near the polyp bases.

The spicules are remarkably uniform in size and shape, being in the form of rather slender smooth bars with rounded ends, somewhat constricted in the middle. They are found longitudinally disposed in the cortex of the branches, and transversely disposed in the expanded bases of the polyps. The remainder of the polyps and the tentacles appear to be without spicules.

The color of the main stem is grayish yellow; branches and polyps bright corn yellow. The iridescence of the exposed axis is brilliant green.

_Type._—Cat. No. 27416, U.S.N.M., Albatross Station 3989, off Kauai, 385-500 fathoms.
This was the handsomest alcyonarian that the writer has ever seen as it came up in the trawl. Nothing could be more graceful than the arrangement and attitude of the slender, symmetrical branches.

The species differs from *Iridogorgia pourtalesii* in having more closely approximated branches, shape, and spiculation of polyps, as well as in size.

Subfamily RHIZAEINÆ.

Colonies branched; twigs borne on only one side of branches; cortex and polyp walls thick; tentacles capable of retraction within the body cavity.

Genus *PLEUROGORGIA* Versluys.

Colony palmate; branchlets in a straight row on one side of branch, and all in the same plane; polyps arranged in a thickly set row on one side of branchlets.

*PLEUROGORGIA MILITARIS*, new species.

Plate XLVI, fig. 8; plate LI, fig. 2.

Colony incomplete, consisting of a straight smooth stem about 112 mm. long, giving off unilateral branches which are 8 mm. apart and all in the same plane. The branches are very slightly curved, but not bent or geniculate; their surface is smooth, and on their upper sides are borne the equidistant polyps which are about 7 mm. apart. On another specimen of the same species the stem bears a row of similarly spaced polyps opposite the branches, each being about one-third the length of an internode below the branch origin on the opposite side.

The polyps are rather slender, cylindrical, 3 mm. high to base of tentacles, the broadest part being beneath the tentacle bases. They stand erect, nearly at right angles to the branch, but are sometimes inclined toward the distal end. The tentacles are long, nonretractile, with conspicuous fringes.

Spicules long, needle-shaped, forming eight very conspicuous longitudinal bands in polyp walls, ending in acute points at tentacle bases. Tentacle spicules few or entirely wanting. The cortex appears smooth, but contains a very thin layer of scale-like spicules with jagged ends, longitudinally disposed.

Color of stem, dark brown with slight iridescence; branches and polyps lighter brown.

*Type.*—Cat. No. 25334, U.S.N.M., *Albatross* Station 4093, northeast approach to channel between Maui and Molokai, 1171 fathoms.

This was one of the deepest successful hauls made during the cruise.

The name *militaris* was suggested by the stiff regularity of the attitude of the polyps.
Family GORGONELLIDAE Wright and Studer.

Branched forms with a calcareous axis, thin smooth cenenchyma, and biradially disposed polyps. Spicules small warty double clubs and stellate forms. Longitudinal furrows on the flattened anterior and posterior faces of the stems and larger branches.

Genus VERRUCELLA Milne Edwards.

Colony branched, calyces wart-like, surmounted by an eight-rayed, star-like pseudo-operculum formed of the tentacle bases.

VERRUCELLA BICOLOR, new species.

Plate XLVI, figs. 6, 7.

Colony incomplete, 25 mm. high, consisting of a short basal stem which almost immediately breaks up into two subequal branches, one of which divides dichotomously twice, the other once; one of the resultant branches also divides once; the whole form being flabellate. Another specimen of about the same size divides into three main branches, each of which sends off irregularly disposed branchlets, only the end divisions being dichotomous.

The polyps are distributed on two sides, and sometimes on the back of the branches, leaving an area in front which is almost entirely devoid of polyps, and which is traversed by two or more longitudinal canals which appear superficially as darker longitudinal bands.

Calyces irregularly spaced, averaging about 1½ mm. apart, verruciform, in the shape of low domes when the polyps are retracted, and in the shape of truncated cones when the polyp is expanded. Height about 1 mm.

Spicules, small warty spindles, often curved, sometimes forming stars or double stars, uniformly distributed in the cortex and calycellar walls. Just below the tentacle bases is a row of curved transverse spicules like a primitive collaret, and above these two converging spicules form the first of the tentacular spicules which are reinforced by one to three narrow spindles on each tentacle. These form the eight-rayed star-like operculum referred to in the generic definition given by Wright and Studer.

Color:—Coral red in one specimen and orange yellow in the other. The exposed polyps are yellow.

Type.—Cat. No. 25333, U.S.N.M., Albatross Station 3982, off Kauai Island, 40-233 fathoms. Red.

Additional locality.—Northeast coast of Maui: Station 4072, 59 fathoms. Yellow.

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EXPLANATION OF PLATES.

The photographic work was done by the author. The drawings of spicules were made by Dr. William B. Bell.

PLATE XI.

Fig. 1. Clavularia spiculicola Nutting. X 1. The Clavularia is seen growing on a sponge spicule.

2. Clavularia corrugata Nutting. X 4. Individual polyps above, and a portion of skeleton growing over the peculiar woody substance on which the colonies were found below.

3. Spongodes alexanderi Nutting. X 4. The specimen was so thick that only portions of it could be brought into focus.


5. Pennatula flava Nutting. Entire colony, reduced about one-third.


7. Pennatula sanguinea Nutting. Entire colony, reduced about one-third.


9. Pennatula patina Nutting. Entire colony, reduced about one-third.


PLATE XII.

Fig. 1. Cattelemann symmetricum Nutting. Entire colonies, slightly reduced.


3. Umbellula jordani Nutting, reduced about one-third.

4. Umbellula gilberti Nutting, reduced about one-third.

5. Cladiscus studeri Nutting. Front and back views of colony, slightly reduced.


Fig. 1. Cletatois flabellum Nutting. Portion of colony, \( \times 4 \).
2. Cletatois grandis Nutting. Individual polyps, \( \times 4 \).
3. Amphilaphis biserialis Nutting. Portion of a colony, \( \times 2 \).
4. Calyptrophora versluysi Nutting. Portion of a colony, \( \times 2 \).
5. Stachyodes boversi Nutting. Colony, showing parasitic Ophiocreas, \( \times \frac{1}{2} \).
6. Stachyodes boversi. Portion of branch, \( \times 2 \).
7. Stachyodes angulatus Nutting. Portion of branch, \( \times 2 \).
8. Calyptrophora versluysi Nutting. Portions of two branches, \( \times 2 \).

Plate XLIV.

Fig. 1. Paramuricca havanaensis Nutting. Portions of branches, \( \times 3 \).
2. Anthomuricca truncispina Nutting. Portion of colony, \( \times 2 \).
3. Clematissa tenue Nutting. Two branches, \( \times 2 \).
4. Clematissa alba Nutting. Portion of branch, \( \times 2 \).
5. Menella grandiflora Nutting. Portion of stem, \( \times 2 \).
6. Stenella helminthophora Nutting. Portions of branch, \( \times 3 \).
7 and 8. Stenella helminthophora. Portions of branches, showing the immensely enlarged scales which form the arcades under which parasitic annelids live.
9. Small portion of branch with scales natural size, \( \times 2 \).

Plate XLV.

Fig. 1. Echinomuricca brevica Nutting. Parts of two branches, \( \times 2 \).
2. Cyclomuricca flabellata Nutting. Distal end of branch, \( \times 2 \).
3. Cyclomuricca flabellata Nutting. Distal part of larger branch, \( \times 2 \).
4. Chrysogorgia arborecens Nutting. Two polyps, \( \times 8 \).
5. Lepidogorgia spiralis Nutting. Portions of colony, \( \times 3 \).
6. Lepidogorgia gibbosa Nutting. Portion of colony, \( \times 2 \).
7. Chrysogorgia delicata Nutting. Portion of colony, \( \times 2 \).
8. Chrysogorgia arborecens Nutting. Part of branch, to show difference in size between the normal polyps (above) and abnormally enlarged polyp (below).
9. Chrysogorgia curvata Versluys. Portion of branch, \( \times 2 \).

Plate XLVI.

Fig. 1. Chrysogorgia flexilis (Wright and Studer). Three polyps, \( \times 2 \).
2. Chrysogorgia lata Versluys. Three polyps, \( \times 6 \).
3. Chrysogorgia stellata Nutting. End of branch, \( \times 2 \).
4. Iridogorgia bella Nutting. Ends of branches, \( \times 2 \).
5. Iridogorgia superba Nutting. Parts of branches, \( \times 2 \).
6. Verrucella bicolor Nutting. Part of colony, red phase, \( \times 2 \).
7. Verrucella bicolor Nutting. Part of colony, yellow phase, \( \times 2 \).
8. Pleurogorgia militaris Nutting. Part of branch, \( \times 2 \).

Plate XLVII.

Fig. 1. Spicules of Ciularia spiculicola Nutting, \( \times 45 \).
2. Spicules of Spongodes alexandert Nutting, \( \times 45 \).
Fig. 3. Spicules of Ceratoisis flabellum Nutting, × 12.
4. Spicules of Amphitopsis biserialis Nutting, × 45.
5. Spicules of Stenella helminthophora Nutting, × 30.

Plate XLVIII.

Fig. 1. Spicules of Stachyodes angularis Nutting, × 30.
2. Cortex scales of Stachyodes hoversi Nutting, × 12.
4. Spicules of Clenatissa alba Nutting, × 45.
5. Spicules of Anthomuricea tenerispina Nutting, × 45.

Plate XLIX.

Fig. 1. Spicules of Cyclomuricea flabellata Nutting, × 45.
2. Spicules of Clenatissa teuc Nutting, × 45.
4. Spicules of Echinomuricea brunnea Nutting, × 45.
5. Spicules of Lepidogorgia gibbosa Nutting, × 45.

Plate I.

Fig. 1. Spicules of Chrysogorgia elegans (Verrill), × 45.
2. Spicules of Iridogorgia superba Nutting, × 45?
3. Spicules of Chrysogorgia stellata Nutting, × 60.
4. Spicules of Chrysogorgia goniculata (Wright and Studer), × 45.
5. Spicules of Chrysogorgia flagrascens Nutting, × 5.
6. Spicules of Chrysogorgia flexilis (Wright and Studer), × 45.

Plate LI.

Fig. 1. Spicules of Iridogorgia bella Nutting, × 45.
2. Spicules of Pleurogorgia militaris Nutting, × 45.
4. Spicules of Metallogorgia squarrosa (Wright and Studer), × 45
5. Spicules of Metallogorgia melanotrichos (Wright and Studer), × 45.
Alcyonaria from the Hawaiian Islands.

For explanation of plate see page 599.
Alcyonaria from the Hawaiian Islands.

For explanation of plate see page 599.
Alcyonaria from the Hawaiian Islands.

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For explanation of plate see pages 600, 601.
ALCYNARIA FROM THE HAWAIIAN ISLANDS.

FOR EXPLANATION OF PLATE SEE PAGE 601.
Alcyonaria from the Hawaiian Islands.

For explanation of plate see page 601.
Alcyonaria from the Hawaiian Islands.

For explanation of plate see page 601.
Alcyonaria from the Hawaiian Islands.

For explanation of plate see page 601.
ON A COLLECTION OF FISHES FROM FIJI, WITH NOTES ON CERTAIN HAWAIIAN FISHES.

By David Starr Jordan and Mary Cynthia Dickerson,

Of Stanford University, California.

On returning from New Zealand in 1907 the senior author made a small collection of fishes from the coral reef at Suva, the capital of Fiji. A larger collection from the same place was sent later by Dr. Bolton Glanville Corney, surgeon of the British Government, resident at Suva, to whom we are indebted for special favors. A series of specimens is in the United States National Museum and in Stanford University.

The fish fauna of the Fiji Islands is evidently in the main identical with that of Samoa. But even in this small collection certain differences appear, and these distinctions approximate it to the fauna of New Guinea and of the East Indies. *Lutianus aurorvittatus* and *Leiognathus smithursti* have been hitherto known only from New Guinea, while *Nystama kapas* and *Rastrelliger brachysonus* have been recorded from the East Indies only. A single species, *Abudefduf corneyi*, seems to be new to science. A few notes on rare Hawaiian fishes, taken on the same trip, are included. These are not numbered in the series.

Family CARCHARIID.E.

1. CARCHARIAS INSULARUM Snyder.

Two partly grown sharks, each about 8 feet long, were taken with a hook from the steamer *Moana* near the equator in the open sea between the atoll called Mary Island and Fiji.

They were gray in color, with conspicuous whitish tips to all the fins. Snout very short and blunt, broader than long; teeth strongly serrate, not notched on the outer margin; pectoral very long, reaching the posterior axis of the very high dorsal; anal and second dorsal small, subequal.

The snout in these specimens seems more blunt than in the figure published by Professor Snyder, but they seem to belong to no other known species.
Family PLOTOSIDÆ.

2. PLOTOSUS ANGUILLARIS (Bloch).

One large specimen, brown, without distinct stripes.

Family MURÆNESOCIDÆ.

3. MURÆNESOX CINEREUS (Forskal).

Common in the Suva market.

Family MURÆNIDÆ.

4. GYMNOTHORAX PICTUS (Ahl).

One specimen.

5. ECHIDNA NEBULOSA (Ahl).

One specimen.

MURÆNA KAILÆ Jordan and Evermann

(Muræna kauila and Muræna lampro Jenkins.)

Of this species (not seen at Fiji) we have one specimen from the market of Honolulu by Mr. Louis Berndt. It has broad, irregular, white bands on ventral region of throat and belly, their width somewhat less than diameter of eye. The brown interspaces posteriorly are about twice as wide as the bands; anteriorly they grow narrower, appearing on the throat as dark bands on a white background. The white spots on the sides are like those of the type of M. kailæ, round and bordered by dark rings, and they do not become elongate until near end of tail. On the sides the dark spots are distinct as in M. kauila Jenkins. This example embodies the characters of M. kauila and M. kailæ, leaving no doubt as to their identity.

Family EXOCETIDÆ.

6. CYP SILURUS OGILBYI Jordan and Snyder, new species.

Head measured to end of opercular flap, 4\(\frac{1}{2}\) in length to base of caudal; width of body at base of pectorals \(7\frac{1}{2}\); depth \(5\frac{3}{4}\); depth caudal peduncle \(3\frac{1}{2}\) in head; eye 3; interorbital space \(3\frac{1}{4}\); snout \(3\frac{3}{4}\); D. 13; A. 9; P. 16; scales in lateral series 50; between occiput and base of dorsal, 27.

Tip of pectoral fin formed by branches of third ray, reaching when depressed to tip of posterior ray of dorsal and anal, but falling considerably short of base of caudal. First ray simple, half as long as fin; second ray branched, the lower branch exceeding the upper in length by a distance equal to a third of the first ray, the
upper branch extending beyond tip of first ray, a distance which is contained two and one-half times in length of the latter; ventrals inserted midway between base of caudal and posterior margin of eye; reaching posteriorly almost to end of base of anal; tip of fin formed by end of third ray. Insertion of dorsal anterior to that of anal, almost midway between the latter and bases of ventrals; the second ray longest, $2\frac{1}{4}$ in head; the other rays consecutively shorter; the last when depressed reaching a point midway between its base and that of caudal; base of fin contained 1$\frac{1}{4}$ in head. Anal similar in shape to dorsal, the longest (second) ray contained three times in head. Gillrakers on lower half of arch, 15, flat and acutely pointed, the anterior four or five very small or rudimentary. Lateral line apparently ending midway between anal and caudal. Teeth on jaws very weak, scarcely evident; none on palatines.

Color metallic steel blue above, sides and lower surfaces pearly white; dorsal edges of upper four or five pectoral rays dusky; the lower ones dusky at bases and toward tips, the middle portions light, giving the effect of a median light area on ventral surface of fin; upper edge of base of pectoral dusky; dorsal and anal immaculate; caudal dusky, with a broad, slightly darker margin; anterior rays of ventral slightly dusky above; upper part of axil of fin dusky.

One specimen, the type, Cat. No. 62229, U.S.N.M., measuring 350 mm., was obtained by Doctor Jordan, it having flown aboard the steamer *Moana* some miles to the westward of Walpole Island, the nearest land otherwise being the New Hebrides.

Named for James Douglas Ogilby, of Brisbane, Australia, who assisted us in comparison of this example with the flying fishes known from Australia.
CYP SIL URUS SPILONOTOPTERUS (Bleeker).

(Cypsilurus bahiensis Jordan and Evermann, Fishes Hawaii, p. 136, perhaps not E. rocatus bahiensis Ranzani, an Atlantic species.)

Head measured to end of opercular flap, 4/4 in length to base of caudal; width of body at base of pectorals 6/4; depth 3/2; depth of caudal peduncle 3/2 in head; snout 3/2; D. 13; A. 10; P. 13; scales in lateral series 43; above origin of ventral, counting upward and forward 10; between occiput and base of dorsal 29.

Interorbital region concave, the width contained two and one-half times in head. Teeth present on jaws and palatines. Gillrakers on lower half of arch 17, the length of longest contained about one and two-thirds times in longest filaments. First pectoral ray simple, its length contained 1 3/4 in fin, 2 3/4 in head and body; second ray branched, the lower part almost equal in length to third ray, which forms the tip of fin, the latter extending beyond tips of posterior rays of depressed dorsal and anal, but not reaching base of caudal; branches of second ray simple, the lower exceeding the upper in length by a distance contained six and one-half times in length of ray, four times in length of first ray; branches of third ray divided. Longest (third) ray of ventral extending to base of sixth anal ray, the second branch of second ray somewhat shorter. Anal inserted below base of seventh dorsal ray; height of longest ray 3 3/4 in head. Longest (third) dorsal ray 2 1/10 in head; last ray not produced; neither dorsal nor anal reaching base of caudal when depressed. Dorsal lobe of caudal, measured along upper edge, 3 3/4 in the length.

Color in spirits, brownish above, silvery below; pectorals with a broad, brown border and a light edge; basal portion of fin brownish, the broad space in middle of fin light. Dorsal with a large black spot.

**Fig. 2.—Cypsilurus spilonotopterus.**
between third and tenth rays, extending upward to the edge but not reaching downward to base of fin. First, second, and third ventral rays dusky above, the color deepening toward their bases. Anal immaculate. Caudal brownish, with a rather darker edge. Seen at Hawaii and southward in the sea.

The species described by Bleeker from the East Indies has been identified by Bleeker, by Lütken, by Günther, and Jordan and Evermann, with Exocoetus bahiensis Ranzani, from Bahia, Brazil. No one has yet made a comparison of specimens. No good description of Cypsilurus bahiensis exists, and in the best of these accounts (that of Exocoetus vermiculatus Poey, from Havana) shows some discrepancies. Meanwhile it seems best provisionally to regard the Pacific species as distinct. We here present a good figure of it.

We may here note that the species figured by Jordan and Seale (Fishes of Samoa, p. 209, fig. 121), as Cypsilurus unicolor is probably not the Exocoetus unicolor of Cuvier and Valenciennes (XIX, p. 97), which is more like E. oxycephalus Bleeker. We are, however, unable to separate the Samoan species from Exonatus or Cypsilurus gilberti Snyder, from Hawaii.

Family MUGILIDÆ.

7. Liza Melinoptera (Cuvier and Valenciennes).

In the market at Suva.

8. Liza Cæruleomaculata (Lacépède).

One specimen, common in the market at Suva.

Family POLYNEMIDÆ.

9. Polydactylus Plebeius (Broussonet).

Common in the market at Suva.

Family HOLOCENTRIDÆ.


Holocentrus diplorhiphus Günther.

One specimen from Suva.

Family SCOMBRIDÆ.

RASTRELLIGER Jordan and Starks, new genus.

The mackerel called Scomber brachysomus by Bleeker is the type of a distinct genus, Rastrelliger Jordan and Starks, distinguished
from *Scomber* by the excessively long and numerous gillrakers (*rastrella*), longer than eye, the mouth looking as if "full of feathers," by the compressed, deep body, and by the feeble dentition, the teeth in the jaws being very minute, and the vomer and palatines toothless.

*Scomber kanagurta* Cuvier and Valenciennes seems to be a second species of this genus and *S. microlepidotus* Rüppell a third. *Scomber loo* (Cuvier and Valenciennes), another South Sea species, with a row of dark spots on the side, is also a species of *Rastrelliger*. It is distinct from *Rastrelliger brachysomus* and apparently from *R. kanagurta* also. The following osteological differences separating *Rastrelliger* from *Scomber* have been worked out by Professor Starks:

The cranium in *Rastrelliger* is less depressed than in *Scomber*, though it does not differ in the crests and ridges of the cranium from that genus. The epiotics appear to meet very broadly posteriorly, but close examination reveals a slender spur from the supraoccipital extending down between them to the exoccipital suture. The top of the cranium in front of the oblique ridge that runs from the supraoccipital to the supraorbital rim is finely sculptured and thickened by a network of fine ridges where in *Scomber* the bone is smooth. The foramen magnum forms a long tunnel of the exoccipitals, as in *Scomber*, and the condition of the exoccipitals over the basioccipital and their condyles is the same.

The mandible and maxillary elements are much weaker than in *Scomber*. The premaxillaries is a long slender bone from which the maxillary arches widely away, being attached to it only at each end; auxiliary maxillaries is small. The most striking difference between this genus and *Scomber* lies in the arrangement of the lateral bones of the skull and the basibranchials. The pterygoid normally (as in *Scomber*) is attached along the anterior edge of the quadrate, at the upper end of which it bends at an angle forward to support the palatine; the metapterygoid is behind and a little above the quadrate. In *Rastrelliger* the metapterygoid is above and somewhat in front of the quadrate, and the pterygoid borders the entire front of both the quadrate and metapterygoid, turning at an angle at the upper edge of the latter.

The basibranchials form a high, sharp, knife-like ridge, while the hypobranchials are deep and compressed and help to elevate the basibranchials still higher. The second and third superior pharyngeals are joined into a single plate a little more firmly and completely than in *Scomber*. The branchial arches are crowded backward against and between the shoulder girdle, and all of the bones of the head give the impression of having been drawn downward and backward and compressed.
There are 14 abdominal vertebrae and 16 caudal, or a total of 31 with the hypural. The vertebral elements are arranged as in *Scomber*, as are the other elements with the above exceptions.

**Type of the genus.—** *Scomber brachysomus* Bleeker.

**II. RASTRELLIGER BRACHYSOMUS** (Bleeker).

*Scomber brachysomus* Bleeker. Makreele, p. 356.

Two large specimens.

Head 3\(\frac{3}{4}\) in length to end of caudal; depth 3\(\frac{1}{4}\); eye 4\(\frac{1}{2}\) in head. D. IX, I-11-V; A. I-11-V. Scales 130, small (though larger than in *Scomber*), not forming a corselet; irregular in arrangement above the ventral fins, enlarged below axillary region. Body compressed, deep; head pointed, unscaled; adipose eyelid conspicuous, covering the anterior and posterior third of the eye and extending forward and backward over the head; preorbital three-fourths diameter of eye; mouth large, the maxillary slipping under the preorbital and reaching to a perpendicular from a point somewhat beyond the middle of the eye; lower jaw projecting; teeth minute, in a single row on the jaws, lacking on vomer and palatines. Opercle short, its posterior border relatively straight; gill rakers 23-44, unusually long, the longest 2\(\frac{1}{2}\) in head (nearly equal to length of pectoral fin).

Dorsals not connected by a groove; second and third dorsal spines 1\(\frac{1}{2}\) in head, nearly one-half the depth of the body; pectoral short, one-half head, slightly longer than ventrals; caudal peduncle with two small keels on each side; depth of caudal fin 4 in width.

Color in alcohol dark with silvery reflections above lateral line, light and coppery below; dorsal fins, pectorals, and caudal margined with black; ventrals and anus yellowish, unmarked.
12. SCOMBEROMORUS COMMERSONII (Lacépède).

In the market at Suva.

Family CARANGID.E.

13. CARANX FORSTERI (Cuvier and Valenciennes).

Common in the market at Suva.

Family LEIOGNATHID.E.

14. LEIOGNATHUS EDENTULA (Lacépède).

Two large examples.

15. LEIOGNATHUS SMITHURSTI (Ramsay and Ogilby).

One large specimen of this well-marked species.

Head 3\frac{1}{4} in length to base of caudal; depth 2\frac{1}{6}; eye 3\frac{1}{6} in head.

D. VIII, 16; A. III, 14; V. I, 5. Scales 64.

Body greatly compressed and conspicuously arched dorsally from a point above the middle of the eye. Interorbital cavity twice as long as broad; two small spines above the eye anteriorly. First dorsal and anal spines minute, second elongate, the length of the second dorsal spine exceeding the depth of the body.

Color in alcohol, silvery, dark along base of dorsal and on upper surface of caudal peduncle; snout black, also the opercle above the angle of the flap and the base of the pectoral fin posteriorly.

Family GERRID.E.

16. XYSTÆMA KAPAS (Biecker).

Three fine specimens.

This species has not been previously recorded from the South Seas. Our species agree fully with Günther's description.

Family KUHLIID.E.

17. KUHLIA MALO (Cuvier and Valenciennes).

Common in the market at Suva.

Family SERRANID.E.

18. EPINEPHELUS MERRA (Bloch).

Common at Suva.

19. EPINEPHELUS STELLANS (Richardson).

Two specimens.
20. **EPINEPHELUS MACULATUS** (Bloch).

One specimen.

**Family LUTIANIDÆ.**

21. **LUTIANUS AUREOVITTATUS** (Macleay).


Two specimens from Suva.

Head 2\(\frac{2}{3}\) to base of caudal; depth 3\(\frac{2}{3}\); eye 4 in head. D. X. 13; A. III, 8. Scales 7–50–12. Preorbital less than diameter of eye; maxillary reaching to middle of orbit; two canines in front of upper jaw. Dorsal spines slender and long, fourth to sixth subequal, nearly one-half depth; anal spines stout.

Color (in spirit) greenish brown, paler below lateral line and white ventrally. A black oval blotch occupies the lateral line below the junction of spinous and soft dorsals. There are four horizontal yellow stripes along the body below the lateral line. Fins yellowish, unmarked.

Specimen described 7\(\frac{2}{3}\) inches long.

**APHAREUS FLAVIVULTUS** Jenkins.

One specimen from Honolulu market, not seen in Fiji.

**Family THERAPONIDÆ.**

22. **THERAPON JARBUA** (Forskal).

Common in the river mouth near Suva.

**Family SPARIDÆ.**

23. **LETHRINUS HARAK** (Forskal).

Two specimens from Suva.

**Family APLODACTYLIDÆ.**

**GONIISTIUS VITTATUS** (Garrett).

One example of this very rare species, measuring 400 mm. in length, was obtained by Doctor Jordan at Honolulu. It had been previously found rather common about these islands.

**Family POMACENTRIDÆ.**

24. **AMPHIPRION CHRYSOPTERUS** (Cuvier and Valenciennes).

*Amphiprion chrysopterus* Cuvier and Valenciennes, Paris, Y, 1830, p. 401; locality unknown; from a drawing.

Dorsal spines short, considerably shorter than the posterior rays of soft dorsal and of anal. Ventral reaching the vent; pectorals extending to the posterior border of the second pearl-colored band; caudal emarginate, with lobes somewhat prolonged.

Blackish-brown with two pearl-colored cross-bands edged with black; the first passes from in front of the spiny dorsal obliquely forward and downward over the opercle; the second is parallel to this, starting from the last two dorsal spines and ending at the vent. The forehead, lips, lower parts of cheeks, and the chin are orange-colored; the line of demarkation between the black ground color and the orange of the face extends across the interorbital space and obliquely downward and backward along the anterior margin of the eye, across the cheek to the angle of the preopercle and on to the lower border of the opercle. All of the fins are yellow and unspotted; spines of the ventral and anal fins dark.

The specimen described is 4 1/2 inches long.

A younger specimen (2 5/8 inches) here figured has a third pearl-colored band across the body at the base of the caudal. Of this we present a figure. This band seems to disappear with age, as the specimen evidently belongs to the same species as the first.

This species has been known hitherto only from a drawing from unknown locality.

25. DASCYLLUS ARUANUS (Linnaeus).

Common in the reefs.

26. CHROMIS CÆRULEUS (Cuvier and Valenciennes).

*Helisstes lepisurus* Cuvier and Valenciennes.

Very common on the reef at Fiji.
27. Abudefusc Corteyi Jordan and Dickerson, new species.

Head 3½ in length to base of caudal; depth 2⅓; eye 3½ in head, 1⅓ in snout. D. XII, 15; A. 11, 12. Scales 3-28-11, lateral line pores 20.

Body compressed; interorbital space somewhat arched; preorbital two-thirds diameter of eye; maxillary not reaching vertical from front of orbit; cheeks and opercle scaled, snout unscaled; margins of suborbital, preopercle, and opercle entire, a single flat spine on the opercle. Teeth compressed, entire, in a single row.

Dorsal spines subequal, first and twelfth shortest, fifth to seventh longest; spinous dorsal covered one-half its length with large scales, soft dorsal and anal scaled similarly but scales minute; pectorals and ventrals equal (three-fourths head), the ventrals scarcely reaching vent; caudal forked, its lobes rounded and the upper lobe the longer.

Color in alcohol deep blackish brown with a conspicuous, though small, black axillary spot; snout black; fins black except the pectorals, which are merely dusky, and the ends of soft dorsal and upper lobe of caudal, which are not pigmented.

This species differs markedly from all the descriptions accessible to us. Glyphidodon limbatus from Ile de France, scantily described by Cuvier and Valenciennes, may be the same, but the ventral is said to reach the middle of the second anal spine and no mention is made of the conspicuous axillary spot. Furthermore, Sauvage claims that G. limbatus is really from St. Helena, and that it belongs to the group Proc. N. M. vol. xxxiv—40
called Stegastes. The number of fin rays, D. XII, 15, well separates Abudefduf cornegi from A. melas and A. bahni, the only black species of similar form. Abudefduf filholi (Sauvage), also from the reef at Suva, is one of the blue species.

Abudefduf jordani Seale, from the Solomon Islands, is similar to A. cornegi, but with the body considerably deeper, depth 1 ½ in length. The paired fins in this species are yellowish.

The type is No. 61678, U.S.N.M., collected on the reef at Suva by Dr. Bolton Glanville Corney, for whom the species is named. One specimen, 3 ½ inches long.

We may here note that the figure of Pomacentrus celticus published by Jordan and Seale is incomplete. The artist has omitted the scales on the preorbital and the serrations on the preopercle.

28. ABUDEFDUF UNIOCELLATUS (Quoy and Gaimard).

Abundant on the reef at Suva.

29. ABUDEFDUF CYANEUS (Quoy and Gaimard).

A small fish of the most intense blue, allied to Abudefduf taupou, abounds about the reefs of Suva. We were unable to obtain any specimens. The species is unlike any seen at Samoa, and is probably the cyanus (later called azureus) of Quoy and Gaimard.

Family LABRIDE.

30. HALICHERES DÆDALMA Jordan and Seale.

Two specimens.

31. NOVACULICHTHYS TÆNIURUS (Lacépède).

Common at Suva.

32. PSEUDOCEILINUS HEXATÆNIA Bleeker.

On the reef at Suva.

Family SCARICHTHYIDÆ.

33. CALLYODON UPOLENSIS Jordan and Seale.

One specimen, agreeing well with the original account.

*Fishes of Samoa, p. 283, fig. 50.*
Family CHÄTODONTIDÆ.

34. CHÄTODON SETIFER Forskal

One specimen.

CHÄTODON EPHIPPİUM Cuvier and Valenciennes.

Two specimens from Honolulu market. The species was not obtained by Jenkins or by Jordan and Evermann in Hawaii. Not seen in Fiji.

35. HOLACANTHUS NICOBARIENSIS (Bloch and Schneider).

Two specimens of this exquisite species.

36. HOLACANTHUS MARIANAS Seale.

Holacanthus marianas Seale, Occas. Papers Bishop Mus., 1, no. 3, 1901, p. 104, Guam; good description.

Fig. 6.—Holacanthus Marianas.

One specimen, agreeing perfectly with Seale’s description. It is conceivable that this may be the young of Holacanthus imperator, although the markings are quite differently arranged, as the figure which we here present clearly shows.
Family HEPATIDÆ.

37. HEPATUS TRIOSTEGUS (Linnaeus).

Six specimens from Suva.

Family TETRAODONTIDÆ.

CANTHIGASTER RIVULATUS (Schlegel).

*Eumycterius hitowianiatus* Jenkins, Bull. U. S. Fish Com., XIX. 1899, p. 400, fig. 12.

A single specimen of a *Canthigaster* collected by Mr. Berndt, when compared with examples of *C. rivulatus* of Misaki, Japan, leaves little doubt as to its identity with that form. A young individual of the same species, small and brightly colored, was described from Honolulu under the name *Eumycterius hitowianiatus*, by Doctor Jenkins. The second example from the same locality measures 6½ inches in length. The stripes extending from the pectoral to the caudal are very indistinct, as is usually the case with adult Japanese examples, although this character is subject to a considerable amount of variation. Radiating lines extending forward, downward, and backward from the eye, and dark vermiculations on the back are usually present in adults and absent in the young. Not seen in Fiji.

38. TETRAODON HISPIDUS Linnaeus.

A large specimen taken on the reef at Fiji.

Family BALISTIDÆ.

39. BALISTAPUS ACULEATUS (Linnaeus).

One specimen.

*Xanthichthys lineopunctatus* (Hollard).

One example from Honolulu market.

Family SCORPÆNIDÆ.

40. SYNANCEJA VERRUCOSA (Bloch and Schneider).

One specimen.

41. PTEROIS SAUSAULELE (Jordan and Seale).

Two specimens.

The group called *Dendrochirus*, to which this species belongs, is probably not distinct from *Pterois*. Its chief character is the absence
of free rays on the upper edge of the pectoral, a character present in the young of *Dendrochirus*, but lost with age. The species of *Pterois* proper are larger fishes with longer fins. In Morita's plate of this species (Fishes of Samoa, Plate IV, fig. 1) the artist has, from a young example, represented the upper rays of the pectoral as detached and has made them much longer than in the adult. In the adult these rays are fully united with the rest of the fin, and the rays are gradually longer to the sixth. The ventrals reach the base of the last dorsal spine. The pectorals reach the base of the last dorsal ray, as in the adult types of *Dendrochirus sansaudele*. Morita's drawing was taken from a young example in which pectorals and ventrals are notably longer than in the adult and the upper rays of the pectoral are more elongate and partly free. The free tips are apparently broken off with age.

Family ECHENEIDÆ.

42. REMORA REMORA (Linnaeus).

Numerous specimens were taken attached to the shark, *Carcharias insularum*. When the shark was taken out of the water these fishes still kept their hold. The larger sucking fish, *Echeneis naucrates*, lets go its hold the moment the shark is raised out of the water.

Family GOBIIDÆ.

43. RUPPELLIA XANTHOSOMA (Bleeker).

Taken in the crevices of corals at Fiji. The generic name *RupPELLia* of Swainson (1839), based on *Gobius echinocephalus*, has priority over *Paragobiodon* Bleeker.

Family BLENNIIDÆ.

44. SALARIAS LINEATUS Bleeker.

On the reef at Suva.
MAMMALS COLLECTED IN EASTERN SUMATRA BY DR. W. L. ABBOTT DURING 1903, 1906, AND 1907, WITH DESCRIPTIONS OF NEW SPECIES AND SUBSPECIES.

By Marcus Ward Lyon, Jr.,
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INTRODUCTION.

During the last eight years Dr. W. L. Abbott has visited various localities along the eastern coast of Sumatra for the purpose of making collections of natural history and of ethnology, all of which he has presented to the United States National Museum. Mammals and birds have constituted by far the greater part of the zoological collections. The following paper is a systematic account of the mammals that he has obtained in the general region of eastern Sumatra. Thirteen new species and three new subspecies are described in it.

Doctor Abbott's first visit to eastern Sumatra was in August and September, 1901. At that time he ascended the Indragiri River (see map, page 623) for a short distance and made collections of mammals from along its banks. This collection, together with material gathered during the same year from the near-by islands of the Rhio-Linga Archipelago, was described in 1902 by Mr. Gerrit S. Miller, Jr. It is not treated of in the following pages except in an incidental manner.

The next visit of Doctor Abbott to eastern Sumatra was in August and September, 1903, when he made a small collection from along the banks of the Kateman River, a stream not far from the Indragiri which had been visited two years before. He again made a trip to the east coast of Sumatra during the period from November 15, 1905, to February 12, 1906, to Aru Bay (see map, page 621). From there he proceeded down the coast for about 250 miles to the strait, known as Salat Rupat, between Pulo Rupat and the mainland of Sumatra.


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(See map, page 623.) From February 24 until April 3, 1906, he collected on Pulo Rupat, on the mainland opposite, on the small island of Payong in Salat Rupat and on the large islands of Bengkalis and Padang. (See map, page 623.) During the autumn of the same year Doctor Abbott visited that part of Sumatra again for a period of nearly five months. October, 1906, to February, 1907. He made collections from along the banks of the Siak and the Little Siak rivers, from the islands of Merbau, Tebing Tinggi, Rangsam, and Penjalei, as well as from the mainland of Sumatra opposite them. (See map, page 623.) The mammals of these several collections are described in detail below. Several preliminary notices of some of the specimens have already been printed, but the collections as a whole are treated of here for the first time. Reference to the earlier papers will be found in the synonymies of the species to which they refer.

In 1889 Dr. F. A. Jentink, a director of the Leyden Museum, published a short paper on a collection of mammals made in eastern Sumatra by Dr. B. Hagen. In 1905 Mr. Gustav Schneider b published a detailed account of his travels in eastern Sumatra and the mammals which he collected there. The names applied by these authors to the various species of mammals in eastern Sumatra are given under the synonymies of the species listed below.

DESCRIPTIONS OF LOCALITIES.

The following account of the localities visited by Doctor Abbott are taken almost entirely from his letters and field notes, and a study of the maps of the region.c

Aru Bay.—(Map, page 621.) This is a small indentation on the east coast of Sumatra at about longitude 98° 15' E., and latitude 4° 10' N. One fresh water river, the Besitan, flows into it. In addition to that several tidal creeks empty into it. The shores of the bay and the rivers generally are fringed with mangroves. A short distance back from the rivers the country is rolling. A rather large island, Pulo Sembilan, is at the entrance to the bay.

The shooting ground was the peninsula between the lower Besitan River and the smaller Sungai Tongkam. This was covered to a great extent with heavy forest, through which many paths and roads had been made by the Chinese


woodcutters. These, however, had only taken the best trees of three or four species and the rest of the jungle was undisturbed.

There were many old clearings and tracts of lalang [long coarse grass] and scrub jungle, besides some new clearings and pepper gardens. I remained at this anchorage opposite Tanjong Rembia from November 17 to December 8, 1905.
The Tongkam River joins the Besitan at Tanjong Kramet. [Tanjong Rembia on map.] The schooner anchored about 4 miles up the Tongkam, which is a tidal creek lined with mangroves. The principal collecting ground was the left bank of the Tongkam. There were a few kebuns and old clearings, but the country was mostly forest, intersected in all directions by the roads of the Chinese woodcutters. There was plenty of heavy original forest. The surrounding country is mostly rolling hills and ridges about 80 to 120 feet high. I remained at the anchorage in the Sungai Tongkam from December 8, 1905, to January 8, 1906. I also shot over the country about the headwaters of the Tongkam, which is covered with heavy forest extending from the Tamang River [belonging to a watershed just to the north, not included or shown on the map, page 621]. Saw many fresh tracks of rhinoceros here. But a Malay who had a gun was continually after them, until, before I left, I could find no more fresh tracks. About a dozen Malays had made a clearing at the head of canoe navigation on the Tongkam.

I was anchored in the Sungai Halahan from January 11 to 28, 1906, about 4 miles up. The shooting ground was usually the peninsula between the Halahan and the Tongkam, which was rolling country mostly covered with heavy forest. There were many roads made by the Chinese woodcutters.

February 1 to 9, 1906, was spent in the upper part of the Besitan River, about 14 miles up from the kwala [mouth of river]. The country was hilly and covered with magnificent unbroken forest. Animal life was not plentiful. There were no habitations beyond about two hours above Besitan Station.—W. L. Abbott.

Salat Rupat.—This is the narrow strait between Pulo Rupat and the mainland of Sumatra. Its average width is about 3 miles and its depth at the upper part is about 5 fathoms and at the lower part decreases to 3 fathoms.

The mainland of Sumatra along Salat Rupat is low and swampy during the rains. The shore is mostly covered with secondary scrub and jungle, but back a short distance the country is all heavy forest. Tigers are abundant and elephants are said to be found at the time of rains. I saw many of their trails. The country is completely tracked up with pigs, tigers, Rusa, and many other animals, but the denseness of the jungle prevents one from catching sight of the larger game.—W. L. Abbott.

Pulo Payong.—See map, page 623.

Is an island about 4 miles long, in the Salat Rupat. It is low and swampy and largely covered with "Nibong" palms.—W. L. Abbott.

Pulo Rupat.—See map, page 623.

Pulo Rupat is the largest of the islands in the straits of Malacca, lying near the east coast of Sumatra, from which it separated by the Salat Rupat. 2 to 3 miles wide and 10 to 15 fathoms deep. The whole island is low and flat, and swampy in the rainy season. The surface is nearly all covered with virgin forest. Some clearings exist along the coast and on the Salat Morong which separates it from Pulo Medang. Including Pulo Medang, this island forms a circle 26 geographic miles in diameter. The inhabitants number 2,000 or 3,000.

and consist largely of a primitive tribe called Orang Akit. They are much mixed with the Malays, however. There are a few Chinese.

In addition to the mammals obtained, Sus ol and Rusa are common. A few bears are said to exist. Ratufa is said to exist, but I never saw or heard them. Gymnura and a wild cat also occur. Dugongs are said not to be rare in the Salat Rupat. Tigers never occur in Rupat, nor do elephants or rhinoceroses cross the strait, although they are all common upon the mainland.—W. L. Abbott.

Pulo Bengkalis.—See map above.

This island is 39 geographical miles long and contains about 400 square miles. The whole surface is low and flat, and swampy during the rains. Along the coast are many clearings and sago kebuns, but most of the surface is covered with heavy forest. It is separated from the mainland by the Salat Panjang, about 3 miles wide (and 5 to 15 fathoms deep).—W. L. Abbott.
Pulo Padang.—See map, page 623.

This island is separated from the mainland of Sumatra by a continuation of the Salat Panjang. It is separated from Pulo Bengkalis by the Salat Padang, about 1 mile in width and 5 or 6 fathoms deep. At its lower end it is separated from Pulos Merban and Tebing Tinggi by narrow channels.

It has about the same area as Pulo Bengkalis; its surface is low and flat and mostly covered with forest.—W. L. Abbott.

The mammals of these islands, Rupat, Bengkalis, and Padang, are remarkably few in number of species, considering their extent and their proximity to the coast of Sumatra. These islands are very low, only a few feet above high water, and nearly everywhere swampy after heavy rains. There are no hills anywhere and they are all doubtless of recent alluvial formation. No typhoons or heavy gales ever occur, so that the tiger and rhinoceros have never been carried across the narrow straits, as has happened in many of the islands of the Mergui Archipelago. When some of the great cyclones have occurred at the head of the Bay of Bengal, Sangar Island and much of the Sundarbans have been completely flooded, andigers, deer, and other mammals swept out to sea in hundreds and drowned. The only heavy gales, except squalls, that occur in the Straits of Malacca are the “Sumatras,” which blow for a short time with almost hurricane violence. They last only a short time, at most four or five hours, and are unaccompanied by much depression of barometer and consequent rise of sea level. The rain pours in torrents, but the short duration and comparatively local character prevent much flooding.

The large rivers which rise in the western range of mountains and flow nearly across Sumatra, to empty on this coast, the Indragiri, Siak, and Kampar, all rise enormously in the rains, particularly in the uplands. They must carry down more or less animal life on such occasions. But when the rivers reach the vast alluvial flat bordering the east coast the level of the water scarcely changes during the highest floods. There are no embankments, and the increase of fresh water simply spreads out over the forest-covered country whose surface is just a few inches above ordinary high-tide level. The fresh water merely displaces the previously salt or brackish water. The whole east coast of Sumatra is simply a huge sponge. This coast district then acts as a sort of strainer which catches any or most of the animals brought down by the floods from the highlands.

Curiously enough the bear exists in all three of the islands of Rupat, Bengkalis, and Padang. This is a common inhabitant of the swampy east coast, but is not often found in islands. It occurs in Banka, however, and in some of the Mergui Archipelago near the coast. The absence of tigers is curious, especially as its particular food pigs and Rusa are very common, and tigers swim very well indeed. In this connection it is to be noted that tigers were absent from Singapore Island at the time of its settlement in 1819, but became abundant ten or fifteen years later when the human population increased. At the present time they seem to swim across the Johor Strait at will. Leopards are not found in the islands. There is a wild cat common in all three islands, probably a form of Felis bengalensis. The natives complain much of its depredations on their poultry. Muntjacis are absent. They like dry ground and low hills and the islands are unsuited to them. They rarely occur on islands, only on Nias and on Pulo Bintang, where they have probably been introduced. Monkeys, Macaca fascicularis and Presbytis cristata, occur on all three islands. [Presbytis percura] on Pulo Rupat only. Sus oi and Sus rüttatus both occur on Rupat, the latter very common. On Bengkalis and Padang, Sus oi was common
and the natives told me that the "Babi bakau," *Sus vittatus*, was very rare. It is common everywhere on the mainland.

On the small island of Pulo Payong, in the middle of Salat Rupat, the small pig, *Sus vittatus*, was very abundant, but *Sus ci* does not occur. The tracks of tiger are said to occur occasionally on Payong, but the natives said they were not real tigers, but "Kinana kwaka" (were tigers).

Manis occurs on Bengkalis. No squirrel is found on Bengkalis, but *Sciurus vittatus* is plentiful across the narrow salat in Pulo Padang. No Ratufa occurs on any of the islands.

The conclusion derived from the distribution of the mammalian fauna of these islands and of the Rhio-Lingga Archipelago is that the present period is one of extension of land areas, either from elevation of land areas or more probably from alluvial deposit. The islands with hills have a much larger fauna. At some past period the islands in all this region extended to the mainland and received their fauna. Then followed a period of depression, when everything was sunk below sea level, except the tops of the hills. These islands were small, too much so, for the larger mammals to continue to exist. The squirrels, *Manis, Tragulus*, etc., remained on the small islands in safety. Then followed the present condition of things, elevation and alluvial deposition, enlarging the islands and extending the coast of Sumatra eastward and receiving additions to its fauna by swimming and introduction by man. According to this theory, the islands of Rupat, Bengkalis, Padang [Merbau, Tebing Tinggi, Rangsam, and Penjalei] are of entirely recent formation and the present fauna has entered only comparatively recently.—W. L. Abbott.

Doctor Abbott's views as to the formation of these islands and the manner in which they received their fauna are entirely in accord with my own as based on study of his collections and of the elevations of the land and depths of the sea. His explanation of the manner in which animals may be carried from the highlands of Sumatra to the lowlands of the east coast may possibly explain some puzzling points noted beyond under *Tragulus* (page 630), *Mus* (page 645), and *Ratufa* (page 636).

**Pulo Tebing Tinggi**.—Also called Pulo Rantow.

**Pulo Merbau**.—A small island.

**Pulo Rangsam** (or *Rangsang*).—Also called Medang, but not to be confused with Pulo Medang off Pulo Rupat.

The location and relative sizes of these islands may be seen on the map, page 623. They are all low alluvial islands, similar in general characteristics to the islands of Rupat, Bengkalis, and Padang, described above.

**Pulo Penjalei** (also called *Mendol*).—This is a small alluvial island at the mouth of the Kampar River.

**Kateman River.**—See map, page 623.

The Kateman has a course of 25 or 30 miles through the low alluvial land of eastern Sumatra. The whole country is more or less swampy. No place is more than 2 feet above high water. There are many sago plantations along its banks. During the past five or ten years [this was written in the summer of 1903] much timber near the river banks has been cut by the Chinese for the Singapore market, but the lumbering operations never extend more than a
mile from the river banks. The timber tongkans (junks) ascend the Kateman for about 18 or 20 miles. Besides the animals obtained, I saw pigs and a black leopard. Tigers also exist, but no elephants or rhinoceroses.—W. L. Abbott.

SYSTEMATIC LIST OF SPECIES.

**SUS VITTATUS** Müller and Schlegel.


Three specimens from Aru Bay, one from Pulo Rupat, two from Pulu Payong in Salat Rupat, two from the Siak region, and two from Pulo Penjalei, at the mouth of the Kampar River. Those from Pulos Payong and Penjalei are very small, but it is doubtful if this is more than individual variation.

For measurements of the adults, see table, page 627.

**SUS OI** Miller.


During his latest trip into eastern Sumatra, Doctor Abbott secured eight additional specimens of this large pig from the mainland or the adjoining islands. These specimens, together with material recently collected by him in western Borneo,

indicate that the members of the *Sus barbatus* group of pigs are somewhat more variable than was at first supposed. The characters pointed out by Mr. Miller, however, appear as a rule to hold good. The most reliable character for distinguishing between *Sus oi* and *Sus barbatus* is the size and shape of the last lower molars. This tooth averages longer in the Bornean pigs and in the majority of the specimens shows three distinct cross ridges and a terminal heel, while in the Sumatran *Sus oi* most specimens have this tooth shorter, with only two cross ridges and a terminal heel, or sometimes what appears like three cross ridges and no heel. As for actual size of the skulls, the largest in the U. S. National Museum comes from Borneo (Cat. No. 142351, upper length 457 mm.). It does not, however, reach the extreme length (505 mm.) given by Mr. Miller for *Sus oi*. All the pigs of this group recently taken by Doctor Abbott on Sumatra or the adjacent islands are distinctly smaller than is the type of *Sus oi*.

For measurements see table, page 627.

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### External and Cranial Measurements of Pigs from Eastern Sumatra

#### Dimensions

<table>
<thead>
<tr>
<th>Type of Site</th>
<th>Cattle No. 14362, adult male</th>
<th>Cattle No. 14363, adult male</th>
<th>Cattle No. 14365, adult male</th>
<th>Cattle No. 14366, adult male</th>
<th>Cattle No. 14367, adult male</th>
<th>Cattle No. 14368, adult male</th>
<th>Cattle No. 14369, adult male</th>
<th>Cattle No. 14370, adult male</th>
<th>Cattle No. 14371, adult male</th>
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<tbody>
<tr>
<td>Head and body</td>
<td>mm</td>
<td>mm</td>
<td>mm</td>
<td>mm</td>
<td>mm</td>
<td>mm</td>
<td>mm</td>
<td>mm</td>
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<tr>
<td>Tail a</td>
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<td>1,400</td>
<td>1,400</td>
<td>1,400</td>
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<td>780</td>
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<tr>
<td>Second upper molar</td>
<td>23</td>
<td>23</td>
<td>23</td>
<td>23</td>
<td>23</td>
<td>23</td>
<td>23</td>
<td>23</td>
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</tr>
<tr>
<td>Third upper molar</td>
<td>31</td>
<td>31</td>
<td>31</td>
<td>31</td>
<td>31</td>
<td>31</td>
<td>31</td>
<td>31</td>
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<tr>
<td>Mandibular toothrow, mm</td>
<td>122</td>
<td>118</td>
<td>116</td>
<td>115</td>
<td>115</td>
<td>115</td>
<td>115</td>
<td>115</td>
<td>115</td>
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<tr>
<td>Second lower molar</td>
<td>22</td>
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<tr>
<td>Third lower molar</td>
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<td>33</td>
<td>33</td>
<td>33</td>
<td>33</td>
<td>33</td>
<td>33</td>
<td>33</td>
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<tr>
<td>Number of cross ridges plus cusp on m(_2)</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>

*Collector's measurements.

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b "Gutted."
TRAGULUS NAPU (F. Cuvier).

1822. Moschus napu F. Cuvier, Hist. Nat. Mamm., IV, pl. XXXIX.

Seven specimens from the vicinity of Aru Bay and five from the Siak region farther down the coast.

For measurements of the adults see table, page 631.

TRAGULUS KANCHIL (Raffles).


Twelve specimens from the vicinity of Aru Bay. This series is in all respects similar to the series of Tragulus collected by Doctor Abbott at Tapanuli Bay, on the west coast of Sumatra. The Tragulus of this group from the Siak region in eastern Sumatra are very variable but present certain average differences, and may be recognized as a distinct race described below.

For measurements of the adults see table, page 631.

TRAGULUS KANCHIL LONGIPES, new subspecies.

Type.—Skin and skull of adult male, Cat. No. 144141, U.S.N.M., collected on the Little Siak River, eastern Sumatra, November 3, 1906, by Dr. W. L. Abbott. Original number 4853.

Diagnostic characters.—Similar in all respects to typical Tragulus kanchil except that the hind foot is distinctly longer.

Color.—The color of typical examples of Tragulus kanchil longipes is exactly like that of T. kanchil kanchil, so that no detailed description is necessary. Certain of the specimens, however, two from Makan-pan, one from Kompeui, and one from Sungei Mandau, are distinctly lighter or more "yellow" in color than is the type and the rest of the series, being practically identical in coloration with the animal described below as Tragulus fulvicollis.

Skull and teeth.—I have been able to detect no differences between the skulls and teeth of Aru and Tapanuli Bay examples of Tragulus and specimens from the Siak region.

Measurements.—See table, page 632, and diagram, page 629. An examination of this table and diagram shows that the Siak Tragulus is essentially similar in size and weight to specimens from Aru Bay with the exception of the hind foot. In Aru Bay examples this

\(^a\) Miller, Proc. U. S. Nat. Mus., XXVI, p. 442; and table, p. 446.
Measurement ranges between 114 and 128 mm., while in those from the Siak region it is between 131 and 145 mm.

**Fig. 3.**—Diagrammatic view of the lengths of hind foot, basal lengths of skull, and of the weights of Tragulus from Eastern Sumatra. The dots represent specimens. Specimens from Aru Bay and Tapanuli Bay are *Tragulus kanchil kanchil*; those from the Siak region and Pulau Penjalei, *Tragulus kanchil longipes*; those from all the other islands, Pulos, Rupat, Bengkalais, Padang, Tering Tinggi, and Rengsam, *Tragulus pulticollis*.

Proc. N. M. vol. xxxiv—08—41
Specimens examined.—Nine from the Little Siak River, four from Kompei, two from Sungei Mandan, two from Makapan, and four from Pulo Penjalei.

Remarks.—The Tragulus of the kanchil group from the Siak region in eastern Sumatra are quite variable. Most of them are like typical kanchil except with larger feet, others of them, one from Kompei, one from Sungei Mandan, and especially the two from Makapan, are almost identical in point of color and size with the Tragulus from the neighboring islands of Rupat, Padang, Bengkalis, Tebing Tinggi, and Rangsam. The Tragulus from Pulo Penjalei, an island at the mouth of the Kateman River, is singularly enough clearly referable to T. kanchil longipes both in point of size and coloration.

TRAGULUS FULVICOLLIS, new species.

Type.—Skin and skull of adult female. Cat. No. 143519, U.S.N.M., collected on Pulo Bengkalis off east coast of Sumatra, March 27, 1906, by Dr. W. L. Abbott. Original number 4765.

Diagnostic characters.—A large member of the Tragulus kanchil group, somewhat like Tragulus ravus Miller, from the Malay Peninsula, but much larger and more richly colored especially about the neck and forelegs; differs from T. kanchil in its larger size and lighter color.

Color.—Type: Upper parts and sides of body a mixture of light and dull orange-buff and black, the black slightly in excess along the middle line of the back, both colors equally prominent along the sides but the black gradually disappearing as the belly is reached so that next to the white of the underparts no black is mixed in with the dull orange-buff. Sides and top of neck tawny-ochraceous with no admixture of black except for a narrow (15 mm. wide), ill-defined nape stripe which gradually blends in with the colors of the middle line of the back. The tawny-ochraceous of the neck gradually blends in with the dull orange-buff of the body. Top of head a mixture of black and tawny-ochraceous, the former color in excess. Sides of head similar to sides of neck but duller. Underparts generally white. Throat pattern normal, the collar and median line of belly (5 mm. wide anteriorly, 30 mm. posteriorly) a light ochraceous or dull orange-buff, the A in front of collar similar in color but faintly lined with black. Inner sides of legs white; outer sides tawny-ochraceous, bright and clear on the forelegs, duller and with a slight admixture of black on the hind legs. Tail above dull tawny slightly admixed with black, below and at the tip white.

Variation in the series: The series as a whole does not show much variation in respect to color. Some of the specimens run slightly lighter than the type. The extent of the black on the top of head

and neck is variable. In some specimens, especially those from Pulo Rupat, it is quite conspicuous. None of the series show a decided approach in color to typical Tragulus kanchil longipes of the adjacent mainland, although several of the mainland form strongly approach the insular race.

**Skull and teeth.**—These show no special peculiarities, but average larger than those of Tragulus from the mainland.

**Measurements.**—See table, page 632, and diagram, page 629. The latter show that Tragulus fulvicollis is a heavier animal and has a larger skull than either T. kanchil kanchil or T. kanchil longipes. In length of hind foot it averages only slightly more than does T. kanchil longipes.

**Specimens examined.**—Fourteen from Pulo Bengkalis, six from Pulo Padang, ten from Pulo Rupat, nine from Pulo Tebing Tinggi, and two from Pulo Rangsam.

**Remarks.**—Typical specimens of Tragulus fulvicollis, compared with typical T. kanchil, appear very distinct, but its relations with the latter must be quite close and are easily traced back to typical kanchil, by way of the abnormal specimens of T. kanchil longipes, and then through normal specimens to T. kanchil kanchil. It would seem that T. kanchil in the lowlands of eastern Sumatra is in a state of active evolution and on the outlying alluvial islands has become T. fulvicollis, while on the mainland and on Pulo Penjalei it retains nearly all of the kanchil characters with the exception of larger hind feet. Certain examples on the mainland, however, show its tendency to become T. fulvicollis.

**Measurements of adult Tragulus from eastern Sumatra.**

<table>
<thead>
<tr>
<th>Name</th>
<th>Locality</th>
<th>Number</th>
<th>Sex</th>
<th>Head and body</th>
<th>Tail</th>
<th>Hind foot with hoofs</th>
<th>Weight</th>
<th>Hind length of skull</th>
<th>Zygomatic width</th>
<th>Maxillary tooth row—alveol.</th>
<th>Mandibular tooth row—alveol.</th>
</tr>
</thead>
<tbody>
<tr>
<td>T. napu</td>
<td>Aru Bay</td>
<td>14344</td>
<td>Male</td>
<td>568</td>
<td>210</td>
<td>92</td>
<td>147</td>
<td>4</td>
<td>105.3</td>
<td>62.3</td>
<td>42.8</td>
</tr>
<tr>
<td>Do.</td>
<td>do.</td>
<td>14345</td>
<td>Male</td>
<td>556</td>
<td>200</td>
<td>90</td>
<td>146</td>
<td>4</td>
<td>100.1</td>
<td>51.1</td>
<td>40.7</td>
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<td></td>
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<td>210</td>
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<td>147</td>
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<td>62.3</td>
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<td>200</td>
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<td>146</td>
<td>4</td>
<td>100.1</td>
<td>51.1</td>
<td>40.7</td>
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*Collector's measurements.*
Measurements of adult Tragulus from eastern Sumatra—Continued.

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* Collector's measurements.  

** Type.

MUNTICACUS MOSCHATUS* (Blainville).

1816. *C[ervus]* moschatus Blainville, Bull. Soc. Phil., p. 77. (Type-

locality: Sumatra.)


December 16, 1906.

Skin and skull of an immature male (last molars just beginning to come through alveoli) from Arn Bay, Cat. No. 145358, U.S.M.N.
Length of head and body, 1,040 mm.; tail, 180; hindfoot, 303; weight 58 pounds (26 kilos); basal length of skull, 178; zygomatic width, 86; length of antler, in a straight line, from the angle which it makes posteriorly with the skull, 128. The antlers are without burr or brow-tine. The proximal two-thirds of them are comparatively smooth, the distal third is deeply rugose with longitudinal furrows.

Two frontlets with their attached antlers, also without brow-tines, were obtained from the natives on Pulo Rangsam. These antlers have been much scraped and smoothed down.

RUSA EQUINA (Cuvier).

1825. Cervus equinus Cuvier, Recherches Ossemens Fossiles, 3d. ed., IV, p. 45, pl. v, figs. 30, 37, and 38. (Type-locality: Sumatra.)

Skin and skull of a young female. Cat. No. 143539, U.S.N.M., from Pulo Bengkalis. The second and third permanent molars have not begun to appear.

The frontlets and attached antlers of ten adult males were secured from the natives, two from along the Siak River, one from Kompei, and seven from Pulo Rangsam.

Measurements of antlers of Sambar deer from Sumatra.

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<th>Circumference of antler above brow-tine.</th>
<th>Length of antler along convexity of curve.</th>
<th>Burr to tip of brow-tine along convexity.</th>
<th>Tip of apical time to its angle with main trunk of antler.</th>
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The first number refers to the left antler, the second, to the right. *b* Tips slightly broken.

SCIUROPTERUS HAGENI Jentink.


Two specimens from Aru Bay, which is not very distant from the type-locality, Deli.

For measurements see table, page 634.
Ten specimens, skins and skulls, from various places on the east coast of Sumatra. For a list of localities and measurements see table below. I can find no essential differences between the series from Sumatra and that from the Batu Islands off the west coast of Sumatra. The extremes of total length of skull in Sumatran examples are: 65 to 68.4 mm., in the Batu series 65.8 to 69.4; the extremes of the maxillary tooth row are, respectively, 14.6 to 16 and 15.5 to 16.8. The teeth in the Batu specimens thus appear a little larger than they do in Sumatran examples and as a whole look heavier. This may probably be accounted for by wear, as in nearly all the Batu skulls the crowns of teeth are worn to a flat surface, while the teeth in most of the Sumatran skulls have the primary cusps unworn. As the cusps become worn down the teeth assume a somewhat heavier appearance.

### PETAURISTA NITIDULA Thomas.


Four skins and skulls from Pulo Rupat. They are distinctly smaller than the related flying-squirrel from Sumatra and so closely

#### Measurements of flying squirrels from Sumatra.

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<td>Sciuropterus hagedii</td>
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<td>Petaurista nitidula</td>
<td>Pulo Rupat</td>
<td>14339</td>
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<td>405</td>
<td>460</td>
<td>77</td>
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<td>75</td>
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<td>470</td>
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<td>46.4</td>
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<td>Do</td>
<td>420</td>
<td>465</td>
<td>82</td>
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<td>44.6</td>
<td>15.8</td>
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<td>...</td>
<td>14214</td>
<td>Male, adult</td>
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<td>500</td>
<td>84</td>
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<td>46.3</td>
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<tr>
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<td>14215</td>
<td>Do</td>
<td>392</td>
<td>483</td>
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<td>65</td>
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<td>Do</td>
<td>405</td>
<td>470</td>
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<td>123135</td>
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<td>520</td>
<td>80</td>
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<td>15</td>
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<td>...</td>
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<td>...</td>
<td>123137</td>
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<td>470</td>
<td>81</td>
<td>66.8</td>
<td>45.4</td>
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</table>

*Collector's measurement.*
resemble topotypes of *Petaurista nitidula* that no constant differences can be found to distinguish them. The greatest length of the skull in the Rupat specimens ranges from 62.5 to 65 mm.; in a series of seven specimens from the Natumas the extremes are 61.6 to 65.3 mm. Ten specimens from the mainland of Sumatra show a range of greatest length of skull from 65 to 68.4 mm.

For measurements of the Rupat specimens see table, page 634.

**RATUFA PALLIATA** Miller.


Nine specimens from Aru Bay and two from Salat Rupat. No Ratufas of this group were taken on Pulo Rupat or other islands, and the only specimen taken by Doctor Abbott farther down the coast on the east side of Sumatra is the type-specimen, Cat. No. 113162, from the Indragiri River.

For measurements see table, page 636.

**RATUFA ARUSINUS** Lyon.


Thirteen specimens, skins and skulls from the vicinity of Aru Bay. This is a very well-marked form, and no specimens from Sumatra are in the National Museum which show evidences of intergrading with it, though doubtless future collections will show it to be a subspecies of *Ratufa hypoleuca* from the west coast of Sumatra.

For measurements see table, page 636.

**RATUFA HYPOLEUCA CATEMANA** (Lyon).


Doctor Abbott's latest collections from eastern Sumatra in the region of the Siak River show that this form of *Ratufa* is more variable than was at first supposed. As shown in the original description\(^d\) specimens from the Indragiri River had a tendency to be whitish on the underparts instead of tawny as in the type and other specimens from the Kateman River. (See table, page 636.) Five of the indi-

viduals recently collected from farther up the coast (Siak River, see map, page 628) have the underparts white or whitish, and continuation of the light underparts extends down the inner side of the hind leg as a narrow line to the heel, about the same as it does in the west coast series of *R. hypoleuca*. This series of east coast *Ratufas* averages smaller, in both external and cranial measurements, than the series of west coast specimens. Some of the specimens, especially Cat. No. 144167, from Makapan are very close to typical *R. hypoleuca* in both size and coloration, so that *R. catemana* must be considered as a subspecies of *R. hypoleuca*. None of the specimens show any approach to *Ratufa arusinus*. For measurements see table below.

Measurements of Giant Squirrels from eastern Sumatra.

<table>
<thead>
<tr>
<th>Name</th>
<th>Locality</th>
<th>Number</th>
<th>Sex and age</th>
<th>Head and body</th>
<th>Tail</th>
<th>Hind foot with claw</th>
<th>Greatest length of skull</th>
<th>Zygomatic breadth</th>
<th>Interorbital constriction</th>
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<td><em>R. pallianus</em></td>
<td>Aru Bay</td>
<td>14330</td>
<td>Male, adult</td>
<td>350 452 88</td>
<td>83</td>
<td>89.7</td>
<td>41.7</td>
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<tr>
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<td>do.</td>
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</tr>
</tbody>
</table>

*Collector's measurements.

*Measured by writer after relaxing feet in water for forty-eight hours.

*Type.

*Underparts white or whitish and inner side of hind leg marked with a narrow extension of the white of the underparts to the heel.

*Imperfect.
SCIURUS MELANOPS Miller.

1899. Sciurus prrovostii, Jentink, Notes Leyden Museum, XI, p. 27.

Twenty-four specimens of this species were collected at various localities in eastern Sumatra. For measurements and list of localities see table, page 639. Sciurus melanops was described from specimens collected along the Indragiri River, Sumatra. Since publishing the original description Mr. Miller has had the opportunity of comparing specimens of S. melanops with the cotypes of S. rafflesii Vigors and Horsfield in the British Museum and made the following notes on the two forms:

At first sight the two appear to be identical, but rafflesii (cotype No. 84.63.8. Sumatra Raffles) differs from melanops in considerably smaller size and apparently in a less blackish cheek. The skin is not in perfect condition, having been mounted and exposed to light. Cheeks very nearly as in Cat. No. 113153, U. S. National Museum (Paratype of S. melanops), but more distinctly grizzled. Whitish spots on cheek and muzzle exactly as in Cat. No. 113153. Red of underparts essentially as Cat. No. 113153, but distinctly browner and darker, especially along median region, outer surface of leg, and on shoulder. In latter region the palest red is about the same as the darkest at side of wrist in melanops. Skull conspicuously smaller and more slender than in melanops; ramus of mandible more slender; teeth slightly larger than in melanops, therefore relatively much larger. Measurements of the skull of cotype of S. rafflesii: Greatest length, 55 mm. (53.3); \(a\) basal length, 48.6 (50.4); basilar length, 45.6 (47.4); palatal length, 24.8 (28.1); diastema, 13.6 (14.4); zygomatic breadth, 31 (34.3); mastoid breadth, 24 (26); breadth of braincase, 24 (25.4); interorbital constriction, 23 (22.8); maxillary tooth row, 11.4 (11.2); mandibular tooth row, 11.4 (10.9).

SCIURUS MELANOPS PENIALIUS, new subspecies.

Type.—Skin and skull of adult female, Cat. No. 144364 U.S.N.M., collected on Pulo Penjalei, at the mouth of the Kampar River, eastern Sumatra, February 5, 1907, by Dr. W. L. Abbott. Original number 5040.

Diagnostic characters.—A member of the Sciurus prevostii group of squirrels, very similar to Sciurus melanops Miller (see above), differing only in the possession of a distinctly darker shoulder, ferruginous instead of ochraceous.

Color, etc.—In all external and cranial characters this subspecies so closely resembles Sciurus melanops Miller, aside from its darker shoulders, that no detailed description is necessary.

Measurements.—See table, page 639.

\(a\) Measurements in parentheses, those of the type of Sciurus melanops Miller.
Specimens examined.—Six skins with skulls and one skull without skin.

Remarks.—Although the Penjalei prevostii squirrel differs from Sciurus melanops of the mainland in apparently but a single character, the darker shoulders, yet this character is easily seen and perfectly constant. Doctor Abbott recognized them as distinct in the field, remarking "there is a new Sciurus melanops with rufous shoulders from Pulo Penjalei." None of the six skins show any tendency toward the light shoulders of S. melanops, and only one out of the large series of S. melanops approaches the dark shoulders of the insular subspecies. This specimen is an adult female, Cat. No. 123109, from Kateman Island. It is the only intermediate specimen between the two forms so far as known.

Sciurus Piceus Peters.


Twelve specimens of this squirrel were taken at Aru Bay. They do not differ from the series of skins collected by Doctor Abbott at Tap-anuli Bay to which M. Miller applied the name Sciurus crebus. While studying material in the Berlin Museum in 1904 Mr. Miller made the following notes on Sciurus piceus Peters:

Type.—Male, in good condition. The locality given on the label and in the original description is Tenasserim, but this is doubtless an error. It was received from Professor Strempel of Rostock together with Prshytis potenziani, also supposed to be from Tenasserim but now known to occur on the islands off the west coast of Sumatra. The squirrel is undoubtedly from Sumatra also, as it agrees in every way with S. crebus. No further history of the specimens can be found in the Museum records. There is no indication of a pale lateral stripe (present in two S. pluto). Measurements, head and body, 280; tail vertebrae, 230; hind foot, with and without claws, 62, 59. Skull inside. The collection contains a second specimen without locality and a third from Sumatra.

Sciurus Nyx, new species.

Type.—Adult female, skin and skull, Cat. No. 143392, U.S.N.M., collected on Pulo Rupat, off east coast of Sumatra, March 10, 1906, by Dr. W. L. Abbott. Original number 4691.

Diagnostic characters.—A member of the Sciurus prevostii group, most like Sciurus piceus Peters, but smaller, and with color of the underparts extending on the upper surfaces of the feet.

Color.—Upperparts, sides, tail, and outer sides of thighs, black; underparts and upper surfaces of feet including adjoining portions of legs, deep ferruginous. At the base of whiskers the black is finely
grizzled with buffy. The region about the shoulder, the outer surface of the upper arm and outer surface of thigh are very faintly grizzled with a buffy or ochraceous buffy color. Ordinarily this grizzling is scarcely noticeable, but evident, though slight in amount when the specimens are placed in certain lights. A still fainter grizzling may be brought out with proper lighting along the side just above the ferruginous underparts.

**Skull and teeth.**—These are distinctly larger and heavier than they are in *Sciurus piceus*, but do not differ in essential respects from skulls of *S. melanops*.

**Measurements.**—See table, page 640.

**Specimens examined.**—Fourteen, all from Pulo Rupat.

**Remarks.**—*Sciurus nyr* appears to be a very well marked member of the *Sciurus prevostii* group of squirrels. Although most like *Sciurus piceus* with regard to general appearances, its large size, red feet, and faint grizzling about the shoulders, thighs, and sides (lacking in *S. piceus*), indicate that it has developed from *S. melanops*, rather than from *S. piceus*. Another fact giving strength to this view is that *S. melanops* is found on the mainland opposite Pulo Rupat, while, so far, *S. piceus* is not known from there.

**Measurements of squirrels of the *Sciurus prevostii* group from eastern Sumatra.**

<table>
<thead>
<tr>
<th>Name</th>
<th>Locality</th>
<th>Number</th>
<th>Sex and age</th>
<th>Head and body, mm</th>
<th>Tail, mm</th>
<th>Hind feet, mm</th>
<th>Greatest length of skull, mm</th>
<th>Interorbital, mm</th>
<th>Zygomatic, mm</th>
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<td>144075</td>
<td>Female, adult</td>
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<td>275</td>
<td>67</td>
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* Collector's measurements.

* Type.
Measurements of squirrels of the *Sciurus prevostii* group from eastern Sumatra—Cont’d.

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<th>Sex and age</th>
<th>Head and body</th>
<th>Tail vertebrae</th>
<th>Hand foot with claws</th>
<th>Greatest length of skull</th>
<th>Interorbital constriction</th>
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</tbody>
</table>

*a* Collector’s measurements.  
*b* Type.

**SCIURUS VITTATUS VITTATUS** (Raffles).


Nine specimens from the mainland of Sumatra. For localities and measurements see table below. Examples from higher up the coast, as those opposite Pulo Rupat, average slightly darker than those taken farther down, the Indragiri-Katemen specimens. The insular race described below can not be considered a highly differentiated form. The fact, however, that the thirty-two squirrels of this group from the lowlands and adjacent islands of eastern Sumatra can be arranged in two fairly well-marked series according to intensity of color, one from the mainland the other from the islands, shows the necessity of recognizing another race of this highly variable group of squirrels.

**SCIURUS VITTATUS RUPATIUS**, new subspecies.

*Type.—Adult female, skin and skull, Cat. No. 143406, U.S.N.M., collected on Pulo Rupat, east coast of Sumatra, March 17, 1906, by Dr. W. L. Abbott. Original number 4733.*
Diagnostic characters.—Closely related to Sciurus vittatus vittatus (comparison with specimens from the lowlands, east coast of Sumatra) but slightly darker, especially on the underparts, black side stripe slightly more conspicuous.

Color.—Type: Upperparts and outer surfaces of legs and upper surfaces of feet a fine grizzle of light tawny-olive and black; upper surface of tail similar but the grizzle coarser; under surface of tail a coarse grizzle of ochraceous and black, the latter color quite conspicuous at the tip; underparts and inner sides of legs generally a bright hazel, or a color between ferruginous and hazel; light side stripe (about 80 by 5 mm.) cream-buff; dark side stripe (85 by 10 mm.) black. Variations in the series: The series of specimens from Pulos Rupat and Padang are on the whole quite uniform, some of the specimens have the underparts slightly lighter than they are in the type. Only one specimen shows any marked deviation. Cat. No. 143414, U.S.N.M., Pulo Padang, in having the underparts ochraceous. It is even brighter beneath than are the skins from Salat Rupat.

Skull and teeth.—Apparently there are no constant cranial and dental characters by which Sciurus vittatus rupatius can be distinguished from related forms.

Measurements.—See table, page 642.

Specimens examined.—Five from Pulo Rupat and ten from Pulo Padang, one from Tebing Tinggi, and two from Pulo Merbau.

Remarks.—While Sciurus vittatus rupatius is not a sharply defined form, the majority of the specimens average enough darker to constitute another race. In general dark color, especially in the underparts, this squirrel is somewhat like Sciurus saturatus Miller, from Pulo Mansalar, off the opposite coast of Sumatra, but the light rings in the hairs of the upperparts in the latter squirrel are tawny ochraceous instead of light tawny olive.

**SCIURUS VITTATUS ALBESCENS** (Bonhote).


Two specimens taken at Aru Bay do not differ from certain of the skins collected by Doctor Abbott at Loh Sidoh Bay. The latter are practically topotypes of *S. albescens*. The majority of the Loh Sidoh Bay skins have many white hairs on the underparts, but two of them have comparatively few such hairs, in this respect resembling the two skins from Aru Bay.

For measurements see table, page 642.
Measurements of squirrels of the Sciurus citellus group from eastern Sumatra.

<table>
<thead>
<tr>
<th>Name</th>
<th>Locality</th>
<th>Number</th>
<th>Sex</th>
<th>Head and body</th>
<th>Tail</th>
<th>Hind foot with claws</th>
<th>Greatest length of skull</th>
<th>Interorbital breadth</th>
<th>Pycnogaline breadth</th>
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<td>Pulo Merbaun</td>
<td>Male, adult</td>
<td>143402</td>
<td>215</td>
<td>190</td>
<td>55</td>
<td>18</td>
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<tr>
<td>S. v. citellus</td>
<td>Salat Rupat</td>
<td></td>
<td>Female, adult</td>
<td>143403</td>
<td>230</td>
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<td>53</td>
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<td>31.7</td>
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<td>Male, adult</td>
<td>143405</td>
<td>215</td>
<td>190</td>
<td>50</td>
<td>18</td>
<td>30.2</td>
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<td>do.</td>
<td>Male, adult</td>
<td>143406</td>
<td>208</td>
<td>150</td>
<td>51</td>
<td>18</td>
<td>28.7</td>
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<tr>
<td>Do.</td>
<td>Little Siak River, at mouth</td>
<td>do.</td>
<td>Male, adult</td>
<td>143407</td>
<td>205</td>
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<td>do.</td>
<td>Female, adult</td>
<td>143408</td>
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<td>143409</td>
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<tr>
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<td>Male, adult</td>
<td>143410</td>
<td>212</td>
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<td>215</td>
<td>210</td>
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<td>18</td>
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</tr>
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</table>

*a Collector's measurements.  
bTail apparently defective.  
cType.

**SCIUROS TENUIS** Horsfield.

1824. *Sciurus tenuis* Horsfield, Zoological researches in Java and the neighboring islands (pages not numbered).

1889. *Sciurus tenuis*, Jentink, Notes Leyden Museum. XI, p. 27.


Twenty-two adult specimens from various localities along the east coast of Sumatra. They show no differences from specimens from other parts of Sumatra or from the island of Singapore, the type locality of the species. For table of measurements and list of localities see table, page 643.

**SCIUROS LOWII** Thomas.

(Type-locality, Borneo.)

A small squirrel, not fully adult. Cat. No. 123116. U.S.N.M., from the Katemen River, may be referred to *Sciurus lowii* Thomas. It differs from specimens of *Sciurus tenuis* collected at the same locality in having a general color effect of dark mummy brown instead of tawny olive. The hairs of the edges of the ears are blackish, and the underparts are creamy white, in marked contrast to the gray under-
parts of *Sciurus tenuis*. These small gray squirrels fall into two groups so far as the clear white of the underparts is concerned. The following species have the hairs of the underparts white or cream-white throughout: *Sciurus lowii* (Borneo, Sumatra), *lingangensis* (Pulo Lingung, Natuna Islands), *piniensis* (Pulo Pinie, Batu Islands), and *bale* (Tana Bala, Batu Islands). In the other series of species the hairs of the underparts have gray or slaty bases and whitish tips. They are: *Sciurus tenuis* (Malay Peninsula, Sumatra), *tenuis surdus* (Malay Peninsula), *parsus* (Borneo), *mansularis* (Pulo Mansalar, west of Sumatra), *bancorius* (Bankaru, Banjak Islands), *pumilus* (Pagi Islands), and *procerus* (Borneo).

Measurements, head and body, 114 mm.; tail, defective; hind foot, 77; greatest length of skull, 31.8; zygomatic breadth, 18.5; interorbital constriction, 10.4.

Measurements of *Sciurus tenuis* from eastern Sumatra.

<table>
<thead>
<tr>
<th>Name</th>
<th>Locality</th>
<th>Number</th>
<th>Sex</th>
<th>Head and body, mm.</th>
<th>Tail verticillate</th>
<th>Hind foot, with claws, mm.</th>
<th>Greatest length of skull, mm.</th>
<th>Zygomatic breadth, mm.</th>
<th>Interorbital constriction, mm.</th>
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<td>Male</td>
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<td>35</td>
<td>36.8</td>
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<tr>
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<td>Little Siak River at mouth</td>
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<td>34.9</td>
<td>23</td>
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<td>141203</td>
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<td>35.3</td>
<td>22</td>
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</tr>
</tbody>
</table>

*Collector's measurements.

*Measured by writer after soaking feet twenty-four hours in water.

**SCIURUS HIPPUROUSUS** Lyon.


One specimen from the Besitan River. Cat. No. 143399, U.S.N.M., adult male; head and body, 260 mm.; tail, 250; hind foot with claws, 62; greatest length of skull, 57.8; zygomatic width, 34.
MUS "RATTUS."


Four rats from the Siak region are referable to this group. They are very little if at all different from Mus neglectus Jentink, so far as may be judged by descriptions and measurements. For list of localities and measurements see table, page 649.

MUS EPHIPPION Jentink.


A small rat, an old male, from the Siak River, may be referred to Mus cphippium provisionally. It does not agree entirely with the original description or measurements, but without an actual comparison of specimens it does not seem advisable to recognize another small species of rat from Sumatra.

For measurements see table, page 649.

MUS ASPER Miller.


Fifteen small spiny rats collected by Doctor Abbott in eastern Sumatra may be referred to Mus asper Miller. They are all small brightly colored rats with rusty bellies, and closely resemble the original series of Mus asper from Trong as well as the other bright colored rats from the Malay Peninsula referable to the same species. For list of localities and measurements see table, page 648. The single skin from Aru Bay is considerably darker than the other specimens, and has very rusty underparts.

MUS MANDUS, new species.

Type.—Skin and skull of adult male, Cat. No. 144225, U.S.N.M., collected at Sungei Mandau (tributary to the Siak River), eastern Sumatra, November 23, 1906, by Dr. W. L. Abbott. Original number 4898.

Diagnostic characters.—A large member of the Mus asper group, differing from typical asper in its larger size, darker upperparts, and gray underparts.

Color.—Type: Upper parts of head and body, a mixture of ochraceous-buff and brownish black, the latter color much in excess; sides of head, neck, and body, a mixture of the same two colors but in about equal proportions. Underparts gray, about like Ridgway's No. 10 gray. Hands and feet whitish; outside of legs similar to sides of body; inner side of the same color as underparts of body. Tail, bicolor, dark brownish above, whitish beneath.
Skull.—The skull of *Mus mandus* does not differ from that of *Mus asper*, except in its distinctly larger size.

Measurements.—For external and craniial measurements of the type and series see table, page 648.

Specimens examined.—Six from Pulo Rupat, six from Pulo Padang, three from the Kateman River, four from the confluence of the Sungei Mandau with the Siak River, and one from the confluence of the Gasip and Siak rivers.

Remarks.—The rats of the *Mus asper* group in eastern Sumatra fall into two well marked groups, a small bright colored form with rusty bellies differing in no essentials from *Mus asper* of the Malay Peninsula and the species just described, larger, duller, darker, and with clear gray bellies. The mouth of the Gasip River is the only locality where both forms appear to have been taken together. Elsewhere in eastern Sumatra only one form has been taken at a given locality. The relations of the two forms are not at all clear, but the material thus far collected show them to be quite distinct, and no intermediate specimens are met with. It is not improbable that both forms may belong to the same species which is branching out in two different directions in eastern Sumatra, and at various localities one form or another is becoming dominant. Rats of this group on the Malay Peninsula are quite variable both as to size and as to intensity of color of the upperparts and rustiness or grayness of the underparts. These variations are most pronounced in specimens from the east coast of the Peninsula, but they are by no means so pronounced or constant as they are in the Sumatran examples, and many intermediate conditions are met with, which is not the case with the rats from Sumatra.

**MUS LINGENSIS** Miller.


Twelve specimens from Aru Bay, eight skins with skulls and four odd skulls.

For measurements see table, page 648.

**MUS FIRMUS** Miller.


One specimen, an adult male, from the Siak River.

For measurements see table, page 649.
MUS BULLATUS, new species.

Type.—Adult male, skin and skull, Cat. No. 143447, U.S.N.M., collected on Pulo Rupat, off east coast of Sumatra, March 16, 1906, by Dr. W. L. Abbott. Original number 4723.

Diagnostic characters.—Similar to Mus firmus Miller a from Linga Island, but lighter in color and with audital bullae about twice as large.

Color.—Upper parts and sides a grizzle of blackish brown and buff, the former color in excess on the back and the latter along the sides. Under parts cream color, darkened to a bright yellow buff toward the sides where it contrasts rather sharply with the blackish brown and buff grizzle.

Fur, etc.—In general the fur is like that of Mus firmus, but coarser and many weak grooved bristles are scattered through it. In M. firmus these bristles are scarcely more than grooved hairs. In the middle portion of the tail there are nine scales to the centimeter.

Skull and teeth.—The skull of Mus bullatus resembles that of Mus firmus, but it is slightly smaller, and the audital bullae are nearly twice as large. The teeth of Mus bullatus are somewhat smaller than those of M. firmus.

Measurements.—See table, page 649.

Specimens examined.—Two skins with skulls from Pulo Rupat, two skins with skulls and two odd skulls from Pulo Padang, and three skins with skulls from the Kateman River.

Remarks.—Mus bullatus is at once distinguished from Mus firmus by its large audital bullae, and by its generally somewhat smaller size. I can detect no differences between specimens from Pulos Rupat and Padang. The three Kateman River specimens give slightly smaller external measurements than those from the islands.

Mus bullatus needs to be compared with Mus mülleri Jentink b from Batang Singalang, Padang Highlands, western Sumatra. I have seen no specimens of this rat, but Mr. Gerrit S. Miller, jr., made full notes of the type and another specimen in the Leyden Museum. His remarks are here published.

Mus mülleri Jentink. Type: Mounted specimen (immature, sex ?), in fair condition. All teeth fully in place except m3, which, however, is almost up but absolutely unworn. Skull with back part broken away to frontals. Mandible perfect. Fur soft, but rather plentifully sprinkled with long coarse hairs on the back. These hairs are not in the least bristly, but with a hand lens most of them can be seen to be grooved. They are nowhere conspicuous but are a little more numerous on rump than elsewhere. Crown, nape, and back about hair-brown, the underfur gray No. 6, and the long hairs not far from rawumber, the result in certain lights closely approaching isabella color. Sides of body and outer surface of legs a dull yellowish brown, between wood-brown and ochra-


b Notes Leyden Museum, II, 1880, p. 16.
ceous-buff, the fur longer than that on the back and apparently belonging to a different pelage. Underparts and inner sides of legs a dirty pale buff, perhaps intermediate between cream-buff and broccoli-brown, lightening to cream-color on the throat, the hairs everywhere except in this cream-colored area slaty gray below middle. Face and cheeks an indefinite buffy gray. Feet a dull broc-
doi-brown. Ears with a grayish pubescence on both surfaces. Tail with rather indistinct rings, of which there are eleven to the centimeter at the middle. At first sight it appears naked, but from the edge of each scale there grow two to three stiff hairs as long as the width of 1⁄2 rings. Color of tail dark brown above, faintly lighter below. Head and body 185 mm., tail 235, hind foot with and without claws 41.6 and 41.

With the type is an adult female (b) also marked Müller from Padang, apparently a typical Mus firmus. It seems hardly probable that the two ani-
mals are the same. Müller differs in relatively longer tail and narrower less distinct caudal annulations. The color is much the same in a general way, allowance being made for age, but the whitish area on the throat of Müller seems to be a distinguishing character. The skulls show one apparently very important character that can hardly be due to age—in Müller the intertery-
goid space extends forward distinctly beyond edge of last molar, while quite the contrary is true in firmus [and also in bullatus]. The anterior portion of the rostrum appears to be less heavily built than that of firmus, but this may readily be the result of the difference in age. Incisive foramina alike. Mandible differs from that of firmus, smaller in size, less prominent protuberance over root of incisor, and wider angular process less distinctly drawn inward. Lat-
eral grooves of palate less well developed in the small skull.

Cranial measurements of the type of Mus Müller: Back of frontal to front of nasal, 33.4 [34.6] ; nasal, 17 [19] ; diastema, 12 [15] ; interorbital constric-
tion, 7 [7] ; depth of rostrum behind incisors, 8 [9] ; width of both nasals to-
mandibular toothrow, 10 [8] ; width of both upper incisors together, opposite
totalization, 3.4 [4.2] [5.4 in firmus]. Molars apparently the same in the two,
allowing for age, the rows the same length, but width greater in the younger
specimen. Pattern not obviously different.

The above description and measurements show that Mus bullatus
is evidently closely related to Mus Müller. Unfortunately nothing is
known regarding the bullae of the latter as that portion of the skull is
missing. The chief points of difference between Müller and
Mus bullatus are the shorter toothrow of the latter, the absence of a
whitish throat patch, and of gray bases of the hairs of the under-
parts. The annulations of the tail in Mus bullatus does not differ
in appearance from that in Mus firmus.

MUS FREMENS Müller.

p. 154, issued June 11, 1902. (Type-locality, Singkep Island.)
3, 1903. (Specimens from Tapanuli Bay, western Sumatra.)

Four skins and skulls and one odd skull, all from Aru Bay.
For measurements see table, page 649.

*Measurements in brackets are those of the type of Mus bullatus.
## Measurements of *Mus mandsus* and *Mus asper* from eastern Sumatra.

<table>
<thead>
<tr>
<th>Name</th>
<th>Locality</th>
<th>Number</th>
<th>Sex and age</th>
<th>Head and body, a</th>
<th>Tail vertebrae, a</th>
<th>Tail length, mm with greatest length of skull, mm</th>
<th>Zygomatic breadth, mm</th>
<th>Maxillary tooth row (above), mm</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Mus mandsus</em></td>
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<td>Male, obst.</td>
<td>151</td>
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<td>126</td>
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<td>119</td>
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<td>101</td>
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<td>135</td>
<td>107</td>
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<td>do</td>
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<td>25</td>
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<td>do</td>
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<td>do</td>
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<td>99</td>
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<td>14.3</td>
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| Measurements by collector in the flesh. |
| Skull only, no skin. |
| Measurements by collector in the flesh. |
| Skull only. |

## Measurements of *Mus lingensis* from eastern Sumatra.

<table>
<thead>
<tr>
<th>Name</th>
<th>Locality</th>
<th>Number</th>
<th>Sex and age</th>
<th>Head and body, a</th>
<th>Tail vertebrae, a</th>
<th>Tail length, mm with greatest length of skull, mm</th>
<th>Zygomatic breadth, mm</th>
<th>Maxillary tooth row (above), mm</th>
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</thead>
<tbody>
<tr>
<td><em>M. lingensis</em></td>
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<td>Male, adult</td>
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<td>177</td>
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<td>Do...</td>
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<td>Male, adult</td>
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<td>196</td>
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<td>11.0</td>
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<td>do</td>
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<td>170</td>
<td>42</td>
<td>42.5</td>
<td>10.6</td>
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<td>do</td>
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<td>Male, adult</td>
<td>188</td>
<td>166</td>
<td>42</td>
<td>42.5</td>
<td>10.6</td>
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<td>Male, adult</td>
<td>203</td>
<td>188</td>
<td>41</td>
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<td>163</td>
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<td>Female, adult</td>
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<td>do</td>
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<td>194</td>
<td>181</td>
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<td>Female, adult</td>
<td>200</td>
<td>170</td>
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<td>18.9</td>
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<tr>
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<td>do</td>
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<td>Female, adult</td>
<td>179</td>
<td>136</td>
<td>39</td>
<td>37.7</td>
<td>17.7</td>
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<tr>
<td>Do...</td>
<td>do</td>
<td>914348</td>
<td>Female, adult</td>
<td>190</td>
<td>171</td>
<td>39</td>
<td>46.2</td>
<td>18.8</td>
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| Collector's measurements. |
| Skull only. |
Measurements of rats from eastern Sumatra.

<table>
<thead>
<tr>
<th>Name</th>
<th>Locality</th>
<th>Number</th>
<th>Sex and age</th>
<th>Head and body, mm.</th>
<th>Hind foot, with claw, mm.</th>
<th>Greatest length of skull, mm.</th>
<th>Zygomatic breadth, mm.</th>
<th>Maxillary tooth proc. breadth, mm.</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>M. fremens</em></td>
<td>Aru Bay</td>
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<td>Female, adult</td>
<td>307</td>
<td>310</td>
<td>46</td>
<td>50</td>
<td>22</td>
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<tr>
<td><em>M. bulatius</em></td>
<td>Pulo Rupat</td>
<td>143447</td>
<td>Male, adult</td>
<td>234</td>
<td>265</td>
<td>48</td>
<td>56.6</td>
<td>25</td>
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<tr>
<td>*M. f. subesp.</td>
<td>Pulo Padang</td>
<td>143448</td>
<td>Female, adult</td>
<td>225</td>
<td>245</td>
<td>46</td>
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<td>*M. f. subesp.</td>
<td></td>
<td>143449</td>
<td>Female, young adult</td>
<td>226</td>
<td>233</td>
<td>42</td>
<td>46</td>
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<tr>
<td>*M. f. subesp.</td>
<td></td>
<td>143450</td>
<td>Male, adult</td>
<td>234</td>
<td>221</td>
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<td>*M. f. subesp.</td>
<td></td>
<td>143451</td>
<td>Adult</td>
<td>312</td>
<td>292</td>
<td>43</td>
<td>50.5</td>
<td>23.2</td>
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<tr>
<td>*M. f. subesp.</td>
<td>Nature Mandai</td>
<td>123129</td>
<td>Male, adult</td>
<td>301</td>
<td>282</td>
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<td>46.7</td>
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<td>*M. f. subesp.</td>
<td>Siak River</td>
<td>14223</td>
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<td>135</td>
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<td>14225</td>
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<td>165</td>
<td>166</td>
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<td>188</td>
<td>171</td>
<td>37</td>
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<td>21.2</td>
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<td>175</td>
<td>163</td>
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*Collector's measurements.*

**ACANTHION LONGICAUDUM** (Marsden.)


Skin and skull of a half grown individual, from Aru Bay.

For measurements see table, page 650.

**THECURUS SUMATRÆ** Lyon.


Twelve specimens from the vicinity of Aru Bay and four from the Siak region.

For list of specimens and measurements see table, page 650.

**TRICHYS MACROTIS** Miller.


Two specimens from Aru Bay and three from the Siak region. They are identical in every way with specimens from Tapanuli Bay, the type-locality. Two of the specimens lack tails entirely.

For measurements see table, page 650.
### Measurements of porcupines from eastern Sumatra

<table>
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<tr>
<th>Name</th>
<th>Locality</th>
<th>Number</th>
<th>Sex and age</th>
<th>Head and body, a</th>
<th>Tail vertebrae, a</th>
<th>Hand foot, a</th>
<th>Greatest length of scalp, b</th>
<th>Z Y &amp; c. etc.</th>
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<td>143431</td>
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<td>515 mm</td>
<td>95 mm</td>
<td>103 mm</td>
<td>55 mm</td>
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<tr>
<td>dom.</td>
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<td></td>
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<tr>
<td>Thecus sumatr...</td>
<td>do...</td>
<td>143432</td>
<td>Male, old...</td>
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<td>100 mm</td>
<td>108 mm</td>
<td>56 mm</td>
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<td></td>
<td></td>
<td>143433</td>
<td>do...</td>
<td>85 mm</td>
<td>90 mm</td>
<td>102.3 mm</td>
<td>56.1 mm</td>
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<td></td>
<td>143434</td>
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<td>540 mm</td>
<td>110 mm</td>
<td>105.8 mm</td>
<td>56.1 mm</td>
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<td></td>
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<td>90 mm</td>
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<td>49.1 mm</td>
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<td>55.8 mm</td>
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<td></td>
<td>49750</td>
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<td>110 mm</td>
<td>97.6 mm</td>
<td>53.2 mm</td>
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<td></td>
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<td>90 mm</td>
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<td>70 mm</td>
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<td>100 mm</td>
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<td>80 mm</td>
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<td></td>
<td></td>
<td>472 mm</td>
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<td>78 mm</td>
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<td>50 mm</td>
<td>98 mm</td>
<td>51.5 mm</td>
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<td></td>
<td>144232</td>
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<td>50 mm</td>
<td>98 mm</td>
<td>51.5 mm</td>
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<tr>
<td></td>
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<td>220 mm</td>
<td>79.7 mm</td>
<td>44.2 mm</td>
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<td>120 mm</td>
<td>100 mm</td>
<td>84 mm</td>
<td>44 mm</td>
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<td></td>
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<td>144218</td>
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<td>385 (b)</td>
<td>63 mm</td>
<td>84.5 mm</td>
<td>44.5 mm</td>
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**HERPESTES BRACHYURUS Gray.**


Thirteen specimens of *Herpestes brachyurus* were collected by Doctor Abbott in eastern Sumatra—seven from the Little Siak River, three from Sungai Mandau, and three from the vicinity of Aru Bay. For measurements see table below.

#### Measurements of Herpestes brachyurus from Sumatra

<table>
<thead>
<tr>
<th>Locality</th>
<th>Catalogue number</th>
<th>Sex and age</th>
<th>Head and body, a</th>
<th>Tail vertebrae, a</th>
<th>Hand foot, a</th>
<th>Weight, a</th>
<th>Basal Leng, b</th>
<th>Zoymetrical width, a</th>
<th>Maxillary tooth, b</th>
</tr>
</thead>
<tbody>
<tr>
<td>Little Siak River</td>
<td>144100</td>
<td>Male, adult</td>
<td>470 mm</td>
<td>210 mm</td>
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<td>90 mm</td>
<td>55 mm</td>
<td>34.5 mm</td>
</tr>
<tr>
<td>Do...</td>
<td>144090</td>
<td>do...</td>
<td>450 mm</td>
<td>210 mm</td>
<td>4.5 mm</td>
<td>4.8 mm</td>
<td>86.5 mm</td>
<td>54 mm</td>
<td>32.8 mm</td>
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<td>144095</td>
<td>do...</td>
<td>480 mm</td>
<td>196 mm</td>
<td>4.8 mm</td>
<td>4.8 mm</td>
<td>83.3 mm</td>
<td>50.8 mm</td>
<td>32.6 mm</td>
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<tr>
<td>Do...</td>
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<td>do...</td>
<td>433 mm</td>
<td>222 mm</td>
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<td>4.8 mm</td>
<td>84.8 mm</td>
<td>53.6 mm</td>
<td>33.7 mm</td>
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<td>do...</td>
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<td>193 mm</td>
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<td>4.8 mm</td>
<td>85.8 mm</td>
<td>53.6 mm</td>
<td>33.7 mm</td>
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<td>Sungai Mandau</td>
<td>144101</td>
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<td>220 mm</td>
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<td>33.7 mm</td>
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<td>144102</td>
<td>Male, adult</td>
<td>445 mm</td>
<td>240 mm</td>
<td>3.1 mm</td>
<td>1.6 mm</td>
<td>83.6 mm</td>
<td>51.5 mm</td>
<td>33.7 mm</td>
</tr>
<tr>
<td>Do...</td>
<td>144103</td>
<td>Female, nearly adult</td>
<td>455 mm</td>
<td>200 mm</td>
<td>3.1 mm</td>
<td>1.6 mm</td>
<td>82.5 mm</td>
<td>48.7 mm</td>
<td>31.4 mm</td>
</tr>
<tr>
<td>Aru Bay</td>
<td>143015</td>
<td>Male, adult</td>
<td>453 mm</td>
<td>200 mm</td>
<td>3.1 mm</td>
<td>1.7 mm</td>
<td>85.7 mm</td>
<td>54.3 mm</td>
<td>33.2 mm</td>
</tr>
<tr>
<td>Do...</td>
<td>143016</td>
<td>Female, nearly adult</td>
<td>440 mm</td>
<td>230 mm</td>
<td>3.1 mm</td>
<td>1.7 mm</td>
<td>83.3 mm</td>
<td>48.2 mm</td>
<td>33.6 mm</td>
</tr>
<tr>
<td>Do...</td>
<td>143017</td>
<td>Female, young</td>
<td>368 mm</td>
<td>172 mm</td>
<td>3.1 mm</td>
<td>1.7 mm</td>
<td>76.4 mm</td>
<td>43.7 mm</td>
<td>31.7 mm</td>
</tr>
</tbody>
</table>

---

*Note: a Denotes Measurements by collector in the flesh. b Type of measurement.*
Cynogale bennettii Gray.


Two specimens of this rare and interesting animal were secured, an adult female from Aru Bay and an immature male from the Siak River. The uterus of the female contained two fetuses. The two specimens, Cat. Nos. 143621 and 144122, U.S.N.M., adult female and young male, measure respectively, head and body, 617, 520 mm.; tail, 180, 185; hind foot, 106, 103; weight, 7 3/4 pounds (3.5 kilos), 4 3/4 pounds (2.2 kilos); greatest length of skull, 123, 110; basal length, 114.8, 102.8; zygomatic width, 60.8, 53.3; interorbital constriction, 10.2, 15: maxillary toothrow (alveoli), 49, 47.

"Female caught by a Malay in a fish trap."—W. L. Abbott.

Arctictis binturong (Raffles).


Six skins and skulls. For localities and measurements see table, page 652.

Three of the specimens are in the black phase and three in the grizzled phase. I can not agree with Schneider \( a \) or Blanford \( b \) that the grizzled or gray phase is entirely characteristic of the young. One specimen of the present series, Cat. No. 143619, U.S.N.M., from Pulo Payong, is an old male, and is much grizzled everywhere except the tail, which is almost entirely black. Its ears are conspicuously tufted. Cat. No. 144118, U.S.N.M., a young male from the Siak River, is as black as any specimen in the collection.

The skulls appear quite as variable as the skins in respect to size and to inflation of the frontal bones. The skull of adult male, Cat. No. 143618, U.S.N.M., from Aru Bay, has a total length of 145 mm., while a much older specimen of the same sex, Cat. No. 143619, from Pulo Payong, has a total length of only 130.5 mm. In Cat. No. 144117, a young adult female from Sungei Mandau, the frontal bones very much inflated in a perfectly symmetrical manner. An examination of their interior structure does not reveal anything that may be considered pathologic similar to the evidently abnormal swellings in the skulls of many specimens of the American genus Mephitis. (See Plate LII, figs. 2 to 4.) Cat. No. 143618, U.S.N.M., from Aru Bay, has a normal or typical skull with respect to the frontal bones. (See Plate LII, fig. 1.) Cat. No. 143619, U.S.N.M., from Pulo Payong, is intermediate between these two extremes as regards frontal inflation.

\( b \) Fauna of British India, Mammals, 1888, p. 118.
External and cranial measurements of Arctictis binturong from Sumatra.

<table>
<thead>
<tr>
<th>Locality</th>
<th>Number</th>
<th>Sex</th>
<th>Age</th>
<th>Head and body</th>
<th>Tail</th>
<th>Hind foot</th>
<th>Weight</th>
<th>Basal length of skull</th>
<th>Basal breadth of postorbital process</th>
<th>Swelling of frontal eminences of postorbital processes</th>
<th>Maxillary tooth row</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aru Bay</td>
<td>143018</td>
<td>Male</td>
<td>Adult</td>
<td>740 mm</td>
<td>690</td>
<td>145 mm</td>
<td>251 mm</td>
<td>11.5 kg</td>
<td>122.5 mm</td>
<td>31.1 mm</td>
<td>42.5 mm</td>
</tr>
<tr>
<td>Sungai Mandau</td>
<td>144117</td>
<td>Female</td>
<td>Young adult</td>
<td>700 mm</td>
<td>640</td>
<td>141 mm</td>
<td>23 mm</td>
<td>10.4 kg</td>
<td>133.5 mm</td>
<td>34.4 mm</td>
<td>46.8 mm</td>
</tr>
<tr>
<td>Sia River</td>
<td>144118</td>
<td>Male</td>
<td>Immature</td>
<td>600 mm</td>
<td>570</td>
<td>125 mm</td>
<td>8 mm</td>
<td>3.6 kg</td>
<td>108.5 mm</td>
<td>28.2 mm</td>
<td>41.4 mm</td>
</tr>
<tr>
<td>Pulo Payong, in Salat Rupat</td>
<td>143309</td>
<td>do</td>
<td>Old</td>
<td>670 mm</td>
<td>650</td>
<td>127 mm</td>
<td>29 mm</td>
<td>9 mm</td>
<td>121.4 mm</td>
<td>29 mm</td>
<td>40 mm</td>
</tr>
<tr>
<td>Pulo Tebing Tinggi</td>
<td>144322</td>
<td>do</td>
<td>Immature</td>
<td>550 mm</td>
<td>530</td>
<td>119 mm</td>
<td>7 mm</td>
<td>3.2 kg</td>
<td>99 mm</td>
<td>24 mm</td>
<td>34 mm</td>
</tr>
<tr>
<td>Do</td>
<td>144323</td>
<td>Female</td>
<td>do</td>
<td>610 mm</td>
<td>550</td>
<td>117 mm</td>
<td>11 mm</td>
<td>5 mm</td>
<td>107 mm</td>
<td>22 mm</td>
<td>35 mm</td>
</tr>
</tbody>
</table>

a Measurements in the flesh by collector.
b Last upper maxillary tooth and permanent canine just coming through their alveoli.
c Last upper maxillary teeth and permanent canine not yet appearing.

ARCTOGALIDIA TINGIA, new species.

Type.—Skin and skull of adult male, Cat. No. 144324, U.S.N.M., collected on Pulo Tebing Tinggi, east coast of Sumatra, January 20, 1907, by Dr. W. L. Abbott. Original number, 4992.

Diagnostic characters.—A medium-sized member of the genus resembling in color Arctogalidia fusca Miller, a from Pulo Kundur, and in shape of skull A. simplex Miller, b from Pulo Linga and Pulo Singkup.

Color.—Type (in an old and worn pelage): The upper parts have the general effect of a dark broccoli brown or a Prout’s brown, the latter most conspicuous posteriorly. Top of head, feet, and terminal two-thirds of tail, dull blackish brown; basal third of tail similar to upper parts. Under parts indefinitely brownish, lightened on the throat and chest by the dirty cream-colored subapical band of the hairs. The median dorsal stripe fairly well indicated, the lateral stripes faintly so. Paratype (Cat. No. 144336, Pulo Merbau): General effect of upper parts, basal third of tail, and outer surface of legs a dark smoke-gray; top of head blackish, slightly grizzled; feet and terminal two-thirds of tail brownish black; under parts generally a very light smoke-gray. Median dorsal stripe fairly well indicated, lateral stripes faintly so.

Skull and teeth.—The skull and teeth of Arctogalidia tingia are not essentially different from those of A. simplex. From its geographical neighbor, A. fusca on Pulo Kundur, it differs in the possession of a narrow postorbital constriction, like that seen in A. simplex. From the still more closely situated A. sumatranus it differs.

in its distinctly smaller size and greater distance between lateral plates of the palate bones.

**Measurements.**—Type, Cat. No. 144324, U.S.N.M., adult male, Pulo Tebing Tinggi, and paratype, Cat. No. 1444336, U.S.N.M., adult female, Pulo Merbau, respectively: Head and body, 465, 450 mm.; tail, 490, 460; hindfoot, 85, 80; weight in pounds, 4, 3½; in kilograms, 1.8, 1.7; greatest length of skull, 98, 96; basal length, 92, 87; basilar length, 91, 86; palatal length, 52, 51; zygomatic breadth, 56, 51.5; interorbital constriction, 19.3, 17; postorbital constriction, 13.3, 15; width of brain case above roots of zygomata, 32, 32.7; maxillary toothrow (alveoli), 35, 33.4.

**Specimens Examined.**—The above two.

**ARCTOGALIDIA SUMATRANA,** new species.


**Type.**—Skin and skull of adult male, Cat. No. 144120, U.S.N.M., collected at Makapan, eastern Sumatra, February 19, 1907, by Dr. W. L. Abbott. Original number 5054.

**Diagnostic Characters.**—A large member of the *Arctogalidia stigmatica* group, closely resembling *A. stigmatica* from Borneo as to color, but cranially more nearly related to *A. major* Miller, from the Malay Peninsula.

**Color.**—Type: General effect of upper parts varies between smoke-gray and mouse-gray, produced by a mixture, almost a grizzling of the dark terminal, the light subterminal, and the dark basal portions of the hairs. Top and sides of head much darker, blackish, slightly grizzled with cream-buff. Ears, feet, and all of tail except terminal fifth, blackish. Legs and terminal fifth of tail similar to upper parts but darker. Median dorsal stripe only faintly indicated and lateral stripes still less evident. The under parts have the general effect of a very light smoke-gray. Paratype (Cat. No. 144121, U.S.N.M.): This differs from the type in being somewhat lighter colored throughout and in having the three dorsal stripes well marked.

**Skull and Teeth.**—The skull and teeth of *Arctogalidia sumatrana* closely resemble those of the Bornean *A. stigmata* and the peninsular *A. major,* but its teeth are smaller. In form the skull exactly resembles that of *A. major.* Both *major* and *sumatrana* differ from *stigmatica* in having distinctly wider postorbital regions and broader rostrums. *A. sumatrana* differs from *A. major* in having the lateral plates of the palate bones very closely approximated, distance between their outer surfaces, 8.5 mm., while in *A. major* it is 12.3 mm. (In *A. stigmatica* this distance is 10 mm.)

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Measurements.—Type. Cat. No. 144120, U.S.N.M., adult male, Makapan, and paratype, Cat. No. 144121, U.S.N.M., adult female, Siak River, respectively. Head and body, 526, 550 mm.; tail, 590, 605; hindfoot, 103, 93; weight in pounds, 8 1/4, 4 1/2; in kilograms, 3.7, 1.9; greatest length of skull, 112.9, 101.2; basal length, 104.7, 95.3; basilar length, 102, 93; palatal length, 61, 55.3; zygomatic breadth, 68, 57.5; interorbital constriction, 21, 17.4; postorbital constriction, 17.3, 19.6; width of braincase above roots of zygomata, 36.2, 34; maxillary toothrow, 39, 35.7; mandibular toothrow, 42.4, 36.8.

Specimens examined.—The above two.

Fig. 4.—Upper toothrows of Paradoxurus hemaphroditus × 1. 1. Cat. No. 143607, adult female, Aru Bay, last upper molar wanting. 2. Cat. No. 143609, adult female, Aru Bay, normal number of teeth present. 3. Cat. No. 144107, adult female, Siak River, a supernumerary tooth present at end of toothrow.

Paradoxurus hemaphroditus (Pallas.)


Of this species Doctor Abbott secured three males and seven females from the vicinity of Aru Bay and one male and two females from the Siak region. The species is evidently as variable on Sumatra as it is on the Malay Peninsula and elsewhere. One peculiar variation is seen in the number of upper cheek teeth. (Fig. 4. Nos. 1, 2, 3.) Six, molars and premolars combined, is the usual number, and it is not
departed from in a large series from the Malay Peninsula. The last small upper molar is lacking in three of the skulls from Sumatra, but two of them are not fully adult and it looks as if a small tooth might have erupted in later life. Cat. No. 144107. U.S.N.M. from the Siak River, is the only one among numerous skulls examined that shows supernumerary teeth. Corresponding variations in the number of teeth do not occur in the lower jaw. The series of skins shows several variations in color or markings. Nearly all of the specimens have three well defined dorsal stripes. Several of them have another pair of stripes lateral to these, indicated by a row of spots placed more or less closely together. Two of the series are practically devoid of any laterally placed spots. The general ground color varies from an effect of light grayish brown like a light broccoli brown to a light tawny olive.

For measurements see table, page 656.

**PARADOXURUS PADANGUS, new species.**

*Type.*—Skin and skull of adult male, Cat. No. 143614, U.S.N.M., collected on Pulo Padang, east coast of Sumatra, April 1, 1906, by Dr. W. L. Abbott. Original number 4791.

*Diagnostic characters.*—A member of the *Paradoxurus hermaproditus* group, most like *P. brunniceps* Miller, from Pulo Kundur, differing from it chiefly in having bullæ of the size found in *P. hermaproditus*, that is, much larger.

*Color.*—General body color very light grayish broccoli brown, with a slight buffy cast on lower back and thighs. On the underparts the grayish broccoli brown is much lighter than it is above. The back is marked by three seal brown or bistre stripes, well defined, though clearly made up of coalescing spots. On either side of these stripes is another ill-defined stripe, made up of spots coalescing only here and there. On the sides of the body and on the thighs are a few irregularly scattered spots. The tail is dull brownish throughout, similar in color to the spots on the back, except at the base, where it is colored and spotted as is the lower back, and at the extreme tip, which is soiled white or light buffy in color. The feet and lower legs are an indefinite light brownish.

*Skull and teeth.*—The skull is larger, heavier, and more angular than *Paradoxurus* skulls of similar age from Sumatra or the Malay Peninsula. The sagittal crest is remarkably well developed, more so than it is in any other *Paradoxurus* skull in the U. S. National Museum. The skull of the type is not that of an aged adult, as judged by the relatively small amount of wear of the molar teeth and

by the distinctness of the occipito-sphenoid suture. The teeth are larger and heavier than they are in any specimens of *Paradoxurus hermaphroditus* from Sumatra or the Malay Peninsula; they are even slightly larger than they are in *P. brunneipes*. The audital bullae are of the size found in *P. hermaphroditus*, and consequently much larger than they are in *P. brunneipes*. See Plate LIII.

**Measurements.**—External measurements of the type taken in the flesh by the collector: Head and body, 556 mm.; tail, 442; hindfoot, 92; weight, 73\(\frac{1}{2}\) pounds (3.5 kilograms). Cranial measurements of the type: Greatest length, 116.7; basal length, 107.8; basilar length, 104; palatal length, 53.3; zygomatic width, 63.8; mastoid breadth, 38.7; interorbital constriction, 11; maxillary toothrow (alveoli), 41.8; mandibular toothrow (alveoli), 48.

**Specimens examined.**—The type and an immature male from Pulo Rupat.

**Remarks.**—The general coloration of *Paradoxurus padangus* is not essentially different from that of *P. brunneipes*. In addition to its being generally lighter in color than the majority of specimens of *P. hermaphroditus*, its light brown feet serve to distinguish it from that species. The skull and teeth of *P. padangus* average a trifle larger and heavier than they do in *P. brunneipes*, but the marked difference in size between the audital bullae is the main distinguishing cranial character. The immature male from Pulo Rupat, Cat. No. 143613, U.S.N.M., may be referred to *P. padangus*. In color it is generally darker and brighter; its teeth are large and massive.

### External and cranial measurements of Paradoxurus.

<table>
<thead>
<tr>
<th>Name</th>
<th>Locality</th>
<th>Number</th>
<th>Sex and age</th>
<th>Head and body, a</th>
<th>Tail, a</th>
<th>Hind foot, with claw, a</th>
<th>Weight, a</th>
<th>Weight</th>
<th>Basal length of skull</th>
<th>Maxillary toothrow (alveoli), a</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>P. hermaphroditus</em></td>
<td>Aru Bay</td>
<td>14304</td>
<td>Male, adult</td>
<td>545 mm.</td>
<td>455 mm.</td>
<td>87 mm.</td>
<td>5 lbs.</td>
<td>2.27</td>
<td>104.2 mm.</td>
<td>39.2 mm.</td>
</tr>
<tr>
<td>Do.</td>
<td>do</td>
<td>14305</td>
<td>Male, nearly adult</td>
<td>535 mm.</td>
<td>465 mm.</td>
<td>87 mm.</td>
<td>4 lbs.</td>
<td>1.93</td>
<td>101.7 mm.</td>
<td>36.7 mm.</td>
</tr>
<tr>
<td>Do.</td>
<td>do</td>
<td>14306</td>
<td>Male, nearly adult</td>
<td>490 mm.</td>
<td>455 mm.</td>
<td>88 mm.</td>
<td>6 lbs.</td>
<td>2.72</td>
<td>103.5 mm.</td>
<td>35.7 mm.</td>
</tr>
<tr>
<td>Do.</td>
<td>Little Sink River</td>
<td>14406</td>
<td>Male, adult</td>
<td>505 mm.</td>
<td>520 mm.</td>
<td>90 mm.</td>
<td>5 lbs.</td>
<td>2.27</td>
<td>102.2 mm.</td>
<td>36.7 mm.</td>
</tr>
<tr>
<td>Do.</td>
<td>Aru Bay</td>
<td>14307</td>
<td>Female, adult</td>
<td>545 mm.</td>
<td>455 mm.</td>
<td>87 mm.</td>
<td>5 lbs.</td>
<td>2.27</td>
<td>96.7 mm.</td>
<td>33.7 mm.</td>
</tr>
<tr>
<td>Do.</td>
<td>do</td>
<td>14308</td>
<td>Female, old</td>
<td>555 mm.</td>
<td>475 mm.</td>
<td>88 mm.</td>
<td>6 lbs.</td>
<td>2.72</td>
<td>102.2 mm.</td>
<td>36.7 mm.</td>
</tr>
<tr>
<td>Do.</td>
<td>do</td>
<td>14309</td>
<td>Female, adult</td>
<td>490 mm.</td>
<td>430 mm.</td>
<td>83 mm.</td>
<td>5 lbs.</td>
<td>2.27</td>
<td>92.5 mm.</td>
<td>36.7 mm.</td>
</tr>
<tr>
<td>P. padangus</td>
<td>Pulo Rupat</td>
<td>143013</td>
<td>Male, immature</td>
<td>403 mm.</td>
<td>430 mm.</td>
<td>90 mm.</td>
<td>4 lbs.</td>
<td>1.81</td>
<td>96.6 mm.</td>
<td>36.6 mm.</td>
</tr>
<tr>
<td>Do.</td>
<td>Pulo Padang</td>
<td>143014</td>
<td>Male, adult</td>
<td>556 mm.</td>
<td>442 mm.</td>
<td>92 mm.</td>
<td>7 lbs.</td>
<td>3.56</td>
<td>107.8 mm.</td>
<td>41.8 mm.</td>
</tr>
</tbody>
</table>

* Measurements in the flesh by collector.
* Last upper molar not in place.
* Last upper molar absent, apparently never had been present.
* Skeleton, no skin.
* Has a supernumerary upper molar.
* Type.
HEMIGALUS HARDWICKII (Gray).


Six adult specimens from the Siak region and an immature male from the Kateman River. For list of specimens and measurements, see table below.

Measurements of Hemigalus hardwickii from eastern Sumatra.

<table>
<thead>
<tr>
<th>Locality</th>
<th>Number</th>
<th>Sex and age</th>
<th>Head and body.a</th>
<th>Tail.a</th>
<th>Hind foot</th>
<th>Weight.b</th>
<th>Weight.c</th>
<th>Basal length of skull.m.m.</th>
<th>Zygomatie width.m.m.</th>
<th>Maxillary tooththrow (alveoli).</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kateman River</td>
<td>12334</td>
<td>Male, young b</td>
<td>500</td>
<td>557</td>
<td>77</td>
<td>1.8</td>
<td>96</td>
<td>44</td>
<td>43</td>
<td></td>
</tr>
<tr>
<td>Little Siak River</td>
<td>144125</td>
<td>Female, adult</td>
<td>577</td>
<td>380</td>
<td>90</td>
<td>1.8</td>
<td>56</td>
<td>43</td>
<td>41</td>
<td></td>
</tr>
<tr>
<td>Do</td>
<td>144126</td>
<td>Male</td>
<td>573</td>
<td>305</td>
<td>92</td>
<td>1.8</td>
<td>56</td>
<td>41</td>
<td>41</td>
<td></td>
</tr>
<tr>
<td>Do</td>
<td>144127</td>
<td>Female, adult</td>
<td>532</td>
<td>335</td>
<td>82</td>
<td>1.8</td>
<td>49</td>
<td>45</td>
<td>40</td>
<td></td>
</tr>
<tr>
<td>Siak River</td>
<td>144129</td>
<td>Male, adult</td>
<td>547</td>
<td>300</td>
<td>87</td>
<td>2.0</td>
<td>97</td>
<td>51</td>
<td>41</td>
<td></td>
</tr>
<tr>
<td>Kompet</td>
<td>144131</td>
<td>Male, young b</td>
<td>615</td>
<td>345</td>
<td>88</td>
<td>2.2</td>
<td>97</td>
<td>42</td>
<td>42</td>
<td></td>
</tr>
</tbody>
</table>

Localities:

Pulo Rupat.............. 143625  Female, immature. 650 335 101 6 2.7 101 51.8 43.2
Siak River near mouth of Gasip. 144115  Female, adult. 660 330 106 10 4.5 118.8
Do.......................... 144116  Male, adult. 600 320 111 7 3.4 108.4 60 46.8
Little Siak River, 6 miles "up. " 144110  do. 680 305 110 8 3.6 111 58.8 45.7
Do.......................... 144111  do. 615 315 108 7 3.2 100 55 44.4
Do.......................... 144112  do. 705 340 109 9 4.1 109 57.8 45
Sungei Mandau............. 144113  Female, adult. 655 315 110 5 2.5 108.7 57.5 45.4

LINSANG LINSANG (Hardwicke).


Two specimens, both adult males, one from the Siak River the other from Sungei Mandau.

Measurements.—Cat. Nos. 144108 and 144109, U.S.N.M. Head and body, 405, 405 mm; tail, 355, 335; hind foot, 69, 75; weight, 1 1/2 pounds (680 grams); —; greatest length of skull, 73.7, 73.3; zygomatic width, 36.5, 34.7; maxillary tooththrow (alveoli), 26.7, 25.5.

VIVERRA TANGALUNGA Gray.


Eight specimens. For list of localities and measurements see table below.

External and cranial measurements of Viverra tangalunaga.
FELIS SUMATRANA Horsfield.

1824. Felis sumatrana Horsfield, Zoological Researches in Java, description, and plate of entire animal. Pages and plates not numbered.

One specimen, an adult male from Aru Bay, Cat. No. 143624, U.S.N.M. It is generally grayer in color than are young examples of tiger cats collected by Doctor Abbott in Borneo and the Malay Peninsula. Horsfield's plate shows an animal distinctly gray, grayer than his plate of Felis jacanica. The bony orbits of this specimen are complete behind, resembling those of Ailurus planiceps.

For external and cranial measurements see table, page 659.

FELIS TINGIA, new species.

Type.—Adult female, skin and skull. Cat. No. 144325, U.S.N.M., collected on Pulo Tebing Tinggi, east coast of Sumatra, by Dr. W. L. Abbott, January 24, 1907. Original number 5022.

Diagnostic characters.—Similar to Felis sumatrana, but smaller and distinctly brighter in color, and with relatively larger teeth.

Color.—Ground color of head, upper surface, and sides of body and tail something between Ridgway's hazel and chestnut. It is spotted and striped in the usual manner of cats of the Felis bengalensis group, these markings being black or brownish black. The ground color of the underparts is whitish, with the usual blackish spots. Under surface of the tail is a mixture of buffy and whitish. The color is everywhere brighter, that is, more reddish than it is in the specimen of Felis sumatrana from Aru Bay.

Skull and teeth.—The skull of Felis tingia is generally similar to that of F. sumatrana, but is smaller throughout. (See table of measurements, page 659.) The interpterygoid space, however, is relatively wider. The orbits lack about 3 mm. of being complete behind. The last mandibular tooth in the skull of F. tingia has the same size as the corresponding tooth in F. sumatrana, but the other mandibular teeth are distinctly smaller, except the incisors, which are about the same size in the two species. With the exception of the canines (which may be due to the difference in sex between the two skulls examined) and the small premolars, the upper jaw teeth of F. tingia are fully as large as they are in the large skull of F. sumatrana. The small premolars were once present in the skull of F. tingia, but were evidently shed at an early age.

Measurements.—See table, page 659.

Specimens examined.—One, the type.

Remarks.—It is not without much hesitation that I have ventured to describe a new species in the already much named Felis bengalensis.
group of cats. The Aru Bay and the Tebing Tinggi specimens are so different, however, that it is impossible to consider them as belonging to the same species. Although the two examples are of opposite sexes, the difference in color and in the relative size of the teeth are too great to be accounted for on that ground entirely.

External and cranial measurements of tiger cats.

<table>
<thead>
<tr>
<th>Dimensions</th>
<th>Felis sumatrana, adult male, Cat. No. 143624, U. S. N. M., Aru Bay, Sumatra</th>
<th>Felis tingia, type, adult female, Cat. No. 144325, U. S. N. M., Pulau Tebing Tinggi</th>
</tr>
</thead>
<tbody>
<tr>
<td>Head and body *</td>
<td>625 mm.</td>
<td>485 mm.</td>
</tr>
<tr>
<td>Tail</td>
<td>145</td>
<td>185</td>
</tr>
<tr>
<td>Hind foot</td>
<td>114</td>
<td>108</td>
</tr>
<tr>
<td>Weight</td>
<td>15 lbs.</td>
<td>4 lbs.</td>
</tr>
<tr>
<td>Greatest length of skull</td>
<td>93.5 mm.</td>
<td>83.2 mm.</td>
</tr>
<tr>
<td>Basal length</td>
<td>78.6</td>
<td>72</td>
</tr>
<tr>
<td>Basilar length</td>
<td>76.8</td>
<td>70</td>
</tr>
<tr>
<td>Palatal length</td>
<td>35.4</td>
<td>32.9</td>
</tr>
<tr>
<td>Zygomatic width</td>
<td>64</td>
<td>56.2</td>
</tr>
<tr>
<td>Postorbital constriction</td>
<td>22.2</td>
<td>26.6</td>
</tr>
<tr>
<td>Width of brain case above zygoma</td>
<td>40.3</td>
<td>37</td>
</tr>
<tr>
<td>Greatest length of bulla</td>
<td>21.8</td>
<td>18.7</td>
</tr>
<tr>
<td>Greatest width of bulla</td>
<td>12.3</td>
<td>12.2</td>
</tr>
<tr>
<td>Alveolar length of last three maxillary teeth</td>
<td>15.8</td>
<td>16</td>
</tr>
<tr>
<td>Alveolar length of last three mandibular teeth</td>
<td>19.6</td>
<td>17.6</td>
</tr>
</tbody>
</table>

*Collector's measurements taken in the flesh.

AILURIN PLANICEPS (Vigors and Horsfield).

1828. Felis planiceps Vigors and Horsfield, Zool. Jour., III, p. 450, pl. xil. (Type-locality, Sumatra.)


Of this interesting and rather rare cat Doctor Abbott secured an adult female (skin and skull, Cat. No. 144119, U.S.N.M.) from along the Little Siak River. The large size of the functional first premolar is well shown by a text figure in Gervais' account (place cited) and even in the plate of the entire animal published by Vigors and Horsfield (place cited). For the present, at least, I consider the great development of this tooth with its two distinct roots as the main character of the genus of which Felis planiceps is the type. The general form of the skull does not differ from Felis proper more markedly than many other so-called members of the composite genus Felis.

Collector's measurements: Head and body, 490 mm.; tail, 169; hind foot, 104. Cranial measurements by writer: Greatest length, 96.5; basal length, 86; palatal length, 35.8; zygomatic width, 56.4; breadth of brain case above roots of zygoma, 37.5.


Two adult males, Cat. No. 144133, U.S.N.M., from Kampong Makapan and Cat. No. 144124, U.S.N.M., from Kompei. The two specimens measure, respectively: Head and body, 445, 448 mm; tail, 370, 340; hind foot, 99, 100; weight, 3 pounds (1.4 kilograms), 4 pounds (1.8 kilograms); basal length of skull, ——, 80 mm.; maxillary tooth-row, 26.7, 28.

HELARCTOS MALAYANUS (Raffles).


Two skins and skulls, an adult male and female, from along the Kateman River, Cat. Nos. 123138 and 123139, U.S.N.M., respectively. Collector's measurements in flesh: Head and body, 1,190, 1,125 mm.; tail, 40, 30; height at shoulder, ——, 490; height at rump, ——, 500; weight, 138 pounds (63 kilograms), 105 pounds (48 kilograms). For cranial measurements see table below.

Cranial measurements of Sumatran sun bears.

<table>
<thead>
<tr>
<th>Dimensions</th>
<th>Cat. No.</th>
<th>Cat. No.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>123138, adult male.</td>
<td>123139, adult female.</td>
</tr>
<tr>
<td>Basal length</td>
<td>mm. 210</td>
<td>mm. 218</td>
</tr>
<tr>
<td>Basilar length</td>
<td>234</td>
<td>217</td>
</tr>
<tr>
<td>Condylar length</td>
<td>117</td>
<td>113</td>
</tr>
<tr>
<td>Palatal length</td>
<td>226</td>
<td>233</td>
</tr>
<tr>
<td>Zygomatic width</td>
<td>286</td>
<td>283</td>
</tr>
<tr>
<td>Mastoid width</td>
<td>158</td>
<td>139</td>
</tr>
<tr>
<td>Width of brain case above zygomata</td>
<td>194</td>
<td>194</td>
</tr>
<tr>
<td>Width at postorbital processes</td>
<td>87.5</td>
<td>81</td>
</tr>
<tr>
<td>Least interorbital width</td>
<td>69</td>
<td>62</td>
</tr>
<tr>
<td>Least width of palate between last upper molars</td>
<td>41</td>
<td>36</td>
</tr>
<tr>
<td>Posterior edge of last upper molar (alveolus) to palate.</td>
<td>36</td>
<td>27</td>
</tr>
<tr>
<td>Posterior edge of last upper molar (alveolus) to tip of pterygoid</td>
<td>66</td>
<td>62</td>
</tr>
<tr>
<td>Alveolar length of last three upper cheek teeth combined.</td>
<td>44</td>
<td>43</td>
</tr>
<tr>
<td>Antero-posterior diameter of canines at alveolus</td>
<td>25</td>
<td>23</td>
</tr>
</tbody>
</table>

TUPAIA FERRUGINEA Raffles.


Ten specimens from the vicinity of Aru Bay. They show no appreciable differences from examples obtained on the west coast of Sumatra or from Singapore (type-locality) and the Malay Peninsula,
but are very different from the Tupaias collected along the Siak River and described below as new. The hairs of the tail are conspicuously annulated, and there is no approach to the "whitish or cream yellow" tail of *Tupaiia ferruginea* demissa Thomas from Tanjong Bringin, only a few miles to the southeast.

For measurements see table, page 662.

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**TUPAIA SIACA**, new species.


*Type.—* Skin and skull of adult female, Cat. No. 144205, U.S.N.M., collected along the Little Siak River, eastern Sumatra, November 4, 1906, by Dr. W. L. Abbott. Original number 4856.

*Diagnostic characters.—* A member of the *Tupaiia ferruginea* group, very similar to *Tupaiia castanea* Miller* from Pulo Bintang, differing mainly in having a duller colored tail, lighter colored head, and an indistinct dark area on the lower back.

*Color.—* The color of *Tupaiia siaca* is so much like that of *T. castanea* that no detailed description is necessary. It is throughout a shade lighter except on the lower back, where there is an indistinct dark area. The color of the back extends forward on the head to well between the ears in *Tupaiia siaca*, and to well between the eyes in *Tupaiia castanea*. The tail of *T. castanea* is brighter in color than that of *T. siaca* and the hairs less annulated with black. The light annulations are orange-rufous in *T. castanea* and tawny-ochraceous in *T. siaca*. Compared with its geographic neighbor *T. ferruginea*, *T. siaca* is everywhere "redder" or more chestnut throughout, most conspicuously seen in the coloration of the tails and of the underparts.

*Skull and teeth.—* I can find no trustworthy characters to distinguish between the skulls of *Tupaiia siaca*, *T. ferruginea*, and *T. castanea*. Those of the latter appear to have slightly broader palates and those of *T. ferruginea* appear a trifle shorter than in the Siak Tree-shrew, but these differences are so slight that they might be caused by individual variations.

*Measurements.—* See table, page 662.

*Specimens examined.—* Three adults and four young, skins and skulls.

*Remarks.—* Although *Tupaiia siaca* is very similar to *T. castanea*, yet from a distributional point of view it seems best to regard it as distinct. No doubt future collections will show that it grades in with *T. ferruginea* on Sumatra.

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*Smithsonian Miscell. Coll., XLIV, November 6, 1903, p. 54.

Proc. N. M. vol. xxxiv—08—43
External and cranial measurements of adult Sumatran tree-shrews.

<table>
<thead>
<tr>
<th>Name</th>
<th>Locality</th>
<th>Number</th>
<th>Sex</th>
<th>Head and body</th>
<th>Tail vertebrae</th>
<th>Hind foot</th>
<th>Greatest extent of skull</th>
<th>Zygomatic breadth</th>
<th>Interorbital condensation</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>T. ferruginea</em></td>
<td>Aru Bay</td>
<td>143328</td>
<td>Male</td>
<td>200</td>
<td>155</td>
<td>47</td>
<td>30.7</td>
<td>26.7</td>
<td>14.4</td>
</tr>
<tr>
<td>Do</td>
<td>do</td>
<td>143329</td>
<td>Male</td>
<td>197</td>
<td>175</td>
<td>50</td>
<td>36.7</td>
<td>29.7</td>
<td>14.7</td>
</tr>
<tr>
<td>Do</td>
<td>do</td>
<td>143330</td>
<td>Male</td>
<td>200</td>
<td>170</td>
<td>50</td>
<td>36.7</td>
<td>26.7</td>
<td>14.5</td>
</tr>
<tr>
<td>Do</td>
<td>do</td>
<td>143332</td>
<td>Male</td>
<td>200</td>
<td>162</td>
<td>47</td>
<td>49.7</td>
<td>35.5</td>
<td>15.7</td>
</tr>
<tr>
<td>Do</td>
<td>do</td>
<td>143333</td>
<td>Male</td>
<td>190</td>
<td>165</td>
<td>45</td>
<td>49.7</td>
<td>35.5</td>
<td>15.7</td>
</tr>
<tr>
<td>Do</td>
<td>do</td>
<td>143334</td>
<td>Male</td>
<td>185</td>
<td>175</td>
<td>45</td>
<td>49.7</td>
<td>35.5</td>
<td>15.7</td>
</tr>
<tr>
<td>Do</td>
<td>do</td>
<td>143333</td>
<td>Male</td>
<td>185</td>
<td>175</td>
<td>45</td>
<td>49.7</td>
<td>35.5</td>
<td>15.7</td>
</tr>
<tr>
<td><em>T. siamensis</em></td>
<td>Little Siak River</td>
<td>144299</td>
<td>Male</td>
<td>198</td>
<td>165</td>
<td>49</td>
<td>51.8</td>
<td>25.1</td>
<td>15.5</td>
</tr>
<tr>
<td>Do</td>
<td>do</td>
<td>144204</td>
<td>Male</td>
<td>210</td>
<td>156</td>
<td>51</td>
<td>51.4</td>
<td>26.4</td>
<td>15.2</td>
</tr>
<tr>
<td>Do</td>
<td>do</td>
<td>144203</td>
<td>Female</td>
<td>205</td>
<td>173</td>
<td>51</td>
<td>52.8</td>
<td>28.6</td>
<td>15.8</td>
</tr>
</tbody>
</table>

a Alcoholic.  b Skull only.  c Type.

**Crocidura lepidura**, new species.

**Type.**—Skin and skull of adult female, Cat. No. 123140, U.S.N.M., from the Kateman River, eastern Sumatra, collected by Dr. W. L. Abbott, September 1, 1903. Original number 2772.

**Diagnostic characters.**—A member of the subgenus *Crocidura* with a long scantly haired tail. Head and body, 105 mm.; tail, 71; hind foot, 18 mm., without claws; 19.5 including claws.

**Color of type.**—The upperparts much like a dark seal-brown of Ridgway; the underparts closely resembling a very dark drab; the bases of the hairs above and below slate-gray. Tail brownish black above and lighter beneath; it is scantly clothed for its entire length with very short hairs, so that the scales are plainly visible. On the basal half of the tail are a few scattered long hairs. Upper surfaces of feet and hands brownish.

**Skull.**—The skull of the type, and only specimen, is much broken, consisting practically of the rostrum and mandible only.

**Measurements.**—Head and body, 105 mm.; tail, 71 (collector’s measurements made in the flesh; the same two measurements on the dried skin are 93 and 68 mm., respectively); hind foot (measured from the dried skin), 18 mm. without the claws and 19.5 including claws. Length of entire upper tooththrow, from front of the most anterior tooth to back of last molar, 11.5; greatest distance between outer edges of upper tooththrow, 7.5; length of entire lower tooththrow, from point of the most anterior tooth to back of last molar, 10.6.

**Specimens examined.**—One, the type.

**Remarks.**—*Crocidura lepidura* differs so conspicuously in size from any of the five previously known Hairy-tailed Shrews from Sumatra that its specific distinctness can not be doubted. A table of measurements of the various species is given below. Except for larger size and darker color *C. lepidura* appears to be closely related to *Crocidura fuliginosa* as described by Blanford.

---

*Blanford, Fauna Brit. India, Mamm., p. 242.*
Measurements of specimens of Crocidura from Sumatra.

<table>
<thead>
<tr>
<th>Name and locality</th>
<th>Head and body</th>
<th>Tail</th>
<th>Hind-foot</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crocidura cephalica, Kateman River, Sumatra</td>
<td>105</td>
<td>71</td>
<td>19</td>
</tr>
<tr>
<td>Crocidura fuliginosa, Assam, Tenasserim</td>
<td>74</td>
<td>63</td>
<td>14</td>
</tr>
<tr>
<td>Crocidura neglecta, &quot;Sumatra&quot;</td>
<td>81</td>
<td>56</td>
<td>12</td>
</tr>
<tr>
<td>Crocidura paradoxa, Mount Singalan, 2,000 m., Sumatra</td>
<td>66</td>
<td>105</td>
<td>16</td>
</tr>
<tr>
<td>Crocidura becardi, Mount Singalan, 2,000 m., Sumatra</td>
<td>66</td>
<td>53</td>
<td>13</td>
</tr>
<tr>
<td>Crocidura brunnea, &quot;Sumatra&quot;</td>
<td>75</td>
<td>47</td>
<td>15</td>
</tr>
<tr>
<td>Crocidura vereri, Singkarah, Sumatra</td>
<td>80</td>
<td>66</td>
<td>12</td>
</tr>
</tbody>
</table>

* Measurements by collector in the flesh.


Four skins and skulls from the mainland of Sumatra and three from Tebing Tinggi. All of them are of the usual color and none of the seven skins show any tendency to albinism.

External and cranial measurements of Gymnura.

<table>
<thead>
<tr>
<th>Localities</th>
<th>Catalogue No.</th>
<th>Sex and age</th>
<th>Head and body</th>
<th>Tail</th>
<th>Hind-foot</th>
<th>Basal length of skull</th>
<th>Zygomatic breadth</th>
<th>Parotid breadth</th>
<th>Peculiar teeth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Little Siak River, 6 miles up</td>
<td>144172</td>
<td>Male, old</td>
<td>372</td>
<td>253</td>
<td>68</td>
<td>77</td>
<td>80</td>
<td>38.5</td>
<td>46</td>
</tr>
<tr>
<td>Do.</td>
<td>144173</td>
<td>... do ...</td>
<td>366</td>
<td>250</td>
<td>69</td>
<td>75</td>
<td>48</td>
<td>38</td>
<td>42.2</td>
</tr>
<tr>
<td>Do.</td>
<td>144171</td>
<td>Female, adult</td>
<td>402</td>
<td>263</td>
<td>68</td>
<td>78</td>
<td>54</td>
<td>41</td>
<td>45.7</td>
</tr>
<tr>
<td>Sungei Mandan</td>
<td>144174</td>
<td>Female, old</td>
<td>371</td>
<td>250</td>
<td>68</td>
<td>76</td>
<td>48</td>
<td>40</td>
<td>44</td>
</tr>
<tr>
<td>Pulo Tebing Tinggi</td>
<td>144339</td>
<td>Female adult</td>
<td>382</td>
<td>280</td>
<td>69</td>
<td>75</td>
<td>49</td>
<td>38.5</td>
<td>45</td>
</tr>
<tr>
<td>Do.</td>
<td>144338</td>
<td>... do ...</td>
<td>370</td>
<td>260</td>
<td>69</td>
<td>75</td>
<td>49</td>
<td>36.5</td>
<td>45</td>
</tr>
<tr>
<td>Do.</td>
<td>144331</td>
<td>... do ...</td>
<td>380</td>
<td>240</td>
<td>68</td>
<td>73.5</td>
<td>47.2</td>
<td>37.5</td>
<td>44.5</td>
</tr>
</tbody>
</table>

* Measurements by collector in the flesh.


Three specimens from Pulo Rupat, two adult females and the young of one of them. They agree in all essential respects with specimens of so-called Galeopterus temminckii from the Malay Peninsula and various Malayan Islands. The adult females, Cat. Nos. 143325 and 143327, U.S.N.M., measure, respectively: Head and body, 480, 410 mm.; tail, 280, 270; hindfoot, 75, 78: greatest length of skull, 73.8, 76.1; zygomatic width, 46.5, 47; interorbital constriction, 19.2, 20.4.
Forty-five specimens of *Cynopterus* from eastern Sumatra may be referred provisionally to *C. brevicaudatus*. They are all medium-sized members of the genus, and have a white border around the ear. They are distinctly smaller than Javan examples of *C. titubaechilus* in the U. S. National Museum. It is not at all probable that they are identical with the continental *C. marginatus*. Two specimens from Aru Bay and two from Salat Rupat are slightly smaller than are specimens from farther down the coast and the adjacent islands. (See table of measurements.) Without a greater number of examples it seems inadvisable to recognize them as a distinct race.

For measurements see table below.

**Measurements of Cynopterus brevicaudatus from eastern Sumatra.**

<table>
<thead>
<tr>
<th>Catalogue No.</th>
<th>Locality</th>
<th>Sex and age</th>
<th>Head and body</th>
<th>Tail</th>
<th>Forearm</th>
<th>Tibia</th>
<th>Foot</th>
<th>Ear from crown</th>
<th>Greatest, length of skull</th>
<th>Maxillary tooth row, including canine</th>
</tr>
</thead>
<tbody>
<tr>
<td>143314</td>
<td>Salat Rupat</td>
<td>Male, adult</td>
<td>90 mm, 55 mm</td>
<td>24 mm</td>
<td>15</td>
<td></td>
<td></td>
<td>7</td>
<td>8.4</td>
<td></td>
</tr>
<tr>
<td>143315</td>
<td>do</td>
<td>do</td>
<td>92 mm, 57 mm</td>
<td>21 mm</td>
<td>14</td>
<td>14</td>
<td></td>
<td>6.6</td>
<td>8.6</td>
<td></td>
</tr>
<tr>
<td>143316</td>
<td>Aru Bay</td>
<td>do</td>
<td>93 mm, 58 mm</td>
<td>22 mm</td>
<td>13</td>
<td>12</td>
<td></td>
<td>6.6</td>
<td>8.6</td>
<td></td>
</tr>
<tr>
<td>143317</td>
<td>do</td>
<td>Female, adult</td>
<td>95 mm, 58 mm</td>
<td>23 mm</td>
<td>15</td>
<td>18</td>
<td></td>
<td>6.6</td>
<td>8.6</td>
<td></td>
</tr>
<tr>
<td>143320</td>
<td>Sungel Mandaun</td>
<td>do</td>
<td>95 mm, 62 mm</td>
<td>25 mm</td>
<td>16</td>
<td>17</td>
<td></td>
<td>7.2</td>
<td>9.3</td>
<td></td>
</tr>
<tr>
<td>143329</td>
<td>do</td>
<td>Male, adult</td>
<td>95 mm, 62 mm</td>
<td>25 mm</td>
<td>16</td>
<td>17</td>
<td></td>
<td>7.2</td>
<td>9.3</td>
<td></td>
</tr>
<tr>
<td>143334</td>
<td>do</td>
<td>Female, adult</td>
<td>100 mm, 65 mm</td>
<td>25 mm</td>
<td>15</td>
<td>13</td>
<td></td>
<td>7.5</td>
<td>9.3</td>
<td></td>
</tr>
<tr>
<td>143335</td>
<td>do</td>
<td>do</td>
<td>105 mm, 67 mm</td>
<td>26 mm</td>
<td>16</td>
<td>15</td>
<td></td>
<td>8.5</td>
<td>9.3</td>
<td></td>
</tr>
<tr>
<td>143336</td>
<td>Little Sink River</td>
<td>do</td>
<td>100 mm, 65 mm</td>
<td>25 mm</td>
<td>15</td>
<td>13</td>
<td></td>
<td>6.6</td>
<td>8.6</td>
<td></td>
</tr>
<tr>
<td>143337</td>
<td>do</td>
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*Skin and skull, measurements of head and body, tail, and ear made by collector.*
NIADIAS MINOR, new species.

Type.—Nearly adult male in alcohol, Cat. No. 144264, U.S.N.M., collected at the confluence of the Gasip and Siak rivers, eastern Sumatra, December 14, 1906, by Dr. W. L. Abbott. Original number 4951.

Diagnostic characters.—Similar in all respects to Niadias princeps (Miller),<sup>a</sup> except in size, being distinctly smaller throughout. Forearm 72 mm., instead of 84.4.

Color.—The color of Niadias minor is apparently not essentially different from that of N. princeps. It is rather lighter throughout and less yellowish on the underparts, perhaps due to its preservation in alcohol and the fact that the hair is rather scant above owing to sloughing. The fingers, the elbows, and the distal two-thirds of the forearms are whitish in color. The antebrachium near its attachment to the body, the wing membrane between the forearm and the fifth finger, and the tips of the wing are also whitish. Some of this may be due to sloughing of the dark epidermis, but as this whitening is symmetrical on both sides of the body it is probably natural.

Skull and teeth.—The skull and teeth of Niadias minor are similar in every way to those of N. princeps, except in size. See measurements below. The Sumatran bat lacks the saggital crest found in the bat from the Nias Islands. It is not fully adult, however.

Measurements.—Type: Head and body, 100 (143);<sup>b</sup> tail, 8 (10); tibia, 26 (30) ; foot, 17 (20.5) ; forearm, 72 (84.4) ; thumb, 27 (35.9) ; second finger, 48 (61.4) ; third finger, 108 (143) ; fourth finger, 89 (112) ; fifth finger, 77 (110) ; skull, greatest length, 32.3 (38.2) ; condylo-basal length, 30 (36.4) ; basilar length, 26.4 (32.6) ; palatal length, 16.6 (20.2) ; zygomatic breadth, 21 (25.4) ; breadth of brain case, 14.4 (15.6) ; interorbital constriction, 6.5 (6.7) ; postorbital constriction, 7.5 (5.8) ; mandible, 25 (28.8) ; depth of mandible at anterior molar, 3.4 (3.6) ; maxillary toothrow, including canine (alveoli), 11.2 (12.2) ; mandibular toothrow, excluding incisors (alveoli), 12.2 (13.8).

Specimens examined.—One the type.

Remarks.—It is unfortunate that the single available specimen of Niadias minor is not fully adult. From an examination of its finger joints its immaturity is scarcely noticeable. The skull, however, shows unmistakable signs of immaturity, but they are hardly sufficient to account for the great difference in size between N. minor and N. princeps. The teeth of N. minor are fully developed. Tooth by tooth they are distinctly smaller than they are in N. princeps, espe-

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<sup>b</sup> The figures in parentheses are those of the type of Niadias princeps.
cially noticeable in the mandibular teeth. The generic characters: "larger cheek-teeth broader and more squarish in outline crown of pm, and m, with distinct terete cusp slightly in front of middle of crushing surface" are shown as distinctly as they are in the type species, but of course on a slightly smaller scale.

**PTEROPUS VAMPRYS** (Linnaeus).


One specimen, skin and skull, Cat. No. 143299, U.S.N.M., from Pulo Payong, Salat Rupat. Collector's measurements: Head and body, 315 mm.; foot, 69; expanse wings, 1,515. Measurements by writer: Forearm, 200; thumb, 77; second digit, 145; third digit, 390; fourth digit, 295; fifth digit, 264; tibia, 103; greatest length of skull, 79; zygomatic breadth, 14; maxillary toothrow, 31.

**EMBALLONURA PENINSULARIS** Miller.


Five specimens from Aru Bay and one from Pulo Padang, all preserved in alcohol.
For measurements see table, page 668.

**MEGADERMA SPASMA TRIFOLIUM** (Geoffroy).


One specimen, a desiccated body, from Pulo Merbau, Cat. No. 144355.
Measurements: Forearm, 56 mm.; tibia, 32; greatest length of skull, 25.5; breadth of braincase, 11; zygomatic breadth, 15.5; maxillary tooth row, 10.3; mandibular tooth row, 11.5.

**RHINOLOPHUS TRIFOLIATUS** Temminck.

1835-1841. *Rhinolophus trifoliatus* TEMMINCK, Monogr. Mamm., II, p. 27, pl. xxxi. (Type-locality, Java.)

One specimen, an adult female, preserved in alcohol, from Pulo Rupat.
For measurements see table, page 668.
MYOTIS CARIMATÆ Miller.


Nine bats of this species were collected at Sungei Makapan.
For measurements see table, page 668.

**MYOTIS MURICOLA** (Gray).


Ten specimens from the Little Siak River.
For measurements of the adults see table, page 668.

**PIPISTRELLUS IMBRICATUS** Horsfield.


One specimen from the Little Siak River may be referred to this species. The close approximation in size between this and the preceding species is remarkable.
For measurements see table, page 668.
### Measurements of Insectivorous Bats from eastern Sumatra.

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<th>Locality</th>
<th>Catalogue number</th>
<th>Sex</th>
<th>Ear from crown</th>
<th>Tail</th>
<th>Forearm</th>
<th>Thumb</th>
<th>Second finger</th>
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PHONISCUS ATROX Miller.


Two specimens, preserved in alcohol, found roosting in the abandoned nest of a Broad Bill, in heavy forest on the banks of the Kateman River.

Measurements\(^a\) of the two specimens, Cat. Nos. 123141, U.S.N.M., adult female, type, and No. 123142, U.S.N.M., adult female: Head and body, 43, 46; tail, 38, 37; tibia, 14, 15; foot, 7.4, 7.6; forearm, 34, 35; thumb, 7, 6.4; second digit, 33, 31; third digit, 73, 71; fourth digit, 53, 52; fifth digit, 49, 49; ear from meatus, 13, 13.6; ear from crown, 10, 9.6; width of ear, 11, 11.6.

NYCTICEBUS MALAIANUS (Anderson).


One specimen from Pulo Tebing Tinggi, an adult female. The skull is considerably smaller than skulls of like age of typical *Nycticebus malaianus*\(^b\). The bone has an unnatural appearance similar to that seen in skulls of animals kept in zoological parks. It may have been a captive specimen or lived amid otherwise unfavorable conditions. The skin is rather light in color. Four upper incisors are present in the skull. The temporal ridges not strongly developed are separated by a space of 10 mm.

Measurements.—Head and body, 285 mm., tail, 10; hind foot, 63; greatest length of skull, 54.5; basal length, 46.4; greatest width, 42.4; width of brain case above zygomatica, 30; maxillary tooth row, 19.4; mandible, condyle to front of symphysis, 36.

MACACA NEMESTRINA (Linnaeus).


Three specimens from Aru Bay and two from the Siak River, all adult males. Four specimens, three adult males and one adult female, were collected by Doctor Abbott in 1903 along the Kateman River.

\(^a\) From the original description, place cited.

Measurements of pip-tailed macaques from Aru Bay and the Sink region.

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<tr>
<th>Cat. No.</th>
<th>Cat. No.</th>
<th>Head and body in mm.</th>
<th>Tail</th>
<th>Hindfoot</th>
<th>Weight in kilograms</th>
<th>Condylar-basilar length of skull, in mm</th>
<th>Basilar length</th>
<th>Basal length</th>
<th>Greatest length</th>
<th>Palatine length</th>
<th>Orbit to gnathion</th>
<th>Front of orbit to posterior point of braincase</th>
<th>Zygomatic breadth</th>
<th>Breadth of braincase above roots of zygomatic</th>
<th>Depth of braincase from posterior extremity of frontal to lower edge of occipital condyle</th>
<th>Maxillary tooththrow (alveoli)</th>
<th>Mandible, back of condyle to front of symphysis</th>
<th>Mandibular tooththrow (alveoli)</th>
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- Head and body in mm. (a)
- Tail (b)
- Hindfoot (c)
- Weight in kilograms (d)
- Condylar-basilar length of skull, in mm (e)
- Basilar length (f)
- Basal length (g)
- Greatest length (h)
- Palatine length (i)
- Orbit to gnathion (j)
- Front of orbit to posterior point of braincase (k)
- Zygomatic breadth (l)
- Breadth of braincase above roots of zygomatic (m)
- Depth of braincase from posterior extremity of frontal to lower edge of occipital condyle (n)
- Maxillary tooththrow (alveoli) (o)
- Mandible, back of condyle to front of symphysis (p)
- Mandibular tooththrow (alveoli) (q)

(a) Skeleton.
(b) Collector's measurements.

MACACA FASCICULARIS (Raffles).


Only two specimens of this usually common monkey were collected by Doctor Abbott in eastern Sumatra: Cat. No. 143583, U.S.N.M., adult male, skull without skin, from Pulo Padang, and Cat. No. 143582, U.S.N.M., adult male, skin and skull, from Pulo Bengkalis. The two specimens measured respectively: Head and body, 412, 445 mm.; tail, 170, 195; hindfoot, 120, 128; weight, 74.5 pounds (3.5 kilos), 93.5 (4.4); basal length of skull, 74.5, 73.4; zygomatic width, 68.5, 75.7; maxillary tooththrow (alveoli), 35.5, 32.8.

PRESBYTIS THOMASI (Collett).


Of this handsome monkey Doctor Abbott secured nine skins with skulls, two skins without skins, and one new-born young preserved in alcohol. Of the females, Cat. No. 143555, U.S.N.M., killed January 21, 1906, contained a small fetus (Cat. No. 143556, U.S.N.M., preserved in alcohol), and Cat. No. 143549, U.S.N.M., killed November
22, 1905, contained a large fetus, at term or nearly so. (Cat. No. 143550, U.S.N.M., preserved in alcohol.)

For measurements see table, page 673.

Iris pale gray brown, ischial calllosities, palms of hands, and soles of feet black, face slatey black.—W. L. A.

**Presbytis percura**, new species.

_Type_.—Skin and skull of adult male, Cat. No. 144088, U.S.N.M., collected at Kompeji, eastern Sumatra, February 26, 1907, by Dr. W. L. Abbott. Original number 5083.

_Diagnostic characters._—A member of the *Presbytis sumatrana-chrysomelas* group, differing from typical *sumatrana* in the absence of the conspicuous light area on the under side of the tail.

_Color._—Upper parts of head and body, outer surfaces of arms and legs, feet and hands, and tail, black or blackish. On the arms and on the upper parts of the thighs there is a very slight amount of grizzling with whitish. The under side of the tail is grizzled with whitish to a greater extent. The bases of the hairs about the forehead are light gray and can be seen without parting them. The belly, inner side of thighs, and a narrow stripe on inner side of leg extending to heel, inner side of arms from axilla to wrist, chin and a narrow line on the chest, whitish. Chest and throat, blackish.

The series of *Presbytis percura* is very uniform in color, the only variation of any note being the amount of blackish suffusion on the chest, which is more extensive in some individuals than it is in others. Some specimens show no grizzling on the arms.

_Skull and teeth._—These show no distinguishing characteristics.

_Measurements._—See table, page 673.

_Specimens examined._—Eleven from the Siak region, eastern Sumatra. For exact localities, sex, and age, see table, page 673.

_Emarks._—*Presbytis percura* is evidently closely related to *P. sumatrana*, but is readily distinguished by the lack of white on the under parts of the tail. No topotypes of *P. sumatrana* are at hand to make an actual comparison, but the original description and figure are so clear as to leave no doubt as to the distinctness of *P. percura* from *P. sumatrana*.

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*a* Schlegel, Mus. Hist. Nat. Parys-Bas, VII, Simiae, 1876, pp. 45 and 46. Locality of specimens in the Leyden Museum is given as Mount Ophir, on the west side of Sumatra, near Padang.

PRESBYTIS CATEMANA, new species.


**Type.**—Skin and skull of adult female, Cat. No. 123149, U.S.N.M., collected along the Kateman River, eastern Sumatra, August 23, 1903, by Dr. W. L. Abbott. Original number 2762.

*Diagnostic characters.*—A member of the *Presbytis sumatrana* chrysomelus group, differing from typical *sumatrana* in being generally brown where *sumatrana* is black, in having conspicuous gray spots on the thighs, and less white on the under side of the tail than has *sumatrana*. It is closely related to *P. cana* Miller, but differs in having less conspicuous thigh patches.

*Color.*—Type: Upper parts of body, base of tail above, and outer side of arms, drab; hands and feet and terminal portion of tail, blackish brown, probably nearest a very dark sepia of Ridgway; hairs of head blackish, but with their bases dirty white; entire under parts, including chin, throat, inner side of arms to wrists, and inner side of legs to ankles, whitish. The whitish color becoming gray extends almost completely around the upper part of the thighs, leaving only a narrow drab band on the outer side, making a mark similar to, but less conspicuous, than that on *Presbytis cana* Miller. Under side of tail for basal third a very light broccoli brown. Series: The four specimens of this species are very uniform in color, showing no essential variations. Cat. No. 113175, U.S.N.M., from the Indragiri River has the thigh patches somewhat darker than they are in the other three skins.

*Skull and teeth.*—These show no distinguishing characteristics.

*Measurements.*—See table, page 673.

*Specimens examined.*—Four, two adult females from the Kateman River and two adult males from the Indragiri River.

*Remarks.*—While *Presbytis catemana* is sufficiently distinct from the related forms on Sumatra its resemblance to *P. cana* Miller, from the off-lying Pulo Kundur, is very close, the only essential difference being that the Kundur animal has the light area of the thigh larger and whiter than has the Sumatran form, differences which were pointed out by Mr. Miller in his description of *P. cana*.a

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*a* Place cited, page 276.
### Measurements of monkeys of the genus Presbytis from eastern Sumatra.

<table>
<thead>
<tr>
<th>Name</th>
<th>Locality</th>
<th>Catalogue number</th>
<th>Sex and age</th>
<th>Head and body</th>
<th>Tail</th>
<th>Hand foot</th>
<th>Weight</th>
<th>Based length of skull</th>
<th>Z &amp; Y max. tooth-row (alveoli)</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Presbytis thomasi</em></td>
<td>Aro Bay</td>
<td>143508</td>
<td>Male, adult</td>
<td>500 675 170 14 6.4 58</td>
<td>69</td>
<td>27.3</td>
<td>16.7 61</td>
<td>69.5 28</td>
<td>72 29.5</td>
</tr>
<tr>
<td>Do.</td>
<td>Do.</td>
<td>143559</td>
<td>Male, adult</td>
<td>500 625 164 13 6.2 63</td>
<td>72</td>
<td>29.5</td>
<td>16.7 61</td>
<td>69.5 28</td>
<td>72 29.5</td>
</tr>
<tr>
<td>Do.</td>
<td>Do.</td>
<td>143560</td>
<td>Female, adult</td>
<td>500 655 169 14 6.4 64</td>
<td>72</td>
<td>27.5</td>
<td>16.7 61</td>
<td>69.5 28</td>
<td>72 29.5</td>
</tr>
<tr>
<td>Do.</td>
<td>Do.</td>
<td>143574</td>
<td>Female, adult</td>
<td>500 655 175 15 6.8 64</td>
<td>72</td>
<td>29.5</td>
<td>16.7 61</td>
<td>69.5 28</td>
<td>72 29.5</td>
</tr>
<tr>
<td>Do.</td>
<td>Do.</td>
<td>143551</td>
<td>Female, adult</td>
<td>500 655 169 14 6.4 64</td>
<td>72</td>
<td>29.5</td>
<td>16.7 61</td>
<td>69.5 28</td>
<td>72 29.5</td>
</tr>
<tr>
<td>Do.</td>
<td>Do.</td>
<td>143555</td>
<td>Female, adult</td>
<td>500 655 175 15 6.8 64</td>
<td>72</td>
<td>29.5</td>
<td>16.7 61</td>
<td>69.5 28</td>
<td>72 29.5</td>
</tr>
<tr>
<td>Do.</td>
<td>Do.</td>
<td>143557</td>
<td>Female, adult</td>
<td>500 655 169 14 6.4 64</td>
<td>72</td>
<td>29.5</td>
<td>16.7 61</td>
<td>69.5 28</td>
<td>72 29.5</td>
</tr>
<tr>
<td>Do.</td>
<td>Do.</td>
<td>143553</td>
<td>Female, young adult</td>
<td>500 655 169 14 6.4 64</td>
<td>72</td>
<td>29.5</td>
<td>16.7 61</td>
<td>69.5 28</td>
<td>72 29.5</td>
</tr>
</tbody>
</table>

*Collector's measurements.*  
*Skull only.*  
*Last molars not through alveoli.*  
*Type.*

### HYLOBATES ALBIMANUS  (Vigors and Horsfield).


The existence in Sumatra of a white-handed gibbon has been very generally overlooked by recent writers in spite of Vigors and Horsfield's description of a specimen evidently from that island, and of Waterhouse's very definite mention of a specimen from Sumatra collected by Raffles, in fact the same individual upon which Vigors and Horsfield based their description of *Hylobates albimana*. Schneider's remark, "new from Sumatra," regarding *Hylobates enteloides*, therefore can not be considered correct. Doctor Abbott secured six adult individuals of the Sumatran Whitehanded Gibbon from the vicinity of Aro Bay. All of them are in the "brown" or "yellow" phase. No specimens are available in the U. S. National

Museum from the west coast of Sumatra to compare with the present series from Aru Bay, but the latter, for the present at least, may be regarded as undoubted specimens of *Hylobates albimanus*.

As this name has for so long been placed as a synonym of *Hylobates lar* Linnaeus and not without cause (for none of the differential characters are brought out in the original description) I give below a description of the Aru Bay specimens and a comparison between them and a series of Whitehanded Gibbons from the Malay Peninsula.

*Color.*—The general color of the body and the limbs is "brown" in varying shades. Top of head, limbs, and underparts of body very similar to Ridgway's Prout's brown, gradually lightening over the shoulders, rump, and sides to a light Isabella color or wood brown. Upper surfaces of hands and feet dirty cream color. A dirty cream color surrounds the face, most conspicuous back of the cheeks and under the chin. There is some variation in the intensity and in the extent of the "brown" colors. One specimen, Cat. No. 143567, U.S.N.M., male, is very light, almost dull cream color throughout, but the top and sides of head are wood brown, and the arms and legs incline toward that color. Cat. No. 143565, U.S.N.M., also a male, has the "browns" more intense than most of series, thus bringing into stronger contrast the light hands and feet as well as the light colored band about the face.

*Skull.*—In the skulls of *Hylobates albimanus* the bony rim of the orbit is much less conspicuous than it is in *H. lar*. The difference is especially noticeable in the supraorbital region; the space between the inner angles of the supraorbital ridges is shallow in the Sumatran Whitehanded Gibbon, but in the Malaccan species a prominent furrow is found between them. (Plate LIV, figs. 1a, 2a.) The nasal bones show almost a straight line from above downwards in *Hylobates albimanus*, while in *H. lar* they are decidedly concave from above downwards, thus making the profiles of the skulls of this species quite different. (Plate LIV, figs. 1b, 2b.) The ascending portion of the mandible is very unequally developed in the two forms, it being much deeper in *H. lar*, about as deep as it is long, in *H. albimanus* being very shallow and longer than it is deep. (Plate LIV, figs. 1b, 2b.) In *Hylobates lar* the mental foramen lies in a broad shallow fossa on the side of the mandible. This fossa is quite lacking in *H. albimanus*, and the foramen opens on a slightly convex surface.

*Teeth.*—The teeth of *Hylobates albimanus* average smaller than they do in *H. lar*. In the peninsular form the three upper molar teeth are of nearly the same size, the third in some individuals being a trifle smaller. In the Sumatran form the third upper molar is reduced in size and distinctly smaller than the subequal first and second molars.

*Measurements.*—See table, page 675.
HYLOBATES AGILIS P. Cuvier.

1821. Hylobates agilis F. Cuvier, Hist. Nat. Mammifères, III, Pts. 32 and 33, September, 1821. (Type-locality, Sumatra.)


Fourteen specimens, skins and skulls, five from Salat Rupat, all black; four from the Little Siak River, one in the brown phase and three in the black; five from the Kateman River, one in the brown phase and four in the black. None of the four females in this series is brown.

For measurements see table below.

**SYMPHALANGUS SYNDACTYLUS** (Raffles).


Five specimens, skins and skulls, from the vicinity of Aru Bay. For measurements see table below.

*External and cranial measurements of Gibbons.*

<table>
<thead>
<tr>
<th>Name</th>
<th>Locality</th>
<th>Catalogue number</th>
<th>Sex</th>
<th>Age</th>
<th>Head and body</th>
<th>Hind foot</th>
<th>Weight</th>
<th>Length</th>
<th>Zygomatic breadth</th>
<th>Frontal bone breadth</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Symphalangus</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>mm.</td>
<td>mm.</td>
<td>lbs.</td>
<td>kilos</td>
<td>mm.</td>
<td>mm.</td>
</tr>
<tr>
<td><strong>Syndactylus</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>From Aru Bay</td>
<td></td>
<td>143377</td>
<td>Male</td>
<td>Old</td>
<td>560</td>
<td>155</td>
<td>24.1</td>
<td>11.0</td>
<td>91</td>
<td>78</td>
</tr>
<tr>
<td>Do. do.</td>
<td>143378</td>
<td>Male</td>
<td>Adult</td>
<td>do.</td>
<td>455</td>
<td>155</td>
<td>21.7</td>
<td>5.9</td>
<td>73.6</td>
<td>37.9</td>
</tr>
<tr>
<td>Do. do.</td>
<td>143379</td>
<td>Female.</td>
<td>Old</td>
<td>do.</td>
<td>455</td>
<td>155</td>
<td>21.7</td>
<td>5.9</td>
<td>73.6</td>
<td>37.9</td>
</tr>
<tr>
<td>Do. do.</td>
<td>143380</td>
<td>Female.</td>
<td>Old</td>
<td>do.</td>
<td>455</td>
<td>155</td>
<td>21.7</td>
<td>5.9</td>
<td>73.6</td>
<td>37.9</td>
</tr>
<tr>
<td>Do. do.</td>
<td>143381</td>
<td>Female.</td>
<td>Old</td>
<td>do.</td>
<td>455</td>
<td>155</td>
<td>21.7</td>
<td>5.9</td>
<td>73.6</td>
<td>37.9</td>
</tr>
<tr>
<td><strong>Hylobates</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>From Salat Rupat River</td>
<td></td>
<td>143372</td>
<td>Male</td>
<td>do.</td>
<td>455</td>
<td>145</td>
<td>13.0</td>
<td>5.9</td>
<td>73.6</td>
<td>37.9</td>
</tr>
<tr>
<td>Do. do.</td>
<td>143373</td>
<td>Male</td>
<td>Old</td>
<td>do.</td>
<td>455</td>
<td>145</td>
<td>13.0</td>
<td>5.9</td>
<td>73.6</td>
<td>37.9</td>
</tr>
<tr>
<td>Do. do.</td>
<td>143374</td>
<td>Male</td>
<td>Adult</td>
<td>do.</td>
<td>455</td>
<td>145</td>
<td>13.0</td>
<td>5.9</td>
<td>73.6</td>
<td>37.9</td>
</tr>
<tr>
<td>Do. do.</td>
<td>143375</td>
<td>Male</td>
<td>Old</td>
<td>do.</td>
<td>455</td>
<td>145</td>
<td>13.0</td>
<td>5.9</td>
<td>73.6</td>
<td>37.9</td>
</tr>
<tr>
<td>Do. do.</td>
<td>143376</td>
<td>Female.</td>
<td>Nearly adult</td>
<td>do.</td>
<td>455</td>
<td>145</td>
<td>13.0</td>
<td>5.9</td>
<td>73.6</td>
<td>37.9</td>
</tr>
<tr>
<td>Do. Little Siak River</td>
<td></td>
<td>144001</td>
<td>Male</td>
<td>Adult</td>
<td>455</td>
<td>145</td>
<td>13.0</td>
<td>5.9</td>
<td>73.6</td>
<td>37.9</td>
</tr>
<tr>
<td>Do. do.</td>
<td>144002</td>
<td>Female.</td>
<td>do.</td>
<td></td>
<td>455</td>
<td>145</td>
<td>13.0</td>
<td>5.9</td>
<td>73.6</td>
<td>37.9</td>
</tr>
<tr>
<td>Do. do.</td>
<td>144003</td>
<td>Female.</td>
<td>do.</td>
<td></td>
<td>455</td>
<td>145</td>
<td>13.0</td>
<td>5.9</td>
<td>73.6</td>
<td>37.9</td>
</tr>
<tr>
<td>Do. do.</td>
<td>144004</td>
<td>Female.</td>
<td>do.</td>
<td></td>
<td>455</td>
<td>145</td>
<td>13.0</td>
<td>5.9</td>
<td>73.6</td>
<td>37.9</td>
</tr>
</tbody>
</table>

*a Collector's measurements,  
b Brown or yellow phase,  
c Black phase.*
PONGO ABELII (Clarke).


Seventeen specimens, skins, skulls, skeletons, and brains, from the vicinity of Aru Bay. Both sexes and many different ages of each are represented in the series. For list of these specimens and measurements see table, page 678. An examination of this material convinces me that not more than one species is represented among them. Taken as a whole the series of skulls shows a considerable amount of variation. Differences in age and in sex among Orang skulls produce great variations in size and in shape. Even when these factors are eliminated and comparisons are made between skulls of like age and sex, considerable individual variation is found to be present, but there are always certain specimens connecting the extremes. In the general region visited by Doctor Abbott, Selenka, however, recognized two subspecies of the Orang and Doctor Abbott in his field catalogue designated some of his specimens as "large species" and others as "small species." So far as the material I have examined shows these differences may be accounted for by differences in age or in the development of cheek callosities. From an examination of the prepared skins it is no easy matter to determine to the degree of development of the cheek callosities. The appearance of a freshly killed old male is shown in Plates LV and LVI.

The color of the skins of this series varies from a dark chocolate to tawny or even ochraceous. The predominating color ranges from chestnut to cinnamon-rufous. None of the specimens are uniform in color throughout, the sides, chest, and limbs being clothed with darker hair than the top of the head, middle of back, or abdomen. The beard is always light in color, about ochraceous. The skin of the face is blackish as well as that of the hands and feet. The face has a thin sprinkling of short ochraceous hairs.

In adult males the beard is about 100 mm. in length at the point, in females and in immature males it is much shorter, 50 mm. or less. On the sides of the back and around the thighs the hair is very long, reaching a length of 375 mm. in the full grown males. It is usually much less in the females and in immature individuals. On the breast the hair may be thick or scant, reaching a maximum length of about 180 mm. On the top of the head and middle of back the hair is relatively short. The long, coarse, shaggy nature of the hair is well seen in Plate L.V.

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The Orang-utan do not occur so far south as the Siak River, at least near the coast. No one seems to know the southern limit of its range.

The natives mentioned a third sort of Mawas [that is in addition to the "large" and the "small" species] which I did not meet with. They called it *Mawas orang* (literally *man orang*) and said it was nearly naked. It was said to occur back in the mountainous districts and also up the Besitan, where I spent eight days without seeing anything but the two ordinary species.—W. L. Abbott.
Measurements of Orangs from Aru Bay, Sumatra.

<table>
<thead>
<tr>
<th>Sex and age</th>
<th>Catalogue number</th>
<th>Crown of head to sole of foot</th>
<th>Head and body</th>
<th>Hind foot</th>
<th>Weight</th>
<th>Basalar length of skull</th>
<th>Zygomatic width</th>
<th>Mastoid width</th>
<th>Upper tooth row including canine (alveol)</th>
<th>Length of humerus</th>
<th>Length of radius</th>
<th>Length of femur</th>
<th>Length of tibia</th>
<th>With nails on great toes</th>
<th>Without nails on great toes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male, adult</td>
<td>14359</td>
<td>1,360</td>
<td>9.80</td>
<td>210</td>
<td>100</td>
<td>36.18</td>
<td>103</td>
<td>171</td>
<td>144</td>
<td>70.5</td>
<td>374</td>
<td>370</td>
<td>287</td>
<td>245</td>
<td>+</td>
</tr>
<tr>
<td>Male, nearly adult</td>
<td>14360</td>
<td>1,340</td>
<td>9.65</td>
<td>200</td>
<td>85</td>
<td>17.08</td>
<td>102</td>
<td>165</td>
<td>149</td>
<td>69</td>
<td>364</td>
<td>361</td>
<td>294</td>
<td>265</td>
<td>+</td>
</tr>
<tr>
<td>Male, young</td>
<td>1,045</td>
<td>500</td>
<td>225</td>
<td>120</td>
<td>80.5</td>
<td>5.04</td>
<td>120</td>
<td>124</td>
<td>126</td>
<td>71</td>
<td>373</td>
<td>361</td>
<td>304</td>
<td>247</td>
<td>+</td>
</tr>
<tr>
<td>Male, very young</td>
<td>850</td>
<td>505</td>
<td>217</td>
<td>105</td>
<td>80</td>
<td>12.70</td>
<td>106</td>
<td>185</td>
<td>128</td>
<td>68.5</td>
<td>359</td>
<td>343</td>
<td>329</td>
<td>283</td>
<td>+</td>
</tr>
<tr>
<td>Female, old</td>
<td>1,180</td>
<td>810</td>
<td>298</td>
<td>74</td>
<td>113</td>
<td>9.13</td>
<td>113</td>
<td>145</td>
<td>114</td>
<td>53.3</td>
<td>332</td>
<td>329</td>
<td>292</td>
<td>219</td>
<td>+</td>
</tr>
<tr>
<td>Female, adult</td>
<td>1,135</td>
<td>850</td>
<td>285</td>
<td>98</td>
<td>115</td>
<td>19.33</td>
<td>114</td>
<td>135</td>
<td>118</td>
<td>64.8</td>
<td>326</td>
<td>323</td>
<td>247</td>
<td>219</td>
<td>+</td>
</tr>
<tr>
<td>Female, nearly adult</td>
<td>1,130</td>
<td>775</td>
<td>268</td>
<td>70</td>
<td>35.53</td>
<td>134</td>
<td>129.5</td>
<td>125</td>
<td>120</td>
<td>57.5</td>
<td>331</td>
<td>332</td>
<td>292</td>
<td>206</td>
<td>+</td>
</tr>
<tr>
<td>Female, young</td>
<td>1,139</td>
<td>715</td>
<td>272</td>
<td>80</td>
<td>36.26</td>
<td>130</td>
<td>138</td>
<td>134</td>
<td>126</td>
<td>66.5</td>
<td>338</td>
<td>326</td>
<td>253</td>
<td>209</td>
<td>+</td>
</tr>
<tr>
<td>Female, very young</td>
<td>1,165</td>
<td>715</td>
<td>268</td>
<td>60</td>
<td>27.21</td>
<td>101</td>
<td>122</td>
<td>130</td>
<td>115</td>
<td>49</td>
<td>324</td>
<td>325</td>
<td>247</td>
<td>221</td>
<td>+</td>
</tr>
</tbody>
</table>

a: Collector's measurements.
b: Measured by Dr. Alec Hrdlička, assistant curator of physical anthropology, U. S. National Museum. Doctor Hrdlička is preparing a detailed account of these orang skeletons.

c: Right foot only.
d: Left foot only.
1: Not so old as Cat. No. 14359, occipito-sphenoid suture not completely closed.
2: Permanent dentition all in place, but occipito-sphenoid suture open.
3: Last upper molars through alveol, but not level with crowns of other teeth.
4: Last upper molars not through alveol: upper canines about half erupted.
5: Milk incisors, canines, and molars still in place; first permanent molar above in place.
6: Teeth practically in same condition as in Cat. No. 14358, but skull shows a younger animal.
7: Uterus contained a well-grown fetus.
8: Not so old as Cat. No. 14359, occipito-sphenoid suture not closed.
9: Last upper molar not quite level with rest of teeth.
10: Milk canines still in place, last tooth up, above, is second molar, last upper molars not nearly through alveol.
EXPLANATION OF PLATES.

PLATE LII.

Skulls of Arctictis binturong. About \( \frac{1}{2} \) nat. size.

Fig. 1. Dorsal view of skull of Cat. No. 143618, U.S.N.M., young male from the Siak River.

2. Dorsal view of skull of Cat. No. 144117, U.S.N.M., nearly adult female, from Sungai Maudau, showing abnormal inflation of frontal bones.

3. Dorsal view of the same skull with its top removed in order to show sinuses.

4. Ventral view of the removed top in order to show sinuses.

PLATE LIII.

Skull of the type-specimen of Paradoxurus padangus, Cat. No. 143614, U.S.N.M., adult male from Pulo Padang. About \( \frac{2}{3} \) nat. size.

Fig. 1. Ventral view of skull.

2. Dorsal view of skull.

3. Lateral view of skull, left side.

4. Lateral view of mandible, left half.

5. Dorsal view of mandible.

PLATE LIV.

Facial and lateral views of skulls of Hylobates albimanus and bar. About \( \frac{3}{4} \) nat. size.

Fig. 1. *Hylobates albimanus*, Cat. No. 143564, U.S.N.M., adult male, Aru Bay.

Fig. 2. *Hylobates bar*, Cat. No. 111970, U.S.N.M., Tanjong Badak, Tenasserim, adult male.

PLATE LV.

Large male Orang, Aru Bay, Sumatra, photographed by Dr. W. L. Abbott shortly after killing.

PLATE LVI.

Profile and portrait views of a large male Orang, Aru Bay, Sumatra, photographed by Dr. W. L. Abbott shortly after killing.
Skulls of Arctictis binturong.

For explanation of plate see page 679.
Skulls of Hylobates albimanus and lar.

For explanation of plate see page 679.
Large Male Orang, Aru Bay, Sumatra.

For explanation of plate see page 679.
DESCRIPTIONS OF TWO NEW SPECIES OF PLEISTOCENE RUMINANTS OF THE GENERA OVIBOS AND BOÖTHERIUM, WITH NOTES ON THE LATTER GENUS.

By James Williams Gidley,
Of the United States National Museum.

Two interesting specimens, each representing an apparently undescribed species of the Bovidae, have recently been placed in my hands for determination. They are from widely different localities, but since they are from practically equivalent horizons and the genera to which they are referable have been closely associated by former writers, they may be conveniently described together. The first to be considered is a nearly complete skull of *Ovibos*, closely related apparently to the living species, *O. moschatus*. It was discovered by Mr. C. W. Gilmore, of the U. S. National Museum, in the Pleistocene silts along the Palisades of the Yukon, Alaska, while exploring that region for fossils during the summer of 1907.

The second specimen, which I provisionally refer to the genus *Boötherium* Leidy, is from a post-glacial swamp deposit near Grand Rapids, Michigan. Unfortunately it consists of only the upper portion of the cranium, with complete horn-cores attached, but this fragment seems sufficiently characteristic to warrant description. The specimen is, the property of the Kent Scientific Museum of Grand Rapids, Michigan, and was discovered by Mr. E. R. Callenbeck in association with the bones of a Mastodon which were being exhumed by a Kent Museum field party, under the supervision of Mr. Herbert E. Sargent, director of that institution.

The descriptions follow in the order in which the specimens are mentioned above.

**OVIBOS YUKONENSIS**, new species.

Plates LVII–LVIII.

*Type.*—The greater portion of a skull, but lacking the nasals, the premaxillaries and most of the teeth. (Cat. No. 5728, U.S.N.M.) The skull is that of an old male with $m^2$ and $m^3$, the only teeth preserved, well worn.
Type-locality.—The Palisades, Yukon River, about 35 miles below Tanana, Alaska.

Horizon.—Pleistocene.

Species characters.—Size of teeth somewhat larger, with the internal median valley in the upper molars less infolded at base than in the living species O. moschatus; skull somewhat larger throughout; ascending process of the premaxillaries nearly or quite reaching the nasals; basisphenoid slightly overlapped by the vomer; otic bulla greatly reduced, being intermediate in size between that of O. moschatus and Symbos tyrrelli (Osgood) Osgood. The horn-cores droop in about the same degree as in the living species. (See fig. below.)

The species further differs from O. moschatus as follows: (1) Posterior narial opening much larger; (2) spheno-palatine foramen about one-third greater in diameter; (3) basioccipital proportionally wider, with a decidedly deeper and broader median fossa; (4) horn-cores more depressed at base; (5) frontals more arched in the median line, owing to their greater depression on either side above the orbits; (6) the much greater anteroposterior width of the horn-cores; and (7) the presence of a regularly striated rugosity on the frontals, fringing the anterior borders of the horn-core bases. This last character may be an age condition only, but it indicates a forward expansion of the horn-covering and suggests a tendency to extend the horn-core base forward, as in Symbos.

While there is no doubt regarding the generic reference of this species, in certain characters in which it differs from O. moschatus it appears to approach Symbos tyrrelli. These deviations are most
marked in the following characters: The modifications at the base of the horn-cores, the small size of the otic bulla, the enlargement of the posterior narial opening and the spheno-palatine foramen, and the broad proportions of the basioccipital.

Table of Measurements.

<table>
<thead>
<tr>
<th></th>
<th>O. yakonensis</th>
<th>O. moschatus</th>
<th>S. tyrrelli</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length of molar-premolar series</td>
<td>145 mm.</td>
<td>135 mm.</td>
<td>168 mm.</td>
</tr>
<tr>
<td>Anteroposterior diameter of m'</td>
<td>30 mm.</td>
<td>31.5 mm.</td>
<td>35 mm.</td>
</tr>
<tr>
<td>Anteroposterior diameter of m''</td>
<td>36 mm.</td>
<td>35 mm.</td>
<td>49 mm.</td>
</tr>
<tr>
<td>Transverse diameter of m'</td>
<td>23 mm.</td>
<td>19 mm.</td>
<td>32 mm.</td>
</tr>
<tr>
<td>Transverse diameter of m''</td>
<td>22 mm.</td>
<td>18 mm.</td>
<td>33 mm.</td>
</tr>
<tr>
<td>Anteroposterior diameter of horn-core at base</td>
<td>186 mm.</td>
<td>138 mm.</td>
<td>35 mm.</td>
</tr>
<tr>
<td>Vertical diameter of horn-core at base</td>
<td>60 mm.</td>
<td>68 mm.</td>
<td>72 mm.</td>
</tr>
<tr>
<td>Length of horn-core, outside (approximated)</td>
<td>230 mm.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anteroposterior diameter of orbit</td>
<td>68 mm.</td>
<td>63 mm.</td>
<td>73 mm.</td>
</tr>
<tr>
<td>Width of face across orbits</td>
<td>250 mm.</td>
<td>232 mm.</td>
<td>191 mm.</td>
</tr>
<tr>
<td>Width of skull across mastoids</td>
<td>190 mm.</td>
<td>180 mm.</td>
<td>192 mm.</td>
</tr>
<tr>
<td>Depth of occiput</td>
<td>119 mm.</td>
<td>123 mm.</td>
<td>117 mm.</td>
</tr>
<tr>
<td>Greatest width of basioccipital</td>
<td>70 mm.</td>
<td>64 mm.</td>
<td>72 mm.</td>
</tr>
<tr>
<td>Inferior lip of foramen magnum to anterior border of palatine notch</td>
<td>194 mm.</td>
<td>177 mm.</td>
<td>184 mm.</td>
</tr>
<tr>
<td>Inferior lip of foramen magnum to alveolus of m''</td>
<td>214 mm.</td>
<td>217 mm.</td>
<td>218 mm.</td>
</tr>
<tr>
<td>Width of palate at m''</td>
<td>80 mm.</td>
<td>79 mm.</td>
<td>81 mm.</td>
</tr>
</tbody>
</table>

*These measurements are taken from a table published by Osgood, Smithsonian Miscel- Coll., XLVIII, Pt. 2, July 1, 1905, p. 184.

BOOTHERIUM SARGENTI, new species.

Plate LIX.

Type.—The upper portion of a skull, supporting the complete horn-cores, now deposited in the Kent Scientific Museum of Grand Rapids, Michigan.

Type-locality.—Moorland Swamp, on the Charles McKay farm, near Grand Rapids, Michigan.

Horizon.—Pleistocene, post-glacial.

Species-characters.—Size about two-thirds that of Orobus moschatus, somewhat larger than B. bombifrons; horn-cores comparatively large, well rounded, long and slender; horn-cores at base horizontally directed at right angles to the skull as in Plate LIX, fig. a, but curving downward and forward in graceful semi-spirals, ending in slender anteriorly directed tips (see Plate LIX, fig. b); orbits comparatively large, depressed below the arching frontals, with thin gently shelving borders, not tubular as in Orobus. In the general form and contour of the skull and horn-cores this species, together with B. bombifrons, is strikingly different from other known species of the Orobovesna.

The type of B. sargenti, compared with that of B. bombifrons, shows the following resemblances: (1) The fragment preserved indicates a skull but little larger in size and of the same general proportions; (2) the position, form, and contour of the orbits as well as (3) the general appearance of the facial and posterior portions of the cranium (see Plate LIX, fig. e) are essentially alike. The horn-cores are also similarly placed, but the differences in their relative size, form and proportions are very marked. In B. sargenti the base of the
horn-core is relatively heavier, is angular in front, and its superior border approaches much nearer the median frontal suture than in *B. bombiferons*. In addition, characteristic rugosites and markings on the frontals indicate that the horn-covering extended much beyond the horn-core base, nearly or quite meeting the one from the opposite side in the median line. In *B. bombiferons* the inter-horn space was apparently covered by a wide skin-band as in *Bos*. The horn characters seem sufficiently different to separate these species generically, but the other cranial characters denote generic relationship. Moreover it is possible that the extreme difference in type of horn-core may be due in part at least to difference in sex.

NOTES ON THE RELATIONSHIPS OF THE GENUS *BOÖTHERIUM* LEIDY.

The genus *Boötherium* has for some time been considered as closely allied to *Ovibos*, and by some authorities as synonymous with that genus. But in 1905 Mr. W. H. Osgood a re-defined *Boötherium*, selecting *B. bombiferons* as the type, and transferred the remaining species, *B. caviferons*, to a new genus, *Scaphoceros*, b of which *S. tyrrellii* is the type. In the publication first cited Mr. Osgood has shown with good reason the untenability of the opinion held by Rümmeleyer and others regarding the types of *B. bombiferons* and *Ovibos [Symbos] caviferons*, which they considered the female and male, respectively, of the same, or closely related, species. He has also pointed out that the type of *B. bombiferons* does not represent an immature male, but a fully adult individual. By an analogy similar to that employed by Osgood it is equally clear that the type of *B. sargenti* can not be referred on these grounds to any species of *Ovibos* or *Symbos*. The validity of the genus *Boötherium* therefore seems to be well established.

The separation of the two species originally referred to this genus permits the study of its relationships in a new light. As now known the genus presents quite as many bovine as ovibovine characters, and if referable to the Ovibovinae it is far removed from the other known genera of the group. From present evidence it seems probable that the finding of more complete material will show that, whether generically distinct from each other or not, the species *B. bombiferons* and *B. sargenti* represent a distinct group, or subfamily, of the Bovidae. To this group may belong also the genus *Lissops* Gidley,c Since, however, so little is known of the species of the group as a whole, owing to the lack of good material, it would be unwarrantable to separate them at present from the Ovibovinae.

c This genus at present is represented by only the type-species which was founded on the posterior portion of a skull.
Superior View of the Cranium of Ovibos yukonensis.

For explanation of plate see page 681.
Palatal View of the Cranium of Ovibos yukonensis.

For explanation of plate see page 681.
Horn Cores of Bootherium Sargenti.

For explanation of plate see page 683.
ON METEORIC CHROMITES.

By Wirt Tassin,
Assistant Curator, Division of Mineralogy, U. S. National Museum.

The analyses of many meteorites show small percentages of chromium, which is present, in part at least, combined as chromite. So common is the reported occurrence of this mineral in meteorites that it may be regarded as a constant constituent. The amount present is small; the stones and stony irons rarely contain as much as 3 per cent of chromite and usually less than 1 per cent, while the irons generally carry less than a hundredth of a per cent.

The small amount of chromite together with the small quantity of the meteorite usually available for chemical and mineralogical study has made it difficult in the majority of cases to do more than report the occurrence of the mineral, a condition that apparently makes it worth while to bring together the results of the several analyses of meteoric chromites obtained from certain of the meteorites belonging to the Museum collections. As a matter of convenience each chromite will be described under the name of the meteorite from which it was derived.

THE MOUNT VERNON METEORITE.

Chromite occurs quite abundantly in this pallasite in two forms—as minute rounded grains frequently occluded in the olivine, and as crystals which are to a large extent probably contained in the eutectic of the metallic portion. The crystals are occasionally of a considerable size, one of them being a millimeter in diameter. They are more or less perfect octahedrons, rarely modified by other forms, and then only by \( O \) (110) as noted in one instance. Color brilliant black with a metallic luster; nonmagnetic, specific gravity 4.49 at 18° C., and of the following percentage composition:

\[
\begin{align*}
\text{Cr}_2\text{O}_3 & \quad 65.01 \\
\text{Al}_2\text{O}_3 & \quad 9.95 \\
\text{FeO} & \quad 18.97 \\
\text{MgO} & \quad 5.06
\end{align*}
\]
The granular form, like the crystals, is nonmagnetic and under
the microscope is seen to be impregnated to a certain extent with
olivine. Color brownish-black with a resinous luster.

Composition:

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Cr₂O₃</td>
<td>64.91</td>
<td></td>
</tr>
<tr>
<td>Al₂O₃</td>
<td>9.85</td>
<td></td>
</tr>
<tr>
<td>FeO</td>
<td>17.97</td>
<td></td>
</tr>
<tr>
<td>MgO</td>
<td>4.96</td>
<td></td>
</tr>
<tr>
<td>SiO₂</td>
<td>1.38</td>
<td></td>
</tr>
</tbody>
</table>

Comparing these two analyses it is interesting to note that notwith-
standing the presence in the granular form of a silicate rich in mag-
nesia and ferrous iron, the content for both of these oxides is less
than that of the crystals which are free from such a silicate.

THE ADMIRE METEORITE.

The first lot of chromite separated from this pallasite was as small
nonmagnetic, jet-black grains having a brilliant luster. No crystals
were noticed, although under the microscope occasional grains would
show planes which may have been either crystal or anhedral faces.
The chromite as analyzed gave:

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Cr₂O₃</td>
<td>65.49</td>
<td></td>
</tr>
<tr>
<td>FeO</td>
<td>23.00</td>
<td></td>
</tr>
<tr>
<td>MgO</td>
<td>0.40</td>
<td></td>
</tr>
<tr>
<td>SiO₂</td>
<td>0.50</td>
<td></td>
</tr>
</tbody>
</table>

A characteristic of the Admire is the interesting association of the
metallic alloys which may briefly be described as consisting of a broad
white outer band of nickeliferous iron surrounding a dark gray area
made up of a more or less spongy iron containing iron sulphide, phos-
phide, chloride, etc. Acid treatment of these metallic portions, which
are practically free from silicates, yielded very minute dust-like par-
ticles in relative abundance. These particles were magnetic; had a
bluish-brown color with a dull luster. An analysis gave:

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Cr₂O₃</td>
<td>56.49</td>
<td></td>
</tr>
<tr>
<td>FeO</td>
<td>10.20</td>
<td></td>
</tr>
<tr>
<td>MgO</td>
<td>29.92</td>
<td></td>
</tr>
<tr>
<td>Al₂O₃</td>
<td>Trace.</td>
<td></td>
</tr>
<tr>
<td>MgO</td>
<td>Trace.</td>
<td></td>
</tr>
</tbody>
</table>

While this analysis in itself is poor, a comparison with the one pre-
ceding makes it evident that there are two different members of the
chromite group present in this meteorite and which may have had
different periods and conditions of formation.

THE MARJALAHTI METEORITE.

Through the kindness of the late H. A. Ward several fragments of
this pallasite were secured for use in making separations. In these
fragments chromite occurred sparingly in crystals of quite a large
size most of them being a millimeter or more in diameter. No rounded grains or minute particles were noted. The crystals were commonly in distorted and occasionally twinned octahedrons. These twins were usually simple, once only were striations noted which would lead to the belief that polysynthetic twinning had occurred. Color, blue-black; luster, brilliant; nonmagnetic. Composition:

\[
\begin{align*}
\text{Cr}_2\text{O}_3 & \quad 61.39 \\
\text{Al}_2\text{O}_3 & \quad 1.96 \\
\text{FeO} & \quad 30.46 \\
\text{MgO} & \quad 6.70
\end{align*}
\]

**THE HENDERSONVILLE METEORITE.**

Chromite occurs very sparingly in portions of the stone as disseminated dust-like, nonmagnetic particles. The mineral showed no evidences of crystallization and was blackish-brown in color with a dull resinous luster. Composition:

\[
\begin{align*}
\text{Cr}_2\text{O}_3 & \quad 56.73 \\
\text{Al}_2\text{O}_3 & \quad 2.98 \\
\text{FeO} & \quad 29.64 \\
\text{MgO} & \quad 2.42
\end{align*}
\]

**THE PERSIMMON CREEK METEORITE.**

Chromite occurs sparingly associated with carbon and olivine in certain troilite areas. No crystals were noted, the mineral occurring in dull black nonmagnetic grains. Not enough material was secured for quantitative work and its identity was established by the blow pipe.

**CASAS GRANDES METEORITE.**

Chromite occurs very sparingly in this iron as minute rounded grains, which under the microscope were decidedly greenish blue in color. The material was strongly magnetic. Because of the very small amount separated it was not possible to do more than prove the presence of chromium by the bead test.

**CANYON DIABLO METEORITE.**

Out of the numerous fragments examined but two contained minerals of the chromite group. In one case it was associated with troilite and silicon compounds in areas rich in carbon. Here the chromite occurred as rounded grains having a blue-black color and a dull luster. It was strongly magnetic and had the following composition:

\[
\begin{align*}
\text{Cr}_2\text{O}_3 & \quad 5.20 \\
\text{Fe}_2\text{O}_3 & \quad 65.25 \\
\text{FeO} & \quad 30.65
\end{align*}
\]
Nothing can be said about the associations of the other occurrence of chromite as only one small octahedral crystal was found among the residues derived from the treatment of many fragments. Unlike the mineral described above, it was nonmagnetic, with a jet black color and a brilliant luster. Its identity was established with the blowpipe.

Another occurrence, probably belonging to the Canyon Diablo, but whose meteoric origin has not as yet been established beyond dispute, though all the evidence at hand points to such an origin, is the chromite found in the borings of hole 16\(^a\) made at the Meteor Crater of Canyon Diablo. This mineral was jet black in color; had a brilliant luster; was nonmagnetic; and occurred in small octahedral crystals and rounded grains. An analysis, after deducting 1.20 per cent of silica and recalculating, gave:

\[
\begin{array}{ccc}
\text{Cr}_2\text{O}_3 & 63.40 \\
\text{Al}_2\text{O}_3 & 5.30 \\
\text{FeO} & 26.30 \\
\text{MgO} & 5.00 \\
\end{array}
\]

\*

THE ALLEGAN METEORITE.

Doctor Stokes\(^b\) found in his chemical work on this stone a small amount of chromite which contained titanium. The results of his analysis are:

\[
\begin{array}{ccc}
\text{Cr}_2\text{O}_3 & 50.31 \\
\text{Al}_2\text{O}_3 & 9.67 \\
\text{FeO} & 28.71 \\
\text{MgO} & 2.76 \\
\text{TiO}_2 & 1.20 \\
\end{array}
\]

Separations made on a fairly large amount of the débris of this stone afforded me quite a quantity of chromite which was nonmagnetic and had a blackish-brown color. The results of my analysis were:

\[
\begin{array}{ccc}
\text{Cr}_2\text{O}_3 & 56.70 \\
\text{Al}_2\text{O}_3 & 12.38 \\
\text{FeO} & 27.60 \\
\text{MgO} & 4.00 \\
\text{TiO}_2 & \text{Trace} \\
\end{array}
\]

The mineral was never in crystals but always in grains which under the microscope had the appearance of having been shattered. A condition that may be explained by the following statement of Doctor Merrill:\(^c\) "The general structure of the Allegan stone can, I believe, be accounted for only by regarding it as an agglomerate of chon-

---

\(^a\) G. P. Merrill, Smithsonian Misc. Coll., Quart., I, 1908, p. 447.


\(^c\) Idem., II, 1900, p. 54.
drules embedded in a fragmental groundmass or matrix, the materials for which were derived from the trituration of other chondrules."

Of the ten chromites here analyzed, one only approximates the typical compound FeO. Cr₂O₃. Eight contain alumina and magnesia. Two contain ferric oxide and are free from alumina and magnesia. One is so rich in ferric oxide that it may be regarded as a chromiferous magnetite. Two of these chromites, from different parts of the same fall, have widely differing compositions.

Tabulating, for comparison, these analyses with such others as were available, thus:

**Chemical composition of various meteorites.**

<table>
<thead>
<tr>
<th>Name</th>
<th>Cr₂O₃</th>
<th>Al₂O₃</th>
<th>FeO</th>
<th>MgO</th>
<th>SiO₂</th>
<th>TiO₂</th>
</tr>
</thead>
<tbody>
<tr>
<td>Admire</td>
<td>65.49</td>
<td>9.08</td>
<td>33.00</td>
<td>0.40</td>
<td>0.50</td>
<td></td>
</tr>
<tr>
<td>Mount Vernon</td>
<td>65.01</td>
<td>9.85</td>
<td>13.97</td>
<td>5.06</td>
<td>1.38</td>
<td></td>
</tr>
<tr>
<td>Do</td>
<td>64.91</td>
<td>9.05</td>
<td>17.97</td>
<td>4.96</td>
<td>5.00</td>
<td></td>
</tr>
<tr>
<td>Canyon Diablo</td>
<td>65.40</td>
<td>5.30</td>
<td>26.30</td>
<td>5.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cooahulla</td>
<td>62.71</td>
<td></td>
<td>33.83</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Bjurbild b</td>
<td>62.00</td>
<td></td>
<td>41.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Marjahanhti</td>
<td>61.39</td>
<td>1.96</td>
<td>30.46</td>
<td>6.70</td>
<td></td>
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<td>65.25</td>
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In the above table the chromic oxide has a maximum percentage of 65.49 and a minimum of 5.20. Disregarding this last which may be regarded as a chromiferous magnetite, the next lowest is 24.60. Ferrous oxide ranges from a maximum of 37.68 to a minimum of 17.79. Arranging the values found for ferrous and chromic oxides in the order of their ferrous oxide contents and placing below this value the chromic oxide found, thus:

FeO———- 37.68 33.83 33.00 31.50 30.46 26.30 26.14 18.97 17.97
Cr₂O₃———- 52.13 62.71 65.49 39.40 61.39 63.40 56.82 65.01 64.91

It becomes apparent that there is no exact relation existing between the proportions of the two oxides. A low ferrous oxide content does not necessarily imply a high chromic oxide value.

The percentages of alumina are: 28.50, 12.38, 11.36, 10.25, 9.95, 9.85, 9.67, 5.30, 2.98, and 1.96. Eight of the ten chromites carrying alumina have more than 5 per cent of this oxide; one has 28.5 and but two
contain less than 3 per cent. The average percentage of alumina for the ten is 10.22, and for the entire sixteen it becomes 6.38 per cent.

Since the majority of these chromites have a fairly large percentage of alumina (an oxide that is generally reported in small amounts only in the analyses of meteorites), the question suggests itself. Will not the alumina present in the chromite account in a large part for the alumina reported in analyses of the feldspar—free meteorites? This is certainly suggested in the case of the Allegan stone, in which no feldspars were recognized in thin section; yet its analysis shows 3.04 per cent of alumina. This meteorite contains 1.3 per cent of a chromite having 9.67 per cent of alumina according to the analysis made by Stokes, and 2.63 per cent of a chromite carrying 12.38 per cent of alumina in the far greater amount of material worked up by me.

The percentages of magnesia show a maximum of 20.90 and a minimum of 0.40. Twelve of the sixteen chromites contain this oxide, the per cents present being: 20.90, 12.22, 6.70, 5.68, 5.06, 5.00, 4.96, 4.00, 2.76, 2.42, 0.60, and 0.40. The average for the twelve being 4.3 per cent. There is an apparent relation between the magnesia and the alumina in that nearly all of those chromites which contain magnesia also contain alumina. There is, however, no relation between the amount of one oxide as compared with the amount of the other oxide. One chromite, for example, has 2.76 per cent of magnesia with 9.76 per cent of alumina while another with nearly the same amount of magnesia, 2.42 per cent, has but 2.98 per cent of alumina.

Ferric oxide is present in four cases only. In two of them the total iron was determined as this oxide. One of the two remaining is so high in ferric oxide, 65.25 per cent, that it may be regarded as a magnetite: the other contains 10.20 per cent. Neither of the two last contain alumina or magnesia.

From the data here given it appears that the majority of meteoric chromites contain magnesia and alumina. That there is little if any relation existing between the amounts of the constituent oxides. One only approximates a compound of the formula FeO.CrO_3. The majority are of the type RO.R_2O_3 in which RO is ferrous oxide and magnesium oxide and R_2O_3 is commonly chromic oxide with alumina less commonly ferric oxide.

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^b Idem., II, 1900, p. 48.
A NEW RABBIT CESTODE, CITTOTÆNIA MOSAICA.

By MAURICE C. HALL,
Of the Bureau of Animal Industry, Department of Agriculture.

The adult tape worms of rabbits have been of considerable importance in the history of helminthology, not only from their anatomical peculiarities, but from their relation in structure and, probably, life history to allied parasites in the horse, cow, and sheep, and from their part in the revision of the old cestode genera.

The Old World genera of rabbit cestodes, Andrya, Anoplocephala, and Cittotenia are all Anoplocephalinae and hence unarmed. The American genera Bertilla and Cittotenia are likewise Anoplocephalinae, while the genus Davainea belongs to the Dipyldidiinae and is armed.

Cittotenia is the only genus of rabbit cestodes represented both in the Old World and in America. To this genus the new species described in this paper is added.

The author is indebted to Dr. Rufus A. Lyman and Dr. Henry B. Ward of the University of Nebraska for the use of Lyman's slides of C. pectinata, and to Dr. B. H. Ransom, Chief of the Division of Zoology, U. S. Bureau of Animal Industry, for assistance in the preparation of this paper. The illustrations were made by Mr. W. S. D. Haines, artist of the Bureau of Animal Industry, and are from camera drawings unless otherwise stated.

CITTOTÆNIA MOSAICA, new species.

Five specimens of Cittotenia mosaiica, new species, were collected by the writer from the small intestines of a large "mountain cottontail rabbit" shot July 12, 1906, on the road from Rosemont, Colorado, to the Seven Lakes in the Pikes Peak region of the same State. From the locality and altitude, the latter over 11,000 feet (3,353 meters), the host was undoubtedly Lepus pinetis (=Sylvilagus pinetis), the form listed for this locality and for high altitudes by Warren (1906). In a personal communication, Mr. Warren writes me "I
have no hesitation in saying that a cottontail taken at the locality you mention would be *Lepus pinetis.* In a later paper, Warren (1908) lists this host as *Sylvilagus pinetis.*

I have found only two references to rabbit cestodes from Colorado. One is an article by Curtice (1892), in which he writes: "In Colorado, cottontail rabbits (*Lepus sylvaticus* Bachman) yielded in 1880 an undescribed *Taenia.*" I have not been able to locate these specimens.

In a later paper, Warren (1908) lists this host as *Sylvilagus pinetis.*

In looking over the files of a sheep breeder's periodical I find a note by a contributor signed "D. K." (1900), who writes from some unspecified locality in Colorado as follows: "Nearly every rabbit here has tapeworms in it."

The specimens of *C. mosaica* were much folded in the intestine, but were readily straightened out after fixation. The lengths of the cestodes were as follows: 5.3 cm., 7.5 cm., 7.5 cm., 8.7 cm., and 10 cm. The proglottids are much broader than long, the maximum breadth being 8 to 10 mm., the maximum length of end proglottids 1 mm., and the maximum thickness 2 mm.

Viewed from the dorsal or ventral surface toward the head and especially in the posterior part of the strobila, the separate proglottids show several irregularities, constrictions, and depressions across their breadth, giving the broad surfaces somewhat the appearance of a mosaic, whence the specific name. (Fig. 1.)

The unarmed head is dome-shaped and is actually and relatively small. (Fig. 2.) It measures 270 to 350 µ in breadth at the base and 110 to 240 µ from the base to the tip, according to the state of contraction. The four small suckers are set far anterior and measure at the aperture 20 to 44 µ. There is no neck, segmentation beginning directly behind the head. The strobila broadens rapidly and becomes lanceolate in outline.

A study of the internal anatomy readily establishes the specific distinctness of this form, and I have adapted the following key from
Stiles (1896) to show its relation to the other rabbit cestodes of the Pectinata group:

1. Anoplocephalinae having ova with pyriform body, genital canals passing dorsal of longitudinal canals and main nerve trunk, uterus a transverse tube, single or double, genital pores double, vagina ventral of cirrus pouch on both sides.-----------Cittotenia. 2

2. Cirrus pouch muscular, generally pyriform, distinct, and swollen proximally by vesicula seminalis ---------------Marmotae Group.

Cirrus pouch resembling nozzle of hose, of nearly equal diameter throughout; not swollen by any prominent vesicula seminalis.----------Pectinata Group. 3

3. Testes in a band extending across the proglottid and lateral of ovaries.----4

Testes in groups or in a band not extending lateral of ovaries.---------5

4. Cirrus pouch about 1 mm. long, extending some distance median of longitudinal canals.--------------------Cittotenia pectinata.

Cirrus pouch 475–640 μ long, entirely lateral of longitudinal canals.

Cittotenia mosaica.

5. Testes in two groups, one for each ovary, extending lateral of ovaries but absent from median field.-------------Cittotenia perplexa.

Testes in a band not extending lateral of ovaries.----------Cittotenia variabilis.

C. bursaria v. Linstow (1906) may be placed with the Marmotae group on the pyriform shape of the cirrus pouch as figured, though no vesicula seminalis is described or figured as occurring within the cirrus pouch. Other features would relate it to the Pectinata group, but for various reasons I have not discussed it further in this paper.

The anlagen of the female glands and the testes of C. mosaica appear almost simultaneously in about the twenty-seventh proglottid, 2 mm. from the anterior end, the genital canals first showing in the fifth or sixth segment after this. In this regard C. mosaica differs from the other members of this group in which the anlagen appear as follows: In C. pectinata the female glands and ducts are first indicated "immediately back of the head," according to Stiles (1896), the testes first appearing 6 to 7 mm. from the anterior end, Stiles (1896), Lyman (1902); in C. perplexa the anlagen of female glands and ducts occur 0.64 mm. from the anterior end, Stiles (1896); in C. variabilis roundish anlagen of the female glands, later becoming pistol-shaped, appear 5 to 10 mm. from the anterior end, Stiles (1896). Seeming differences in actual and relative occurrence of anlagen may be due to differences in technique. In C. mosaica the anlagen of the ovaries and testes first occur practically simultaneously in section, though the anlagen of the ovaries are visible long before those of the testes in toto mounts of the entire animal. Part of the statements of Stiles and of Lyman may have been, and in fact appear to have been, based on studies of toto mounts.

The testes are in the posterior part of the proglottid, and from a dorsal or ventral view show mostly a single row, with only occasional doubling, extending past the ovaries almost to the lateral canals. In a cross section of the worm the testes are seen to be arranged in

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two or three irregular, vertical rows, so that the number of testes which from a dorsal view appears to be between 36 and 40, is found in cross section to be about 60 to 80 to each proglottid. C. pectinata has 100 to 125, C. variabilis 60 to 100. The testes are approximately globular to oval in shape, ranging in diameter from 60 to 90 μ. Each testis consists of a number of lobules which resemble in section a cluster of grapes, the whole inclosed in a capsule which defines the testis sharply from the neighboring parenchyma.

On each side of the proglottid the vas deferens is formed by the union of two tubules, one of which originates near the middle of the proglottid and the other near the margin. These unite just behind the median lobe of the ovary to form the vas deferens. Each testis connects with the tubule by a short duct. (Fig. 3.)

The vas deferens forms a series of vertical loops, extending just median of the longitudinal excretory canals for a space of 405 to 550 μ, then runs straight across these canals to the beginning of the cirrus pouch. (Figs. 3 and 4.) This latter measures 475 to 640 μ in length, averaging 550 μ, and is wholly lateral of the longitudinal canals. In C. pectinata the cirrus pouch is 925 to 1,075 μ long and extends median of the excretory canals. In C. perplexa it is only 288 to 320 μ long, and in C. variabilis 400 μ. At its proximal end the cirrus pouch is 62 μ in diameter, thinning toward the distal end to 38 μ and then slightly increasing in size again. Inside the cirrus at its proximal end is a vesicula seminalis the length of which varies greatly, depending possibly on variations in the pressure of the cirrus pouch muscles. The extremes noted for its length are 129 and 337 μ.

The outer layer of longitudinal muscles of the cirrus pouch is about 3 μ thick, the inner circular layer about 5 μ thick, the cirrus about 6 μ. The cirrus pouch proceeds anterior and dorsal of the vagina nearly to the genital pit where they both open in the same frontal plane, often bending sharply forward near the end. The genital aperture is located in the anterior half of the proglottid margin, in

![Diagram](image-url)
which respect this form differs from the diagnosis or figures of the other species of the group, in which it is given or figured as median or in *C. pectinata* as posterior also. However, in Stiles's specimens of *C. perplexa*, which I examined, I find the location to be anterior as well as median, and indeed it is so figured, though the diagnosis (Stiles, 1896) only gives the median location. In *C. mosaica* the cirrus pouch runs straight practically to the tip, or else curves slightly forward, whereas in the available European specimens of *C. pectinata*, including Riehm's cotype and those in the collection of Stiles, the cirrus pouch very commonly presents a wide arch, bowing back to the posterior part of the segment margin. This is not so noticeable in the American specimens of this species from Lyman's collection.

The aîlagens of the ovaries quite generally appear bilobed in frontal section and mature ovaries very often appear so in section, though there are branches running anteriorly also. The central portion of the ovary is not located anterior of the lobes of the ovary as Lyman has described and figured for *C. pectinata*, but is located ventrally, its relation to the lobes being shown in cross-section and not in frontal section. Instead of "Indian-club shaped" lobes with a maximum diameter of 16 µ at their tips, as Lyman (1902) describes for his specimens of *C. pectinata*, *C. mosaica* has a more irregular set of lobes with diameters ranging from 40 to 75 µ.

The vitellarium is a densely staining, kidney-shaped gland posterior and dorsal of the median part of the ovary and between the posterior parts of the ovarian lobes. The shell gland is a globular structure lying between the vitellarium and the median region of the ovary, and is composed of elongate cells. Measuring across the proglottid, the lateral dimensions of the various female glands are as follows: Width of ovary, 590 to 645 µ; of yolk-gland, 200 to 230 µ; of shell gland, 74 to 92 µ.

Fig. 4.—Cross section near margin of segment. *c*, Cirrus; *cp*, Cirrus pouch; *dm*, Dorsal nerve; *cc*, External excretory canal; *ic*, Internal excretory canal; *lm*, Longitudinal muscles; *mn*, Main nerve; *o*, Ovary; *vs*, Receptaculum seminis; *sg*, Shell gland; *t*, Testes; *tlm*, Tangential longitudinal muscles; *tm*, Transverse muscles; *u*, Uterus; *v*, Vagina; *vd*, Vas deferens; *vn*, Ventral nerve; *vs*, Vesicula seminalis; *yg*, Yolk gland.
The total length of the vagina and receptaculum seminis varies with the age of the segments, increasing from 885 to 1,290 μ. At the genital depression the vagina and cirrus reach the exterior by a short tube. The vagina extends inward as a thick-walled, relatively narrow tube surrounded by deeply staining cells until it crosses the longitudinal canals when it dilates to form a thin-walled, cylindrical receptaculum seminis extending to near the median part of the ovary. Here it narrows and bifurcates, one branch proceeding to the ovary as the oviduct and one passing through the shell gland to the yolk gland. From this latter branch the ootype originates near the middle of the shell gland and proceeds to the uterus, which at first lies dorsal of the median part of the ovary in this neighborhood. (Fig. 5.)

Eggs appear in utero in about the seventy-second proglottid, 5.8 mm. back of the first appearance of the genital anlagen and therefore 7.8 mm. from the anterior end of the worm. This is much earlier than their appearance in C. pectinata, in which Stiles (1896) states that the first trace of the uterus occurs 14 mm. from the anterior end. Here, again, Stiles may have based his statement on a study of a toto preparation. Such a preparation of C. mosaica shows the uterus with eggs about 14 mm. from the anterior end. (Fig. 6.)

The single transverse uterus is located anterior of the yolk and shell glands and the testes. It does not extend past the longitudinal excretory canals. Lyman (1902) states that the uterus in C. pectinata extends past these canals, but I was unable to confirm this from his specimens and it is not so figured for the European form by Stiles (1896). As in other species of this genus, the uterus of C. mosaica develops pouch-like widenings along its entire extent, the pouches ultimately becoming so wide that the parts between them appear as mere digitations extending into the lumen of the uterus. These pouches are relatively wider and shallower than in C. pectinata, giving the uterus a more regular, more nearly cylindrical lumen.
The eggs vary in shape from spherical to the many-sided forms figured by Blanchard (1891, fig. 29) for Moniezia pectinata (=Cit- totaenia pectinata). The outer shell membrane is about 2 μ thick. The dimensions of the eggs are naturally very variable, ranging from 67 to 105 μ. The diameter of the pyriform bulb is about 20 μ, the length to the point at which the horns come off is 28 to 34 μ. The horns are filamentous and about 43 μ long, with a width of 6 μ at the base.

In toto preparations the ovaries are seen to disappear very suddenly with the growth of the gravid uterus (fig. 6), but the testes and a remnant of the yolk and shell gland continue for a long time, and the cirrus pouch and vagina persist to the end of the strobila.

The two lateral excretory canals lie at practically the same level in the proglottid, as Stiles (1896) figures them for C. marmota (figs. 3 and 4). In C. variabilis the dorsal canal lies dorso-median of the ventral. Lyman (1902) gives the same position for the canals in his American C. pectinata, while in the European form Stiles (1896) states that a dorsal canal was not observed, and Richm (1881) only found it for a short distance back from the head. In C. mosaica the external of the two canals is the larger. The transverse canals occupy the posterior part of the proglottid and connect the four canals with each other. Other smaller canals connect the main longitudinal canals of each side, while others connect the transverse canals so that the excretory system forms a network as in C. pectinata, underlyi underlying the dorsally situated reproductive system. In the posterior part of the strobila the transverse network disappears, as does the inner longitudinal vessel, leaving only the outer which follows closely the lateral contour of the uteri in a series of arcs. An excretory reservoir with lateral openings, as Lyman (1902) describes and figures for the terminal proglottid of C. pectinata was not found in C. mosaica, the two large external canals apparently opening in the posterior proglottid direct. Possibly the original terminal proglottid was not present in the specimens studied.
The main nerve cord lies in the same frontal plane as the excretory canals, as is also the case in *C. marmota*. From a plexus in the posterior part of each proglottid a conspicuous branch passes toward the margin of the segment, a smaller branch passing inward. Above and below the main cord are a dorsal and ventral cord, respectively, the former being also dorsal of the genital canals. In the posterior part of each proglottid, commissures connect the three nerve cords on each side, as stated for *C. pectinata* by Lyman (1902).

The longitudinal muscles run in two general series made up of separate bundles. These muscle sheets lie external of the reproductive, excretory, and nervous systems. The inner bundle extends just past the proximal end of the cirrus pouch, the outer continuing nearly to the margin of the segment. The same appears to be true of Lyman’s specimens of *C. pectinata*, though he states that the two muscle sheets finally meet near the lateral margins. Inside of the inner longitudinal plate, the transverse muscles form a sheet of varying thickness. Here again I am unable to confirm Lyman’s statement that there are two such sheets in *C. pectinata*, his specimens presenting the same appearance in this respect as those of *C. mosaica*. Where the inner sheet of longitudinal muscles recurses the transverse sheet passes on through them to the outer layer. External to the outer longitudinal sheet is a set of fine muscle fibers, running in a general antero-posterior direction but tangential to the longitudinal fibers (fig. 4). Narrow sagittal fibers traverse the proglottid dorso-ventrally.

Types of this species have been deposited in the U. S. National Museum, Helminthological Collection, No. 7147 (type) and 7148 (paratype).

A hasty comparison of specimens of the European and American *C. pectinata* shows certain differences that should be determined as accidental or shown to be of specific or subspecific importance, and the writer hopes to publish a note on this in the near future as soon as additional material can be obtained.

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THE COLLECTION OF JEWISH CEREMONIAL OBJECTS IN THE UNITED STATES NATIONAL MUSEUM.

By Cyrus Adler and I. M. Casanowicz, Of the U. S. National Museum.

INTRODUCTION.

When the Board of Regents of the Smithsonian Institution, in 1847, first planned that which was to grow into the United States National Museum they laid out a comprehensive programme in all departments of human knowledge and endeavor capable of representation by collections. In describing the ethnological section, they specifically mentioned religions as one of the subjects suitable for museum collections. During the course of years objects pertaining to religious cults formed a considerable part of the series. The Museum, differing from most others at that time, abandoned the severely geographical classification and, though to a certain extent such considerations dictated the arrangement and installation of the objects, special subjects were treated independently of either areas or national limitations, in order to show the history of given ideas or endeavors in the human race treated as an entirety.

In 1890 the question was taken up of the possibility of applying such treatment to religion, a subject of whose importance in the history of humanity there has never been any question. There was a doubt, however, in the minds of many as to whether the abstract ideas which group themselves about the word "religion" could be adequately or even fairly portrayed through ceremonial objects, numerous as they might be. Two members of the staff were instructed, while abroad, to examine into this subject, with the result that, in 1891, it was decided to secure objects of religious ceremony with the view primarily to exhibit them at the World's Columbian Exposition in Chicago, and ultimately with the intention of bringing them together for installation in the National Museum.

At that time the tendency in museums abroad, and to a certain extent among the students of the history of religions generally, was
to deal only with the religious practices and ideas of the semi-
civilized or barbarous nations, and to treat but sparingly those of
the more civilized and cultivated nations of the earth. It was deter-
mined, in taking up the subject here, to adopt a course contrary to
that hitherto followed, and to endeavor, from the educational point
of view, to interest the people in the history of religion by leading
them to the unknown, as it were, in the terms of the known. Accord-
ingly the first three religions to which attention was given were
Judaism, Christianity, and Mohammedanism, in the order of their
respective establishments. A partial illustration of all three was set
up by the National Museum in the Chicago Exposition, the Christian
religion being represented by objects illustrating the ceremonies of
the Greek Catholic and Armenian churches, and there were added
Egyptian, Assyro-Babylonian, and Greek and Roman casts, thus giv-
ing a conspectus of some of the features of religious life which have
grown up about the Mediterranean Sea. Other religions were later
illustrated, especially Brahmanism and Buddhism, and an exhibit of
some of these was sent to the Tennessee Centennial Exposition in
Nashville in the year 1897.

At these expositions, and in the Museum itself, the interest of the
public was plainly evinced in this section of its work, and gifts and
deposits of value were added, representing Ancient Egypt, Shintoism,
the Parsee religion, and other of the great cults.

No attempt has thus far been made to bring these collections into
relation with the prehistoric cults or with those of semicivilized or
barbarous tribes, although the Museum is very rich in such collections,
and the section is in fact and by its organization limited to the historic
religions. In dealing with this difficult subject a rigorous historical
and scientific method has been followed. The religious ideas have
been described through objects or examples of ceremony. The pro-
fessors of each creed have received full faith and their own explana-
tions of the ideas involved in a given ceremony have been adopted.
It ought to be said that the difficulty of adequately portraying the
religion of a people has been fully recognized: that of the two great
divisions, creed and cult, it is the cult which most readily lends itself
to museum exhibition; that, except where worship has been affected
by geographical considerations, cults are best shown in groups by
themselves and not in their geographical relations, that the subject
of religious belief and cults is susceptible of arrangement under cer-
tain well-recognized heads: Public worship, its furniture and appoint-
ments; the sacerdotal person, his costume and implements; sacred
writings, the altar or its equivalent; public religious ceremonies on
special occasions, etc. Another, and indeed larger, class of objects
have to do with the relation of the individual to cult in such matters
as marriage, birth, and in some cases betrothal, and the secret and
mystical religious practices, among which charms and divinations would fall. This general plan, with modifications, of course, is susceptible of application to all of the historic religions.

From time to time catalogues of special exhibitions, indicating selections of objects of the various religions, have been published by the Museum, but no complete catalogue of any one of the great divisions of this subject has yet been issued. In view of the fact that the collection of Jewish ceremonial objects in the Museum is the largest and most complete, indeed one of the best anywhere, and of the fundamental importance of this cult, the present catalogue has been prepared for publication. It is not expected that it will add to a knowledge of the history or of the practices of the Jewish religion, but it is hoped that it will prove useful to students and teachers, and that it may be productive of an increased interest in this and other subdivisions of the Division of Historic Religions in the National Museum.

There is in addition a collection of over forty Bibles, including facsimiles of manuscripts and old and rare editions of the original texts, as well as copies of the most important ancient and modern translations of the Scriptures. As the interest attached to this collection is more archeological, or paleographic, than religious, it comes under the head of historic archeology. The collection has been, moreover, in the main described in a paper entitled "Biblical Antiquities," printed in the Report of the U. S. National Museum for 1896, pages 1013–1023.

I. OBJECTS USED IN PUBLIC WORSHIP.

The Synagogue.—Jewish public worship finds its expression in the services of the synagogue. There is no fixed style of architecture. Generally the synagogue is a rectangular building with the entrance on the west side, so that the worshipers in the western world face east, the direction of Jerusalem, while praying. The general arrangement inside the synagogue is that the Ark of the Law, or Holy Ark (aron ha-kodesh), i. e., the closet or chest, which holds the Torah scrolls, is placed against the center of the east wall. It is raised a few feet above the floor and is reached by steps. To the right of the ark and removed a few feet from the east wall is the praying desk (amud, properly column or pillar), from which the precentor leads the congregation in prayer. In the center is the bimah or almenar (Arabic al-minbar, pulpit), an elevated platform, usually surrounded by a railing on which stands the desk for reciting the lessons from the Scriptures. The remainder of the interior is occupied with benches for the worshipers. In most modern synagogues, however, both the prayers and lessons are read from the bimah or reading desk, which is combined with the platform on which the ark rests, in order to secure a larger area for seats.
The Ark of the Law, holding the Torah, the most sacred and precious possession of the Jew, is the important architectural feature of the synagogue. It is called "Holy Ark" (aron ha-kodesh), after the Ark of the Covenant in the Tabernacle and Temple, whose place it has taken. The Holy Ark is set in or against that wall of the synagogue toward which the worshipers turn in the more solemn parts of the liturgy, the wall which is in the direction of Jerusalem. Whenever the Holy Ark is opened the congregation rises in reverence for the Law of God it holds. It is often surmounted by a headpiece of the Tables of the Law, or Decalogue, or some other emblems called kapporeth, and before its doors is a curtain, of costly material, which is named parocheth, after the curtain which in the Tabernacle and the Temple screened the Holy of Holies.

1. Top Piece of the Holy Ark in the Synagogue (kapporeth).—Made of red velvet and adorned in silver appliqué work with the following principal parts of the Tabernacle and Temple (proceeding from right to left): (1) The golden frontlet of the high priest (Exodus xxviii. 36; (2) the table of shew bread (Exodus xxv, 23); (3) the laver (Exodus xxx, 17); (4) the Ark of the Covenant with the two tables of the Law, surmounted by two cherubim (Exodus xxxv, 10); (5) the altar of incense (Exodus xxx, 1); (6) the candlestick (Exodus xxv, 31); (7) the breastplate of the high priest (Exodus xxviii, 15). The whole is surmounted by the three crowns of the Law, the Priesthood, and the Kingdom, and is inclosed between wings, symbolizing the presence of God. Made in England. Date 5509 A. M.—1749 A. D.

Height, 2 feet 8 inches; width, 8 feet 1 inch. (Plate LX, Cat. No. 3627, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.

2. Top Piece of the Holy Ark (kapporeth).—Made of salmon-colored velvet and adorned in silk embroidery and gold and silver appliqué work with the following parts of the Tabernacle and Temple (proceeding from right to left): (1) The table of shew bread (Exodus xxv, 23); (2) The altar of burnt offerings (Exodus xxvii, 1); (3) the Ark of the Covenant with the two tables of the Law surmounted by two cherubim upholding a crown (Exodus xxv, 10); (4) the altar of incense (Exodus xxx, 1); (5) the dress of the high priest (Exodus xxvii, 6). The whole is surrounded by a gold border and gold fringe. Measurements, 4 feet 2½ inches long, 2 feet wide. (Cat. No. 248914, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.

3. Veil of the Holy Ark (parocheth).—Made in Padua in 1736, of yellow silk and richly embroidered in silver, gold, and silk, with

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a Exodus xxv, 17; xxvii, 6.
b Exodus xxvii, 21; xxxiv, 35; xl, 21.
flowers, and the first words of the Decalogue (Ten Commandments) borne upon clouds—the symbol of the Divine Presence. Measurements, 6 feet 3 inches long, 5 feet 2 inches wide. (Plate LXI, Cat. No. 154602, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.

4. Veil of the Holy Ark.—Made, probably in Asia Minor, of yellow silk, with silver-lace borders embroidered with flowers in silk, with silver appliqué work, representing vases of flowers upon columns on either side with the Temple in the center. A Hebrew inscription in gold appliqué indicates that the veil was dedicated by Benjamin, Modico, and Solomon Nabaro to the congregation “Talmud Torah” (Study of the Law). Measurements, 5 feet 10 inches long, 5 feet 3½ inches wide. (Plate LXII, Cat. No. 1286, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.

5. Veil of the Holy Ark.—Made in Smyrna, Asia Minor, of blue silk and richly embroidered in gold, with the inscription in Hebrew, “Portuguese congregation.” Measurements, 6 feet 3 inches long, 4 feet wide. (Plate LXIII, Cat. No. 154588, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.

6. Veil of the Holy Ark.—Made in Constantinople, Turkey. The border of green velvet is embroidered in gold and silver with flowers. The center, of red velvet, has in the four corners, in Hebrew, the names of the four archangels, Raphael, Gabriel, Uriel, and Michael. On the top are the words: “But the Lord is in His holy temple; let all the earth keep silence before Him” (Habakkuk ii, 20), and, “I have set the Lord always before me” (Psalms xvi, 8). Below is a burning lamp hanging down by chains, representing the perpetual lamp before the Holy Ark, and symbolizing the light which emanates from the Law of God. On the sides are the words: “This is the gate of the Lord; the righteous shall enter into it” (Psalms cxviii, 20).

Measurements, 9 feet 5 inches long, 6 feet 3 inches wide. (Plate LXIV, Cat. No. 154758, U.S.N.M.)

7. Veil of the Holy Ark.—Made of red velvet, embroidered in gold and silver with designs of lilies and scrolls, forming an arch, with the candlestick (menorah) in the center and the Hebrew words: “In honor of the House of God.” French needlework. Measurements, 5 feet 10 inches long, 3 feet 9½ inches wide. (Cat. No. 4834, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.

8. Veil of the Holy Ark.—Made of red cotton. Measurements, 5 feet 10 inches long, 4 feet 2 inches wide. (Cat. No. 3708, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.

9. Veil of the Holy Ark.—Made of salmon-colored velvet and richly adorned with gold and silver appliqué work and colored
stones. On the top two lions, standing upon columns which are twined with garlands, uphold the "crown of the Law." Underneath the crown are the two tables of the Law, of cream-colored silk, with the Ten Commandments painted upon them. Under the tables is the inscription in Hebrew: "The society for the study of the Talmud." In the center, with the base reaching down to the bottom, is the candlestick (menorah) with the inscription: "Made in the year 5522 (1762)." The whole is surrounded by a gold-lace border. Measurements, 2 feet 11 inches long, 25 inches wide. (Cat. No. 248915, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.

10. HEADPIECE OF THE HOLY ARK.—Made of cream-colored silk, embroidered in gold and silver with the "crown of the Law" and a prayer in Hebrew. Dated 5528 A. M. = 1768 A. D. Measurements, 11½ inches high, 4 feet 3 inches long. (Cat. No. 3628 U.S.N.M.)

Lent by Hadji Ephraim Benguiat.

THE TORAH SCROLL.—The Pentateuch, called by the Jews Torah, i. e., the Law (properly instruction), is considered by them the most important and sacred portion of the Scriptures. In order to keep it alive in the minds of the people, it is divided into pericopes a according to the number of Sabbaths, the whole to be read through during the service in the synagogue within a year. b For this purpose a manuscript copy of the Pentateuch is used. The copy is written by a professional scribe (sofer) on parchment made of the skin of a clean animal (one whose flesh may be eaten), in Hebrew, without vowel points, accents, or verse divisions, in certain stated columns. These sheets are fastened together with sinews of a clean animal so as to form a scroll, and mounted on wooden rollers, called "tree of life" (etz hayim). When the time arrives for the reading of the Torah, which is about the middle of the service, the scroll is taken out of the Holy Ark and carried in procession, the congregation standing, to the bimah or almendar and is unrolled upon the table or desk. A pointer, terminating in the form of a hand and hence called yad ("hand") guides the reader, preventing him from losing his place in the manuscript. This table or desk is covered with a costly cloth similar to the curtain of the Holy Ark.

When the scroll is to be returned to the ark it is girded with a wrapper or band (mappah) and inclosed in a mantle, both being often of costly material and elaborately worked. Where the congre-

a Such a weekly pericope is called by the German Jews (Ashkenazim) sidra, or "order;" by the Portuguese Jews (Sefardim) parasha, division, section. This latter term is applied by the Ashkenazim to the shorter divisions into which the sidra is divided.

b Many modern Jewish congregations have adopted a triennial cycle, which was also known in ancient times.
gation can afford it, the Torah scroll is adorned with a crown or bells of precious metal, which are fitted over the upper ends of the rollers, while around them are hung by a chain the pointer and a breastplate, chased or embroidered with religious emblems. Frequently the scroll itself as well as its decorative appurtenances are donated by private persons.

11. **Torah Scroll.**—Parchment scroll of the Pentateuch in Hebrew mounted on wooden rollers, wrapped in a cloth of green velvet embroidered in silk, which is held by a silver-worked belt and covered with a mantel of black velvet embroidered in gold. The upper handles of the rollers are of carved wood, the lower of ivory, with silver bells on the rollers. The scroll was made in Smyrna, Asia Minor, in the eighteenth century. The bells were manufactured in Damascus and bear the inscription: “Joseph, son of Ephraim Benguiat.” Height of scroll 7 inches, of rollers 14 inches. (Plate LXV, fig. 1. Cat. No. 154606, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.

12. **Torah Scroll of Parchment.**—Height, 18 3/4 inches. (Cat. No. 3619, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.

13. **Torah Scroll of Leather.**—Palestine. Height, 18 inches. (Cat. No. 216158, U.S.N.M.)

Lent by Mr. S. S. Howland.

14. **Torah Scroll of Parchment.**—Tunis, North Africa. Height, 16 inches. (Cat. No. 217676, U.S.N.M.)

15. **Miniature Torah Scroll Printed on Paper.**—Height, 3 1/4 inches. (Cat. No. 154762, U.S.N.M.)

Gift of Mr. David Sulzberger.

16. **Wrapper for the Torah Scroll.**—Made of yellow silk, embroidered with flowers and Hebrew inscription in silver, gold, and silk, with silver-lace fringes. The inscription reads: “And it brought forth buds, and bloomed blossoms, and yielded almonds. (Numbers xvii, 8.) Embroidered as a holy work by the hands of Magdalene Bassan in the year 5496 (1736).” Measurements, 11 feet 1 inch long, 6 1/2 inches wide. (Plate LXVI, fig. 1, Cat. No. 154603, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.

17. **Wrapper for the Torah Scroll.**—Made of green silk, embroidered with flowers and Hebrew inscription in silk. The inscription reads: “This holy cover was made by Simha, wife of Levy Hai, of Buttrio (Italy), in the year 5457 (1697), and was purchased by Phineas Veneziani and brothers.” Measurements, 8 feet 1 1/2 inches long, 7 3/4 inches wide. (Plate LXVI, fig. 2, Cat. No. 154604, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.

18. **Mantle of the Torah Scroll.**—Made of red velvet and embroidered brocade; opened at the bottom, closed at the top except for
two openings to allow the scroll’s handles to pass through. Decorated in front, in silver appliqué work, with the two crowns of Priesthood and Kingdom. Beneath these is an inscription reading: “Asher, son of Abraham Schulhof, and his wife Eve, daughter of Wolf Rheinthal. Let my heart be sound in thy statutes (Psalms cxix, 80); the fruit of the righteous is a tree of life (Proverbs xi, 30).” At the bottom are representations of the candlestick and the table of shew breads. On the back is likewise in appliqué work the crown of the Law. Dated 5470 A. M. = 1710 A. D. Height, 38\(\frac{1}{4}\) inches; width, 12\(\frac{1}{4}\) inches and 10\(\frac{1}{2}\) inches. (Plate LXVII. Cat. No. 3620, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.

19. Mantle of the Torah Scroll.—Made of yellow silk brocade. Embroidered in gold with the words: “For the repose of Rachel, daughter of Abraham Benguiat.” Made in the seventeenth century. Height, 36\(\frac{1}{4}\) inches; diameter, 10\(\frac{1}{2}\) inches. (Cat. No. 3621, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.

20. Cylindrical Case for Holding the Torah Scroll.—Made of wood, carved and gilded; surmounted by two carved headpieces, called *rimmonim*. In the Orient carved wooden boxes are often substituted for mantles. Height, 2 feet 11\(\frac{1}{4}\) inches; diameter, 15\(\frac{1}{4}\) inches. Tunis, Africa. (Cat. No. 217677, U.S.N.M.)

21. Samaritan Case of the Torah Scroll.—Made of copper and inlaid with silver. The case consists of three sections connected with one another by hinges so as to form a cylinder. The top and bottom are closed by three segments of copper forming a circle. Each of the three top segments has a hole which probably served for a projection to hold some ornaments, while from the bottom project two handles for holding the case. The top is decorated with a turreted border. Each section is divided horizontally into two panels, separated by a band outlined in silver. Geometrical designs in silver, formed of arabesques, decorate the center and corners of each panel. Inscriptions in silver, in Samaritan characters but in the Hebrew language, run along the sides of each section and around the bands of the case, and read as follows: “The Lord our God, the Lord is one, He alone” (Deuteronomy vi, 4); “The Lord is His name, the Lord is my banner” (Exodus xvii, 15); “The Lord God merciful and gracious” (Exodus xxxiv, 6); “God will provide; the Lord will provide” (Genesis xxii, 8 and 14); “The Lord is my God, the Lord is mighty: And it came to pass when the ark set forward, that Moses said, Rise up, Lord, and let thine enemies be scattered; and let them that hate thee flee before thee” (Numbers x, 35); “The Lord bless thee and keep thee” (Numbers vi, 24). “In the name of God. This case for the holy writing was made in Damascus by the humble servant Joseph, son of Abas-poh of the tribe of Patar. Under the direction of Rabban Abi Azzai, son of Rabban Joseph in Damascus.” “In the year 976 of the King-
dom of the Ishmaelites (Mohammedans—about 1565 A.D.).  May the Lord forgive him his sins, Amen.” Measurements, 2 feet high, 7 inches in diameter.  (Cat. No. 1557, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.

22.  **PAIR OF BELLS FOR THE TORAH SCROLL** (*rimmonim*).—Made of silver and silk.  Height, 10 3/4 inches.  (Cat. No. 3623, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.

23.  **PAIR OF MINIATURE BELLS OF THE TORAH SCROLL**.—Made of silver in form of tapering towers surmounted by crowns; hammered and open work.  Height, 3 1/2 inches.  (Cat. No. 3624, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.

24.  **PAIR OF HEADPIECES FOR THE TORAH SCROLL** (*rimmonim*).—Made of wood, carved, stuccoed, and gilded. Palestine.  Height, 16 1/2 inches.  (Cat. No. 3622, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.

25.  **SILVER POINTER** (yad).—Hammered and chased work.  Made in Morocco in the seventeenth century.  Length, 11 1/2 inches.  (Plate LXV, fig. 2, Cat. No. 158347, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.

26.  **SILVER POINTER** (yad).—Chased work.  Length, 11 1/2 inches.  (Plate LXV, fig. 3, Cat. No. 154508, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.

27.  **SILVER POINTER**.—Repoussé and hammered work.  Length, 12 inches.  (Cat. No. 248918, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.

28.  **SILVER POINTER**.—Chased work.  Length, 9 1/4 inches.  (Cat. No. 248919, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.

29.  **POINTER**.—Made of black wood.  Eleven inches long.  (Cat. No. 154452, U.S.N.M.)

30.  **POINTER**.—Made of olive wood in Jerusalem, with hand of bone.  Combined with a spice holder at the top.  Nine inches long.  (Cat. No. 201261, U.S.N.M.)

Gift of Mr. S. N. Meyer.

31.  **SILVER BREASTPLATE OF THE TORAH SCROLL**.—Repoussé work.  On the top, between two cherubim and surmounted by a crown, is a miniature ark, the doors of which are in the form of the Tables of the Law, with the ten Commandments engraved thereon.  Inside are the words in Hebrew, “Holy Sabbath,” and a sliding plate with the Hebrew names of the various festivals on which the scroll decorated with the breastplate is used.  Underneath, amid flower designs, are two crowned lions holding an oval shield, which is engraved with a conventional tree and the Hebrew words: “This was donated by Frieda Beile, daughter of Elkanah Baruk, son of Moses the Levite.”

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The whole is inclosed by two columns, which are wound with flowers. Measurements, 11 inches high, 10 inches wide. Plate LXVIII, Cat. No. 154990, U.S.N.M.) Constantinople, Turkey.

32. Silver Breastplate of the Torah Scroll.—Representing the twelve stones which were set in the breastplate of the High Priest, as described in Exodus xxviii, 15-21, with the names of the twelve tribes of Israel underneath them. Above are the words in Hebrew which were inscribed on the golden frontlet of the High Priest (Exodus xxviii, 36): “Holiness to the Lord.” Underneath is the inscription, in Hebrew, “Gift of Mr. Abraham, son of Simha Marcus, and his daughter Pearl and his son Simha, in memory of his wife and their mother, Beila, daughter of Judah and their parents Simha, son of Meir, and Elka, daughter of Abraham Judah, son of Menachem, and Pearl, daughter of Abraham. In the year 5648 (1888), Boston, America.” The whole is surrounded by a border of vines. Measurements, $13\frac{1}{2}$ by $13\frac{1}{2}$ inches. (Cat. No. 154765, U.S.N.M.)

33. Silver gilt Breastplate of the Torah Scroll.—Repoussé work. The basis of the design is two curtains parted at the top, symbolizing the entrance to the holy of holies. They are surmounted by a crown (the “Crown of the Law”) which is supported by two lions. Between the bodies of the lions was probably the name of God or a sun, the symbol of God, which is now missing. The slides bearing the names of the various festivals on which the breastplate adorned the Torah scroll are also wanting. Height, $15\frac{1}{2}$ inches; width, $11\frac{1}{2}$ inches. (Plate LXIX, Cat. No. 248916, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.

34. Silver gilt Breastplate of the Torah Scroll.—Repoussé work. On the top is a crown between two spiral columns, engraved with the Hebrew words, “Crown of the Law.” In the center is an aperture holding the slides engraved with the names of the festivals on which the scroll decorated with the breastplate was used. The whole is adorned with vines and other floral designs. From the bottom hang three bells. Measurements, $10\frac{3}{4}$ by $10\frac{3}{4}$ inches. (Plate LXX, Cat. No. 248917, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.

35. Silver Band (fragment).—Inscribed in Hebrew: “David, King of Israel, lives and is established forever.” Perhaps part of an ornament of the Torah Scroll. Measurements, $7\frac{1}{2}$ inches long, $\frac{3}{8}$ inch wide. (Cat. No. 1291, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.

36. Cover for the Reading Desk.—Made of yellow silk and embroidered with flowers in silver and silk. Measurements, 4 by 3 feet. (Plates LXXI and LXXII. Plate LXXII shows the Torah Scroll unrolled on the reading desk.) (Cat. 154806, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.
37. COVER FOR THE READING DESK.—Made of brocade with silk fringes. Measurements, 3 feet by 2 feet 7 inches. (Cat. No. 3625, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.

38. HANGING BRASS CANDLESTICK WITH SIX ARMS.—Made in the seventeenth century. Measurements, height 18½ inches; span of arms, 21½ inches. (Cat. No. 3377, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.

39. HANGING BRASS OIL LAMP.—Measurements, 4½ inches high, 6½ inches in diameter. (Cat. No. 3678, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.

40. HANGING LAMP.—Made of brass and gilded. The body is cast in form of a vase 11 inches in diameter terminating in a knob, both heavily ribbed. Round the vase are six projections for inserting the arms which hold the candles. Between the projections are ornamental knobs or buckles. The whole is suspended by three chains formed each of three rods, which are joined together by links in shape of coiled double-headed snakes. The lamp was received by Mr. Benguiat from a synagogue in Russia, but he thinks that it was made in India in the fifteenth century. Measurements, height, 2 feet 10 inches; span of arms, 2 feet 6 inches. (Plate LXXIII, Cat. No. 4826, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.

41. SILVER HANGING LAMP.—Cast and hammered work. The vase-shaped body of the lamp has at the top ten notches or spouts for the wicks. Underneath it is another smaller receptacle likewise in form of a vase, terminating in a point. The whole is suspended by four trefoil chains. Perhaps English work of the beginning of the nineteenth century.a Measurements, height, 4 feet 3 inches; diameters, 14 and 5 inches. (Plate LXXIV, Cat. No. 4559, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.

42. BRASS HANGING LAMP.—The vase-shaped base is provided with seven notches for wicks. The lamp was originally used by the Beni Israel in India. Measurements, height, 2 feet 6 inches; diameter, 6½ inches. (Cat. No. 4827, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.

43. LAVER.—Made of pewter, engraved with floral designs and the Hebrew inscription, "Synagogue, Alfasi, Tunis." In the Tabernacle and Temple, there was a laver for the ritual washing of the priests before entering the sanctuary to offer sacrifices (Exodus xxx, xxx.

a Mr. Benguiat thinks that the lamp was used over the wedding canopy (hupphah), or during the feast of Weeks (Shabuoth).

b No doubt the surname of the eminent Talmudist of the eleventh century, Isaac Ben Jacob Alfasi, named after the city of Fez.
17-21). Some synagogues have in the vestibule a laver for the worshippers to wash their hands before performing the prayer which has taken the place of sacrifices. The washing of hands is accompanied by a benediction. Measurements. height 6½ inches; diameters, 4¼ and 3½ inches. Tunis, North Africa. (Cat. No. 217687, U.S.N.M.)

44. Laver.—Made of copper with two handles. Height, 6¾ inches; diameters, 5½ and 4¾ inches. (Cat. No. 248925, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.

45. Almsbox.—Made of copper. Height, 6 inches; diameters, 4⅛ and 3 inches. (Cat. No. 248926, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.

II. OBJECTS USED AT PRAYER.

46. MINIATURE PRAYER BOOK (siddur, i.e., order, or seder tefilloth, order of prayers).—Containing all the prayers and devotions used on week days and on special festal occasions, in the synagogue and at home. Printed at Amsterdam, Holland, in the year 5499 (1739). Bound in leather, with silver clasps, with the name of “Ephraim Benguiat” in Hebrew characters impressed on the left cover. (Plate LXXV, fig. 1, Cat. No. 154581, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.

47. PHYLACTERIES (tefillin).—(Plate LXXV, fig. 2, and Plate LXXVI, fig. 1, Cat. No. 154583, U.S.N.M.) The phylacteries, or tefillin, are two square boxes of parchment. The boxes are fastened to a kind of a base made of thick parchment with a loop on one side, so as to let a narrow leather strap pass through (Plate LXXVI, fig. 1). Into these boxes are inserted the following passages from the Pentateuch, written on strips of parchment: Exodus xiii, 1-10; Exodus xiii, 11-16; Deuteronomy vi, 4-9; and Deuteronomy xi, 13-21. By means of the straps the boxes are bound around the arm and head and worn by all male Jews who have attained religious majority—i.e., passed the thirteenth year of age—during morning prayers of week days; hence their Hebrew name tefillin, from tefillaḥ, prayer. The name phylacteries is derived from the Greek Φυλακτήρια (phylacteria), which is used in the New Testament,a meaning, properly, things that guard, i.e., amulets, talismans, which the Jewish tefillin are not. The New Testament name may be based upon an external resemblance between the tefillin and the Greek phylacteiria. The obligation to wear tefillin is derived from the command included in the extracts mentioned above: “And you shall bind them as a sign upon your hand and for frontlets between your eyes.”b

The tefilla for the head is embossed on two sides of the exterior with the Hebrew letter ϋ shin (sh), and inside is divided into four

a Matthew xxiii, 5.
b Deuteronomy vi, 8; xi, 18. Compare Exodus xiii, 9 and 16.
compartments, in each of which one of the four extracts from the Pentateuch is put, and the strap is tied at such a distance as to fit the head of the wearer, forming a knot shaped in the form of the Hebrew "daleth" (d). The tephilla for the hand or arm has no letter impressed on the outside and no divisions inside, and the four passages it contains are written continuously on one strip of parchment. One end of the strap is made into a small noose, with a knot resembling the Hebrew "yod" (y or i). The three letters thus exhibited on the outside of the tephillin constitute the Hebrew name of God _ln Shaddai, rendered by the English versions: "Almighty." The materials used in making the tephillin must come from a clean animal, and the extracts from the Pentateuch are written in the same manner as the Torah Scroll. (See p. 706.)

In "laying the tephillin" (hanohath tephillin) that of the arm is put on first. The box is fastened on the naked left arm above the elbow, and the strap is wound seven times around below the elbow. Then that of the head is put on so that the box comes to rest on the forehead below the hair and between the eyes, the knot being at the nape of the neck, while the ends of the strap pass over the shoulders and hang down on either side. Next, the end of the strap of the tephilla of the arm is wound thricе around the middle finger and around the hand. Each of these performances is accompanied by appropriate benedictions and the recitation of passages from the Scriptures. In taking off the tephillin that of the head is removed first, then that of the arm. The straps are folded around the boxes (Plate LXXV, fig. 2), and the tephillin are reverently put into a bag, which is sometimes included in another, so that the sacred objects may be more carefully protected.

Lent by Hadji Ephraim Benguiat.

48. Inner Bag for Tephillin.—Made of silk and embroidered. Made at Chaleis (island of Euboea, Greece), in the seventeenth century, and found there after the Jews had departed for the battle of Athens in 1822. Plate LXXV, fig. 3, Cat. No. 154582, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.

49. Bag of Tephillin.—Made of velvet in Morocco. (Plate LXXVI, fig. 2, Cat. No. 154580, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.

50. Phylacteries.—Gift of Mr. David Sulzberger. (Cat. No. 130276, U.S.N.M.)

51. Phylacteries.—Lent by Mr. S. S. Howland. (Cat. No. 216159, U.S.N.M.)

52. Phylacteries.—Tunis, North Africa. (Cat. No. 217686, U.S.N.M.)

^a Genesis xvii, 1.
53. Bag of Phylacteries.—Made of red velvet, adorned with arabesques in gold appliqué. (Cat. No. 3653, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.

54. Prayers and Benedictions recited in putting on the Phylacteries.—Stamped on yellow silk. Made in Jerusalem. Measurements, 9 by 13 inches. (Cat. No. 154445, U.S.N.M.)

Gift of Dr. Aaron Friedenwald.

55. Prayer Shawl (tallith).—Made of white brocade silk, with gold-embroidered edges. Length, 6 feet; width, 1 foot 5 inches. (Plate LXVII, Cat. No. 154588b, U.S.N.M.)

The tallith is a rectangular piece of cloth, made of wool or silk, worn by male adults (among the Sefardim, or the observers of the Portuguese rite, also by small boys) at the morning services and when performing certain religious functions. To each of the four corners of the tallith are attached the cicith or fringes, consisting of four threads (usually woollen) run through an eyelet near the corner and then doubled and knotted in a certain manner so that eight threads are allowed to hang down as a fringe. It is, besides, usually bordered with bluish-black stripes and adorned with a silk ribbon or silver-corded lace called "crown" (atarah) on the top. The tallith is loosely thrown over all the other garments, sometimes passing across the top of the head and flowing down over the upper part of each arm and over the back, sometimes wrapped around the neck. The obligation to wear a garment with fringes is derived from Numbers xv, 38; as follows: "That they make them fringes in the borders of their garments throughout their generations, and that they put upon the fringe of each border a cord of blue. And it shall be unto you for a fringe, that ye may look upon it, and remember all the commandments of the Lord, and do them; and that ye go not about after your own heart and your own eyes"; and Deuteronomy xxii, 12: "Thou shalt make thee fringes upon the four borders of thy vesture, wherewith thou coverest thyself." Besides the tallith, which is worn at stated seasons, the Jews wear at present under the upper garments during the entire day a garment with fringes, called the "small tallith" (tallith katan), or the "four corners" (arba kanfoth). It consists of a piece of rectangular cloth of any material, but usually of wool, about 3 feet long and 1 foot wide, with fringes fastened to the four corners in the same manner as to the tallith, with an aperture in the center sufficient to let it pass over the head, so that part falls in front and part behind. This small tallith is assumed to have originated in the times of persecution, when the Jews had to refrain from exhibiting the garment with fringes and could only in this manner comply with the commandment to wear fringes.

Lent by Hadji Ephraim Benguiat,
56. **Prayer Shawl (tallith).**—Made of white silk with blue stripes on the borders. Measurements, 6 feet 6 inches long, 2 feet wide. (Cat. No. 30296, U.S.N.M.)

Gift of Hon. N. Taylor Phillips.

57. **Prayer Shawl (tallith).**—Made of rose-colored silk with variegated stripes. Measurements, 4 feet 5 inches long; 17 inches wide. (Cat. No. 3653, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.

58. **Prayer Shawl (tallith).**—Made of white wool embroidered in silk with the “Shield of David” (Magen-David, an hexagonal star), and the inscription in Hebrew: “Joseph is a fruitful bough, even a fruitful bough by a well, whose branches run over the wall.” (Genesis xlix, 22.) Measurements, 3 feet long, 2 feet 3 inches wide. (Cat. No. 3654, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.

59. **Prayer Shawl (tallith).**—Made of white silk with blue borders. Inclosed in a gilded frame. Measurements (of the frame), 28 by 21\(\frac{1}{2}\) inches. (Cat. No. 248924, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.

60. **Arba Kanfoth** (four-cornered garment).—Made of wool. (See p. 714.) Measurements, 3 feet by 17 inches. (Cat. No. 154578, U.S.N.M.)

Gift of Mr. Simon Dalsheimer.

61. **Frings (gîçith).**—made of woolen threads. (See p. 714.)

Tiberias, Palestine. (Cat. No. 154457, U.S.N.M.)

Gift of Mrs. B. F. Ulman.

### III. Objects Used on Festivals.

#### Sabbath.

The Jews, like other Oriental peoples, compute the day from sunset to sunset. The Sabbath, therefore, begins at sunset on Friday and terminates at sunset on Saturday.

It is inaugurated in the home by blessing and lighting of the candles by the mistress of the house, and in the synagogue by a special service. On returning from the service, and before the evening meal, the head of the house fills a cup with wine, raises it in his right hand, and recites Genesis ii, 1-3, which relate the origin of the Sabbath, and pronounces a benediction over the wine, to God, who “has sanctified the Sabbath.” For this reason the ceremony is called *kiddush*, i.e., sanctification. He then drinks from the cup and hands it to the other persons at the table to partake of. Where no wine or other liquor is available, the *kiddush* is pronounced over two loaves of bread, which are laid on the table in memory, it is assumed, of the two portions of manna that were gathered in the wilderness on Fri-
The Sabbath is inaugurated at the home by a benediction over a cup of wine (see p. 715) and is terminated in a like manner. In addition to the cup a wax candle and a box containing some spices are used. The head of the house takes the cup in his right hand and the spice box in his left, while the candle is usually held by a
child, and, after reciting several passages of the Scriptures, pronounces a blessing over the wine, then over the spices, smelling them and passing them to the others present, then over the light, closing with thanksgiving to God for the distinction He made between Sabbath and workdays, between things sacred and profane, etc. The cup is then passed around among the members of the family and the candle extinguished with drops of wine from the cup. This ceremony is called haddalah, i.e., separation or division, because it divides or separates the Sabbath from the other days of the week.

68. Silver Candlestick used for Habadalah.—The base is in the form of a leaf, 2½ inches long and 2½ inches wide; height of the candlestick, 1 inch, with an extinguisher. (Plate LXXIX, fig. 4, No. 154586, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.

69. Spice Bottle, used for Habadalah.—Made of china, with neck of oxidized silver. Measurements, 4½ inches high; 1½ inches in diameter. (Plate LXXIX, fig. 3, Cat. No. 154587, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.

70. Spice Box.—Made of brass in five pear-shaped compartments resting on five legs. The cover of each compartment is surmounted by a lion, while in the center stands a peacock. Measurements, 5 by 4½ inches. (Plate LXXX, Cat. No. 248920, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.

71. Silver Spice Box.—Made in form of a tower resting on a base. Supposed to have been manufactured in Lahnheim, Germany, about 1740. Height, 8 inches. (Plate LXXXI, fig. 4, Cat. No. 130297, U.S.N.M.)

THE NEW MOON.

72. Tablet in gilded frame, inscribed in gold letters on a blue ground with the Hebrew words: New Moon.—In the Pentateuch the new moon festival is enumerated among those which were observed by additional sacrifices, Numbers xxviii, 11-15, and whose appearance was heralded by the sounding of trumpets, Numbers x. 10. The day is referred to as a sacred one also in 1 Samuel xx. 5-18; II Kings iv. 23; Isaiah i. 13, 14; lxvi, 23; Ezekiel xlvi, 1, 3; Hosea ii, 13; Amos viii, 5. Some modern Jews observe the new moon day by reciting, in the open air and facing the moon, special prayers, which devotion is called “Blessing of the Moon” (birkath ha-hodesh), and abstaining from unnecessary work. Dimensions, 11 by 6 inches. (Cat. No. 1429, U.S.N.M.)

Lent by Mr. David Sulzberger.

PASSOVER.

The feast of Passover is celebrated in commemoration of the deliverance of Israel from the bondage of Egypt, as related in the first
chapters of the book of Exodus. It begins on the evening of the 14th of Nisan (March–April) and continues, with the Jews who live in Palestine, for seven days, with those in other places for eight days. It is the first of the three pilgrimage festivals (shalosh regalim), the others being the feast of the weeks, or Shabuoth, occurring seven weeks after Passover, at the close of the spring harvest, now chiefly observed in commemoration of the giving of the Torah, and the feast of Tabernacles or booths Sukkoth (for which see below.)c Passover thus begins the ecclesiastical year.b

73. Liturgy for the Three Festivals (mahzor, i.e., cycle) containing the particular prayers, hymns, and Scripture lessons incorporated in the service of the Synagogue for the Three Festivals, according to the rite of the Portuguese Jews (Sefardim).—Printed in Amsterdam, Holland, in 5488 A. M. (=1728 A. D.). (Cat. No. 3690, U. S. N. M.)

Lent by Hadji Ephraim Benguiat.

Observance of Passover in the Jewish Home.

In ancient times the celebration of Passover centered around the Paschal lamb. As it could not be slaughtered outside of the sanctuary,c its use ceased with the destruction of the Temple, and the eating of unleavened bread, or maccoth, is now the principal feature of the Passover feast. The eating or even the keeping of anything leavened or fermented (hamec) is strictly prohibited.d hence the Passover is also called the "feast of unleavened bread."e On the evening preceding Passover the ceremony of "searching for leaven" (bedi-goth hamec) takes place. The head of the house, furnished with a wax taper, a wooden spoon, and a feather brush, goes over the whole house and gathers all suspicious crumbs into the spoon. These are burned on the morning of the 14th of Nisan in the courtyard (b'wr hamec), both ceremonies being accompanied by benedictions. In the evening the feast begins with a service in the synagogue. In the home the evening meal is of the nature of a commemoration service, called seder—order, arrangement, or programme. At the head of the table are cushioned chairs or lounges for the master and mistress of the house to recline on, as was done and is still customary in the Orient among the high and freeborn. On the table are the articles emblematic of the events commemorated. These are: Three maccoth, or cakes of unleavened bread, baked in the shape of large, thin, round

a Compare Exodus xxiii, 14-17; xxxiv, 23; Deuteronomy xvi, 16.
b Compare Exodus xii, 2; Leviticus xxiii, 5; Numbers xxviii, 16.
c Compare Deuteronomy xvi, 2.
d Compare Exodus xxii, 19; xxiii, 7; Deuteronomy xvi, 3 and 4.
e Exodus xxiii, 15.
crackers, the "bread of affliction," a piece of roasted meat, usually the bone of a lamb, representing the Passover lamb; bitter herbs, usually horse radish (mavor), in commemoration of the "embittering of life" which Israel suffered in Egyptian servitude; a roasted egg, in memory of the festal sacrifice (hagigah) offered in the Temple; a compound of almond, apples, and sirup, which has the color of brick clay (haroseth), in commemoration of the labor of brickmaking the Israelites performed in Egypt and into which the bitter herbs are dipped before they are partaken of; green herbs—parsley or lettuce (karpos)—as the "food of poverty;" a cup of salt water, in which the green herbs are dipped to represent the hyssop dipped in the blood of the Paschal lamb. There are, besides, wine in cups or glasses for each at the table, as everyone assisting at the celebration is supposed to partake of four cups of wine.

The service begins with kiddush, as on Sabbath and other festivals. The family then sits down and the hagadah, i.e., narration, consisting of an account of the sufferings of Israel at the hands of the Egyptians and their miraculous deliverance by God, accompanied by psalms and hymns, is recited. At appropriate passages of the hagadah the articles mentioned above are partaken of, symbolical ceremonies performed, and the evening meal is eaten.

74. LITURGY OF THE PASSOVER MEAL, hagadah.—In Hebrew and Spanish, with maps and illustrations. Printed in London, 5573 A. M. (=1813 A. D.) During the semiritual meal of the Passover feast, called seder, the hagadah, i.e., narration, consisting of an account of the sufferings of Israel at the hands of the Egyptians and their miraculous deliverance by God, is recited, accompanied with psalms and hymns. Dimensions, 9 1/2 inches by 7 1/2 inches. London, England. (Cat. No. 217678, U.S.N.M.)

75. LITURGY OF THE PASSOVER MEAL (hagadah).—The same as No. 74. (Cat. No. 3691, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.

76. TWO CUSHIONS, USED TO LEAN UPON AT THE PASSOVER MEAL, OR SEDER.—Made of green silk and richly embroidered in gold and silk, in Samacov, Bulgaria, in the eighteenth century. Length, 19 inches; width, 16 3/4 inches. (Plate LXXXII, Cat. No. 154600, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.

77. EWER AND BASIN, USED FOR THE ABLUTION AT THE PASSOVER MEAL, OR SEDER.—Gilt bronze repoussé and casted work. Height of ewer, 13 inches; diameter of base, 7 inches; height of basin, 14 3/4 inches; diameter, 14 1/2 inches. (Plate LXXXIII, Cat. No. 154718, U.S.N.M.) Washing of the hands (netilath yadayim) by pouring water over them is observed by the Jews before prayer and before

\[a\] Deuteronomy xvi, 3. \[b\] Exodus i, 14. \[c\] Ibid., 14; v. 7 ff. \[d\] Ibid., xii, 22.

\[e\] See p. 715.
meals, sometimes also before saying grace after meals. The custom is also referred to in the New Testament.\(^a\)

Lent by Hadji Ephraim Benguiat.

78. **Passover dish.**—Used at the Passover meal, or seder, to hold the maccoth and the other symbolical articles of the service. Made by the Jews of Spain in the thirteenth century, glazed in Italy in the sixteenth century. On its surface are painted the benediction of *kiddush* and the sixteen words containing the programme of the ceremonies performed during the Seder, and four vignettes representing the family in the various stages of the service. Height, 3\(\frac{3}{4}\) inches; diameter, 18\(\frac{3}{4}\) inches. (Plate LXXXIV, Cat. No. 154594, U.S.N.M.) Lent by Hadji Ephraim Benguiat.

79. **Brass plate used at the Passover meal.**—Adorned with animal figures and flowers and containing an Arabic inscription in Hebrew characters. Made in Constantinople. Diameter, 26 inches. (Plate LXXXV, Cat. No. 130291, U.S.N.M.)

80. **Silver Passover plate.**— Embossed and chased with interlaced scrolls and seven medallions on the border, representing the Patriarchs, Abraham, Isaac, Jacob, Moses, Aaron, David, and Solomon.\(^b\) Italian Renaissance period. Diameter, 23\(\frac{1}{2}\) inches. (Plate LXXXVI, Cat. No. 3673, U.S.N.M.) Lent by Hadji Ephraim Benguiat.

81. **Passover cloth.**—Made of pewter. Engraved with parts of the liturgy recited at the Passover meal (seder). Diameter, 14\(\frac{3}{4}\) inches. (Cat. No. 248921, U.S.N.M.) Lent by Hadji Ephraim Benguiat.

82. **Passover cloth.**—Made of white silk, in Jerusalem. Stamped with the principal prayers recited at the Passover meal, or seder, and illuminated with representations of the Temple Mount and other buildings of the city of Jerusalem; as also with the cities of Jericho and Shechem; with the candlestick (*menorah*); and the tables of the Law (*Decalogue*). Measurements, 18 by 18 inches. (Cat. No. 155263, U.S.N.M.) Gift of Moses A. Dropsie, Esq.

83. **Cover for the Unleavened Bread, or Maccoth, used at the Passover meal, or Seder.**—Linen, embroidered in silk. Made in Chalcis (Euboea), Greece, in the seventeenth century. Measurements, 16\(\frac{1}{2}\) by 15 inches. (Plate LXXXVII, Cat. No. 154599, U.S.N.M.) Lent by Hadji Ephraim Benguiat.

84. **Brass dish, used for holding the green herbs at the Passover meal, or Seder.**—Chased work. Made in Venice, Italy, in the

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\(^a\) Compare Matthew xv, 2; Mark vii, 2; and Luke xi, 38.

\(^b\) May also have been used for the ablution of the priests before blessing of the people on festivals.
fifteenth century. Height, 3½ inches; diameter, 17½ inches. (Cat. No. 154595, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.

85. COVER FOR THE GREEN HERBS, USED AT THE PASSOVER MEAL, OR SEDER.—Purple-colored silk, embroidered in silver and gold. Made in Chios (an island off the coast of Asia Minor) in the eighteenth century. Measurements, 21 by 19 inches. (Plate LXXXVIII, Cat. No. 154597, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.

86. Pewter Passover Plate.—Made in Tettenhausen, Germany. Diameter, 15 inches. (Cat. No. 130299, U.S.N.M.)

87. ENAMELED SAUCER AND SILVER SPOON.—Used for the compound of almonds, apples, and other fruit, or haroseth, at the Passover meal, or seder. Height of saucer, 3 inch; diameter, 4½ inches; length of spoon, 5½ inches. (Plate LXXXIX, fig. 3, Cat. No. 154596, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.

88. ANTIQUE CHINA CUP.—Used for the salt water at the Passover meal, or seder. Height, 1¼ inches; diameter, 2¼ inches. (Plate LXXXIX, fig. 2, Cat. No. 154618, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.

89. TWELVE WINE GLASSES.—Used for the drinking of the "four cups" (arber kossoth) at the Passover meal, or seder. Cut glass with gilded rims, and engraved with scenes from human life (the two glasses on the plate, for instance, represent a woman at the loom and a sailing vessel, the others being a woman spinning; a rural idyl; a harvesting scene; a country homestead; a landscape; a chariot race; a house with its inhabitants; a hunting scene). Made in the seventeenth century. Height of each glass, 4½ inches; diameter, 1½ inches. (Plate LXXXIX, fig. 1, Cat. No. 154593, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.

90. EIGHT SILVER CUPS.—Used for the drinking of the "four cups." Engraved with floral designs and buildings. Measurements, height, 5½ inches and 4½ inches; diameter, 2½ and 1¾ inches. (Cat. No. 4553, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.

91. GLASS AND PLATE.—Used for the counting of the ten plagues inflicted on the Egyptians. Height of glass, 6½ inches; diameters, 5½ inches and 3½ inches; height of plate, 1 inch; diameter, 8½ inches. (Plate XC, Cat. No. 1290, U.S.N.M.) During the reciting of the account of the deliverance from Egyptian servitude in the liturgy of the seder, or hagadah, at the mention of the ten plagues sent against the Egyptians (compare Exodus vii–xii) a drop of wine is poured out from a glass into a plate at the mention of each plague, or sometimes is dipped out with the finger.

Lent by Hadji Ephraim Benguiat.
92. **BOWL OF CUT GLASS, WITH GILDED RIM.**—Used at the Passover meal. Measurements, height, 2½ inches; diameter, 5½ inches. (Cat. No. 4554, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.

93. **COVER FOR PASSOVER DISH.**—Silk embroidery on linen. Italian work of the early sixteenth century. Measurements, height, 22½ inches; width, 2 feet 7½ inches. (Cat. No. 4552, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.

94. **PIECE OF BROCADE.**—Used as tablecloth at the Passover meal, or seder. Measurements, 3 feet 10½ inches by 1 foot 6½ inches. (Cat. No. 154596, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.

95. **TABLE CENTER.**—Used at the Passover meal, or seder. Linen, with edge and corners richly embroidered in silk and gold. Made in Janina, Turkey, in the seventeenth century. Length, 3 feet 10 inches; width, 1 foot 7 inches. (Plate XCI, Cat. No. 154601, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.

96. **SERVETTE.**—Used at the Passover meal, or seder. Woolen, with lace edge worked in silver and silk. Made in Chios in the sixteenth century. Length, 4 feet 3 inches; width, 1 foot 7½ inches. (Cat. No. 154598, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.

97. **OMER TABLET.**—Manuscript in gilded frame.

The harvest season was formally opened with a ceremony of waving a sheaf of barley in the Sanctuary on the second day of the Passover feast, which began on the 15th of Nisan (March-April). Before this ceremony took place the harvesting of grain was forbidden:  

"And ye shall eat neither bread, nor parched corn, nor fresh ears, until this self-same day, until ye have brought the oblation of your God." From that day seven weeks, or forty-nine days, were counted,  

b to the feast of Pentecost; hence its Hebrew name *Hag ha-Shabuoth* "feast of Weeks," and the usual English name "Pentecost," which is the παντεκοστή *pentekestē*, meaning the fiftieth day. It is also called  

"feast of harvest,"  

c because the grain harvest then approached its close, and "day of first fruits,"  

d because two loaves of bread from the new wheat were offered on that feast.  

c With the destruction of the Temple the ceremony of waving the sheaf in the Sanctuary necessarily fell away, but the counting is still observed and the prayers

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a Leviticus xxiii, 14.
b Leviticus xxiii, 15; Deuteronomy xvi, 9.
c Exodus xxiii, 16.
d Numbers xxviii, 26.—Compare Exodus xxxiv, 22.
e Leviticus xxiii, 17. Since the dispersion Pentecost has been connected by tradition with the day on which the Law (Torah) was given on Mount Sinai, and the festival is called *hag mattan torah*, the feast of giving the Law.
This tablet is used in the synagogue for reckoning the period between Passover and Pentecost. The tablet is in Hebrew. It contains the words: "Blessed art thou, O Lord our God, King of the universe, who has sanctified us with His commandments and commanded us to count the Omer." Then follows the count (in Hebrew), and below it the words: "May the Lord restore the worship of the temple speedily in our days," and Psalm lxvii. The letters H, S, and D on the left, mean, respectively, Omer (written Homer by the Spanish Jews), week (Sabbath), and day. The figures on the right indicate that it is the forty-seventh day of Omer, i.e., six weeks and five days. Measurements, height, 2 feet 6 inches; width, 2 feet. (Plate XCII, Cat. No. 154404, U.S.N.M.)

Lent by Mr. David Sulzberger.

NEW YEAR (ROSH HA-SHANAH); THE PENTITENTIAL SEASON.

98. RAm's Horn (SHOFAR).—In ancient times the horn or shofar was used, according to the Pentateuch, for the announcement of the New Moon and solemn festivals, for the proclamation of the year of release (Sabbatical year), and above all for military purposes, like the modern bugle, to give the signal for going out to battle, for the announcement of a victory, and for a recall of the troops. It was also used as a musical instrument in religious processions.

At present the shofar is especially employed during the penitential season, which begins with the 1st of the month Ellul (August-September) and culminates on the Day of Atonement (Yom kippur) on the 10th of Tishri (September-October). During the month of Ellul the shofar is sounded three times at the close of the morning service each day, with the exception of the Sabbaths, in some congregations and in others at the evening service. On the 1st of Tishri, the beginning of the civil year (Rosh ha-shana), one of the most solemn of the Jewish holy days, and the "memorial of blowing of trumpets," thirty blasts, among the Sefardim seventy-two, are sounded on the shofar in the middle of the morning service, after the reading of the day's lesson from the Torah, and before the "additional service" (musaf). On Atonement Day the shofar is sounded once, among the Sefardim four times, at the close of the concluding service (ne'ilah), and on the seventh day of Tabernacles (Hoshanna Rabba) it is sounded at each of the seven circuits. The shofar is...
usually made of a ram’s horn, but the goat’s horn is also employed. (Plate XCLIII, fig. 1, Cat. No. 154589, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.

99. Ram’s Horn (shofar).—(Cat No. 95142, U.S.N.M.)

100. Manuscript written on vellum.—Measurements, 14 by 9½ inches. Mystical interpretation of the significance of the blowing of the shofar. Tunis, North Africa. (Cat. No. 217695, U.S.N.M.)

101. Liturgy for New Year’s Day in Hebrew.—Containing the particular prayers and Scripture lessons of the service on New Year’s Day. Printed 5486 A. M. (1726) in Amsterdam, Holland. (Cat. No. 3689, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.

102. Liturgy of New Year’s Day in the Marathi Language.—Used by the Beni-Israel, the native Jews of India. (Cat. No. 154572, U.S.N.M.)

Lent by Rev. Henry Cohen.

103. Liturgy for the Day of Atonement in the Marathi Language. (Cat. No. 154568, U.S.N.M.)

Lent by Rev. Henry Cohen.

104. Propitiatory Prayers (selihoth) in the Marathi Language.—Propitiatory prayers are poetical compositions, sometimes in form of litanies, expressive of confession of sin and supplication for God’s mercy and forgiveness, hence their Hebrew name, selihoth, forgiveness. They are recited during the penitential season and on fast days. (Cat. No. 154571, U.S.N.M.)

Lent by Rev. Henry Cohen.

THE FEAST OF TABERNACLES, OR BOOTHS (SUKKOTH).

105. Curtain for the booth or tent (sukkah) of the Feast of Tabernacles.—Made of linen and silk, with gold threads in the edge, by the Beduins of Jerusalem in the eighteenth century.

The Feast of Tabernacles takes place on the 15th of Tishri (September-October), and continues, according to Leviticus xxxiii, 39–43, seven days, with an eighth day for the conclusion of the feast, to which is added the feast of the “Rejoicing of the Law,” thus extending it to nine days. It is celebrated in remembrance of the wandering of the Israelites through the desert, where they dwelt in booths or tents. In ancient times the feast was coincident with the harvest season and was a feast of thanksgiving. It was one of the most important and joyous of the three pilgrimage festivals. The most character-


b Compare Leviticus xxiii, 43.

c Leviticus xxiii, 39; Exodus xxiii, 16; xxxiv, 22.
istic feature of the celebration of this feast is the dwelling in booths or tents, whence is derived its Hebrew name, Sukkoth, or, more fully, haq ha-sukkoth, the feast of booths. The booth has three sides of wood, usually boards or planks, while the fourth side, on which is the entrance, is hung with a curtain. It must be erected in the open air and covered with green branches and leaves, affording protection against the sun by day, but permitting a small portion of the sky to be seen and the stars to show at night. Inside it is usually adorned with draperies and garlands. Being the "dwelling place" during the festival, the meals are taken in the booth, and especially pious people even sleep in it. Sick and feeble people, however, are exempt from the obligation of "dwelling in tents," and the precept is generally suspended in inclement weather. Length, 10 feet 2 inches; width, 6 feet 4 inches. (Cat. No. 154590, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.

106. CURTAIN TIE.—Linen, with edges embroidered in gold and silk. Made by the Jews of Smyrna, Asia Minor, in the seventeenth century. Length, 8 feet; width, 8 1/2 inches. (Cat. No. 154617, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.

107. FOURTEEN TABLETS, USED FOR THE DECORATION OF THE BOOTH.—The tablets are manuscripts on paper inscribed partly with passages from the Bible, partly with original Hebrew compositions bearing on the feast of Tabernacles and the residing in the booth. One contains, in addition to the tables of the Law, surmounted by the three crowns of the Law, Priesthood, and Kingdom, the whole of the book of Ecclesiastes, which is the roll (megillah) read on the feast of Tabernacles. It is artistically written to form various geometrical figures and shapes of birds and flowers. Another is inscribed in the same manner with portions of the book of Proverbs and Canticles, etc. (Cat. Nos. 217679-685, U.S.N.M.)

108. LULAB AND ETHROG IN A SILVER BOX.—The lulab and ethrog, the former being the shoot of the palm bound up with myrtle and willow branches, the latter the fruit of the citron tree (a variety of the Citrus medica), are used by the Jews at the feast of Tabernacles (15-22 of Tishri—September-October) in pursuance of Leviticus xxiii, 40: "And ye shall take unto you, on the first day, the fruit of goodly trees, branches of palm trees, and boughs of thick trees, and willows of the brook, and ye shall rejoice before the Lord, your God, seven days." At certain stages of the liturgy the lulab and ethrog, the former being held in the right hand, the latter in the left, are waved up and down and to all points of the compass, in acknowledgment of God's sovereignty over nature. After the additional service (musaf) each day a processional circuit (hakka'hah) is made

\[\text{a} \text{ Leviticus xxiii, 42.} \]

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with the lulab and ethrog around the reading desk (as was done in the Temple around the altar) on which the Torah scroll is held in an upright position, while reciting the prayers, beginning and closing with the invocation "Hosanna." On the seventh day seven such processions take place, and willow branches are beaten on the benches, and this day is therefore called Hosanna Rabba, the day of the great Hosanna. Length of the lulab, 4 feet 7 inches; height of silver box, 6 inches; diameters, 3 and 2½ inches. (Plate XCIV, Cat. Nos. 3636 and 3687, U.S.N.M.)

109. LULAB AND ETHROG. (Cat. No. 154448, U.S.N.M.)
Gift of Mr. David Sulzberger.

110. LULAB AND ETHROG IN A GLASS CUP. Cat. Nos. 3687 and 3637, U.S.N.M.)
Lent by Hadji Ephraim Benguiait.

111. LULAB AND ETHROG. Cat. Nos. 4567 and 3710, U.S.N.M.)
Lent by Hadji Ephraim Benguiait.

The Feast of Hanukah (Dedication).

112. Hanukah Lamp.—Made of copper, probably of Dutch origin. The feast of dedication or Hanukah (the latest addition to the cycle of Jewish festivals) is celebrated for eight days, beginning with the 25th of Kislev (December-January), in commemoration of the purification of the Temple and the restoration of the service after the deliverance of Jerusalem from the oppressions of Antiochus Epiphanes, King of Syria, by the Maccabees in 164 B.C. The institution of this festival is related in 1 Maccabees iv, 47-59. In the New Testament (John x. 22) it is mentioned under the name of ἐγκαίνια (εὐκαίνια), "dedication." The principal feature in the observance of this festival is the lighting of lights in the synagogue, as well as in private houses, whence it is also called the "feast of lights." (Compare Josephus, Antiquities, xii, 7, 7.)

On the first night one light is lit, on the second two, and so on to the eighth. The lights are set in a place where people on the street may see them, in the window or by the door. They are considered sacred, and must not be employed for any ordinary purpose. For this reason a "servant light" (shammash) is placed next to them, which is used in lighting them. Rabbinical tradition accounts for this feature of the feast by the story that when the priests entered the sanctuary after the Syrians had been driven out, to light the perpetual lamp, they found a vial of sacred oil unpolluted, which, under ordinary circumstances, was only sufficient for one night, but by a miracle lasted for eight nights, until new oil could be prepared for the lamps of the candlestick.

When possible, lamps burning olive oil are to be used, though frequently candles made of pure beeswax are employed. In the syna-
gogues there is usually for this purpose a lamp made after the form of the candlestick (menorah) of the tabernacle and temple, as described in Exodus xxxv, 31-140. Measurements, 10 2/3 inches long; 2 3/4 inches wide. (Plate LXXVIII, fig. 2, Cat. No. 130295, U.S.N.M.)

113. Hanukah Lamp.—Made of brass. Height, 7 1/2 inches; width at base, 6 1/4 inches. (Plate XCVIII, fig. 2, Cat. No. 154591, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.

114. Hanukah Lamp.—Made of brass, in the seventeenth century. Represents the temple front, with the word "Jerusalem" in Hebrew. Height, 10 3/4 inches; width, 8 1/4 inches. (Cat. No. 3674, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.

115. Silver Hanukah Lamp.—Repoussé work. Adorned with a flower vase in the center, surrounded by other floral designs and surmounted by a crown. Measurements, 7 7/8 inches high, 7 inches wide. (Plate XCV, fig. 1, Cat. No. 248922, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.

116. Hanukah Lamp.—Made of brass, hammered work. In the center is a heart with the Hebrew words in relief: "To kindle the light of Hanukah." Lions on either side support a crown. Measurements, 10 inches high, 11 inches wide. (Plate XCV, fig. 2, Cat. No. 248923, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.

117. Hanukah Lamp.—Made of brass. Measurements, 5 inches high; 9 1/4 inches wide. (Cat. No. 4831, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.

The Feast of Esther (Purim).

118. Roll of the Book of Esther.—Parchment scroll inserted in a revolving silver case, with marginal illuminations illustrating the events narrated in the book. Written in Venice, Italy, in the seventeenth century. The silver case was once in possession of the Jews of Granada, Spain.

Five of the shorter books of the Bible—Canticles, Ruth, Ecclesiastes, Lamentations, and Esther—are called the "Five Rolls" (hamesh me'gilloth), and are read on special occasions during the service in the synagogue, namely, Canticles on Passover, Ruth on Pentecost or Feast of Weeks, Ecclesiastes on Tabernacles, Lamentations on the 9th of Ab, and Esther on the Feast of Purim. The first three are read privately by each member from his own copy during a pause in the public service (between the first part of the liturgy and the reading of the Torah). The Lamentations are chanted by the leader and members of the congregation, each reading a chapter, during the services of the 9th of Ab (August) in commemoration of the destruction of the Temple of Jerusalem. Still more ceremony is at-
tached to the reading of the Book of Esther, which takes place during the services of the Feast of Purim, and is celebrated on the 15th of Adar—(March-April) to commemorate the deliverance of the Jews of Persia from the machinations of Haman. For this purpose a parchment scroll, written in the same manner as the Pentateuch (see The Torah Scroll, p. 706), is used. The reading takes place from the same desk as that of the Torah, and is preceded and followed by a benediction. At certain passages the congregation joins in, reciting them before the public reader. The Book of Esther is therefore known as the roll (megillah). Another feature of the feast of Esther or Purim is the presenting of gifts to friends and the poor. Height of scroll, 8 inches. (Plate XCVI, fig. 1, Cat. No. 154592, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.

119. Roll of the Book of Esther.—Parchment scroll inserted in a revolving silver case. Written in Smyrna, Asia Minor, in the eighteenth century. The case was once in possession of the Jews of Granada, Spain. Height of scroll, 8 inches. Plate XCVI, fig. 2, Cat. No. 154592b, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.

120. Roll of the Book of Esther.—Written in columns of eight lines and about an inch wide, on a scroll of vellum seven-eighths of an inch wide, and inserted in a hexagonal revolving silver case, surmounted by a cupola, from which rises a crescent and star, the emblem of the Mohammedan peoples. Height of case, 1½ inches; diameter, 1 inch. Made in Fez, Morocco. (Plate XCVI, fig. 3, Cat. No. 158347, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.

121. Benedictions recited at the reading of the Megillah.—Manuscript, written on leather. Measurements, 7½ by 5 inches. (Cat. No. 158464, U.S.N.M.)

122. Book of Esther.—Manuscript, written on parchment. The columns of the text are divided by columns in pen and ink drawing. The margins on top and at bottom are illuminated, likewise in pen and ink drawings, with floral designs and scenes illustrating the events narrated in the book. Height, 10 inches. (Cat. No. 3634, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.

123. Silver case for the Book of Esther.—With designs of vases and flowers in hammered work. Height, 13½ inches. (Cat. No. 3635, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.


Lent by Mr. David Sulzberger.
125. MANUSCRIPT OF THE BOOK OF ESTHER.—Written on leather. Height, 7 inches. (Cat. No. 158465, U.S.N.M.)

IV. OBJECTS USED ON SPECIAL OCCASIONS AND INCIDENTS OF LIFE.

126. SILVER SET OF INSTRUMENTS USED AT THE RITE OF CIRCUMCISION.—Consisting of knives, scissors, shields, platters, boxes for powders, etc.

The rite of circumcision (milah) is practiced in pursuance of Genesis xvii, 10-12: "This is My covenant, which ye shall keep, between me and you and thy seed after thee; every male among you shall be circumcised. And ye shall be circumcised in the flesh of your foreskin; and it shall be a token of a covenant betwixt me and you. And he that is eight days old shall be circumcised among you, every male throughout your generation." Circumcision is accordingly performed on the eighth day after the child's birth. But in case of sick or weak children it is postponed until they are strong enough to undergo the operation. The performance of the rite of circumcision is accompanied by the recital of prayers and benedictions and is combined with the naming of the child.¹

Circumcision was common in Egypt as early as the fourth dynasty.² At the present day it prevails among the Kaffirs and some negro tribes of Africa, in parts of Australia, in many of the South Sea Islands, and it is said to be practiced by the Abyssinian Christians as a national custom. Early Spanish travelers found it to be prevalent in the West Indies, Mexico, and among tribes in South America. It is a common rite among Mohammedans everywhere. (Cat. No. 3631, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.

127. SILVER CUP AND KNIFE USED AT CIRCUMCISION. (Plate LXXXI, figs. 1-3, Cat. No. 154435, U.S.N.M.)

128. LITURGY OF THE RITES OF CIRCUMCISION AND REDEMPTION OF THE FIRSTBORN.—Manuscript, written on parchment. Dated, 1840. The redemption of the firstborn (pidyon ha-ben) is observed in compliance with Exodus xiii, 2, 12-15, compare Numbers xviii, 15, according to which the firstborn was considered as particularly belonging to God because when the Lord slew the firstborn in the land of Egypt He spared the firstborn of the Israelites. The rite takes place on the thirty-first day after the child's birth, and consists, in accordance with Numbers xviii, 16, in the parents giving a sum to the value of 5 shekels (about $2.50) to a priest, i.e., a descendant of Aaron. If either of the parents belongs to the family of Aaron, or to the tribe of Levi, the child need not be redeemed. The law applies only to the firstborn of the mother, but not of the father. The ceremony is

² Compare Herodotus ii, 36, 37, 104; Wilkinson, Ancient Egypt, ch. xv.
accompanied by prayers and benedictions, and, like circumcision, is the occasion of a festival. (Cat. No. 156047, U.S.N.M.)

129. Wrapper used on the occasion of carrying a child to synagogue.—Linen with embroidered inscription in Hebrew reading: “Jacob, surnamed Kapel, son of Naphthali Shalita, surnamed Hirsh Heller, born Wednesday, the 15th of Shebat (January–February) 5604 (1844). May the Lord let him grow up to the study of the Torah, to marriage and good works. Amen. Selah.” Made in France.

Among Jews it is the custom when a child is brought for the first time to the synagogue that the father takes it to the desk, where the lesson from the Law is read during service, and presents a wrapper for the Torah scroll. Length, 9 feet 4 inches; width, 6 inches. (Plate XCVII, Cat. No. 154605, U.S.N.M.)

Lent by Hadji Ephraim Benguïat.

130. Wrapper used on the occasion of carrying a child to synagogue.—Made of white linen, and embroidered in variegated silk with figures of plants, birds, and animals, and Hebrew inscription, giving the name of the child as Meir, son of Judah Gomperz, born 15572 A. M. (1812 A. D.). Length, 12 feet; width, 7½ inches. (Cat. No. 4535, U.S.N.M.)

Lent by Hadji Ephraim Benguïat.

131. Wrapper used on the occasion of carrying a child to synagogue. (Similar to No. 130). Length, 9 feet 7 inches; width, 7 inches. (Cat. No. 5556, U.S.N.M.)

Lent by Hadji Ephraim Benguïat.

132. Wrapper used on the occasion of carrying a child to synagogue.—Made of linen, embroidered with Hebrew inscription, giving the name of the child as David, son of Judah, born 5598 A. M. (1838 A. D.). Length, 11 feet 3 inches; width, 7½ inches. (Cat. No. 154447, U.S.N.M.)

Gift of Mr. David Sulzberger.

133. Ode of a Siyum.—Written on parchment and richly illuminated.

With the orthodox Jews the study of the Bible, and especially of the Pentateuch or Torah, is considered a religious duty as well as a means of culture. As soon, therefore, as the young scholar has mastered the elements of Hebrew he studies in school the Pentateuch with some standard commentaries. His first reading through of the whole Pentateuch is sometimes the occasion of a family festival, called siyum, i.e., completion. The young student recites passages from the Pentateuch or makes a short speech, and receives presents from relatives and friends.

This also takes place sometimes after the finishing of a tract of the Talmud. This ode by an unknown poet celebrates such a siyum of a
young student of a prominent family in Rome, named Isaac Berachyah, son of Mordechai Raphael.

After an introductory historical note the ode relates the merits and virtues of the family of the student, and extols the advantages of the study of the sacred law of God. The singing of the ode was distributed to different voices, which are marked at the various stanzas. The margin contains, besides the arms of the family and some symbolical figures, the last parashah or pericope, which is read in the synagogue on the last Sabbath of the year, Deuteronomy, xxxiii—xxxiv (the blessing of Moses and the record of his death). (Plate XCVIII, Cat. No. 1546377 U.S.N.M.) Measurements, 23\(\frac{1}{2}\) by 18 inches.

134. Marriage Contract.—Manuscript written on parchment and illuminated.

Marriage is usually preceded by an engagement or betrothal, on which occasion it is customary among some Jews to draw up a formal writ of agreement between the bride and groom, whence the ceremony is called tena'im, "articles of agreement," which set forth the stipulations preliminary to the agreement to marry. The marriage ceremony takes place under a canopy (huppah) of silk or velvet about two yards square, supported by four poles. The bride and bridegroom are led under it by their parents and friends. The rabbi, or anyone competent to perform the ceremony, takes a cup of wine, and after pronouncing an appropriate blessing, gives it to the bride and bridegroom to taste. The bridegroom then places a ring on the finger of the bride with the words: "Behold, thou art wedded to me by this ring, according to the law of Moses and Israel." This act, which is called sanctification or consecration (kiddushin), in itself makes the marriage valid. Then the marriage contract is read. This is written in an Aramaic dialect after an established form usually beginning with the words: "Under good auspices, and with good luck to bridegroom and bride, 'Whoso findeth a wife findeth a good thing, and obtaineth favor of the Lord.'" It states that the bridegroom agrees to take the bride as his lawful wife, and that he will keep, maintain, honor, and cherish her, etc., and also specifies the sum he settles upon her in case of his death. The minimum of the dowry is fixed by the law to be 200 zuz (about $30) for a virgin and 100 (about $15) for a widow or divorced woman. To this is usually added what the bride has received from her parents and what the husband settles on her voluntarily, all of which she gets in case of the death of the husband, or of divorce.

After that the bridegroom crushes an empty glass with his foot in remembrance of the destruction of Jerusalem.\(^a\) The rabbi, or

\(^a\) Compare Psalms cxxxvii, 5.
whosoever performs the ceremony, takes another cup of wine, pronounces over it seven benedictions, and hands it again to the bride and bridegroom, who taste it, and the ceremony is then concluded.

The contract is dated Rome, in the year of creation 5576 (1816). The contracting parties are Elijah Saki and Masal-Tob (Fortune), of Castelnuovo. The witnesses to the contract are Joshua Gerson Ashkenazi and Michael Hayim Megula.

The margin is decorated with various symbolical figures, and contains the liturgy of the wedding ceremony and passages from the Bible and the Talmud referring to marriage and married life, artistically intertwined in garlands. Above, in the center, are probably the arms of the bridegroom; to the right a boy standing on a wheel pouring out the horn of plenty, with the motto: "All depends on merit and good luck;" to the left a female figure with tambourines, and the words: "Peace and welcome to those nigh and far." Below, to the right, is a female figure holding two burning hearts linked together by a chain, with the adage: "A well-mated couple is chosen by God" (marriages are made in heaven); to the left another female figure holding a tambourine and a flower, with a quotation from Isaiah xxxii, 8. The representation at the bottom, of Elijah ascending to heaven in a fiery chariot, his mantle falling on his disciple and successor Elisha, was probably suggested by the name of the bridegroom.

Measurements. 30 by 19\(\frac{1}{2}\) inches. (Plate XCIX, Cat. No. 153633, U.S.N.M).

135. Gold Wedding Ring.—Made in form of two hands linked. The Jewish marriage is made valid by the kiddushin, that is, by the bridegroom putting a ring on the hand of the bride while saying the words: Behold thou art wedded to me by this ring, according to the law of Moses and Israel. (Cat. No. 154435, U.S.N.M.)

136. Marriage Contract.—Manuscript, written on parchment and illuminated. Dated Rome, 5590 A. M. (1830 A. D.). The contracting parties are Mahalalel of Susa and Virtuosa Binah. The witnesses are Joshua Gerson Ashkenazi and Moses Milano. The margin is decorated with floral designs and figures. To the right is a female figure holding a crown and an olive branch; to the left is that of Justice with scales and sword; while below an old man points the young wanderer on the pathway of life heavenward. Measurements, 32\(\frac{1}{2}\) by 21\(\frac{3}{4}\) inches. (Cat. No. 154630, U.S.N.M.)

137. Marriage Contract.—Manuscript, written on parchment and illuminated. Dated Rome, 5597 A. M. (1837 A. D.). The contracting parties are Aaron Marcus and Quintiliana of Capua. The witnesses are Joshua Gerson Ashkenazi and Raphael Johanan Ephraim Casnulu. The margin is ornamented with floral designs and figures. Above is the representation of a young couple bound

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a II Kings ii. 11-13.
together by a ribbon wound around their necks from which a heart is suspended. At the bottom is the figure of the high priest in full robes, probably suggested by the name of the bridegroom, Aaron. Measurements, 3\frac{1}{2} by 20\frac{1}{2} inches. (Cat. No. 154631, U.S.N.M.).

138. Marriage Contract.—Manuscript, written on parchment and illuminated. Dated Rome, 5512 A. M. (1751 A. D.). The contracting parties are Macliah de Castro and Rebekah Tarmi. The witnesses are Mahanalal Modilitani and Hezekiah Amrin. The margin is decorated with floral designs and Biblical passages referring to marriage and married life. Measurements, 33\frac{1}{2} by 20\frac{1}{2} inches. (Cat. No. 154632, U.S.N.M.).

139. Document of Betrothal (tena'im) and Marriage Contract (kethubah).—Manuscript, written on parchment and illuminated. Dated Livorno (Leghorn, Italy), 5479 A. M. (1719 A. D.). The contracting parties are David, son of Abraham Rodriguez Miranda, and Dona Esther, daughter of Moses Franco. The decoration is in form of a facade of a Greek temple, the columns upholding the coats of arms of the bridegroom and bride, which are flanked on either side by angelic figures blowing trumpets. The documents— the kethubah to the right and the tena'im to the left—are framed by a curtain which is raised by two Cupids on either side. On the bases of the columns are inscribed, in allusion to the names of the bridegroom and bride, the passages: “And David behaved himself wisely in all his ways, and the Lord was with him” (I Samuel xviii, 14), and, “And Esther obtained favor in the sight of all of them that looked upon her” (Esther ii, 15). Measurements, 37 by 24 inches. (Cat. No. 216162, U.S.N.M.)

Lent by Mr. S. S. Howland.

140. Marriage Contract.—Manuscript, written on parchment and illuminated. Dated Aquila (or Aquino (?), Italy), 5600 A. M. (1840 A. D.). The contracting parties are Simeon Jedidiah, son of Jeushin, and Bella Leah, daughter of Eliezer Cohen. The margin is decorated with a representation of the city of Jerusalem, the signs of the Zodiac, the emblems of the twelve tribes, floral designs, and Biblical passages. Measurements, 27 by 19 inches. (Cat. No. 3681, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.

141. Marriage Contract.—Written on parchment in the so-called Rashi or Rabbinical script with gilded initials and decorated borders. Height, 12 inches; width, 18\frac{1}{2} inches. Dated Haskeuy. Constanti-nople, the 7th of Tishri (September–October), 5361 A. M. (1601 A. D.). The contracting parties are Solomon Medinah and Mereada, daughter of Moses Firmon.

Lent by Hadji Ephraim Benguiat.

142. Marriage Contract.—Manuscript, written on parchment and illuminated in gold and colors, with flowers and Biblical passages.
Dated 5509 A. M. (1749 A. D.). The contracting parties are Joseph and Rebekah. Height, 2 feet 9 3/4 inches; width, 25 1/4 inches. (Cat. No. 3680, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.

143. Marriage Contract.—Written on parchment. The margins are richly decorated; of the writing only a few traces are left, which, however, exhibit fine workmanship. Height, 20 1/4 inches; width, 18 1/4 inches.

Lent by Hadji Ephraim Benguiat.

144. Burial Prayers.—Manuscript written on parchment. The prayers, which are recited at the cemetery at the open grave, are expressive of submission to God's will and include the kaddish or "holy," that is, a doxology, acknowledging God's holiness and greatness. The kaddish is repeated at every service during the first year of mourning and on the anniversaries of the death. It is believed by many Jews that the recital of the kaddish benefits the deceased. Measurements, 2 feet 2 inches by 9 inches. (Cat. No. 158354, U.S.N.M.)

Gift of Mr. David Sulzberger.

V. MISCELLANEOUS.

145. Costume of a Rabbi in Mohammedan Countries.—Consisting of trousers, inner robe of striped silk reaching below the knees and held by a girdle round the waist, outer coat of cloth, with short, ample sleeves, shawl, shoes with goloshes, and headgear of red felt, around which a piece of gray silk is twisted like a turban. When the Jews first settled in Mohammedan countries they were compelled by a decree to wear a dress different from that of the Mohammedans. At present the decree has been suspended, but many of the Jews continue to wear a distinctive costume. It is chiefly marked in the color of the turban. That of the Mohammedans is of white muslin or cashmere, while the Jews wear black, blue, gray, or light-brown turbans and generally dull-colored dresses. (Cat. No. 154761, U.S.N.M.)

146. Knife with its sheath, used for slaughtering of animals.—The killing of animals, that is mammals and birds, for food is performed by cutting through the windpipe and gullet, with a perfectly sharp and smooth knife called halaf, by a swift motion forward and backward across the throat of the animal. The act of slaughtering is called shehitah, and the person performing it is called shohet. He must be qualified by knowledge and skill. The knife must be thoroughly examined by him before and after the killing, and if it be found to have a notch (pegimah), the animal killed with it is ritually unfit for fool (terefah). The shehitah is followed by the bedikah, i.e., examination, first of the throat of the animal to ascertain whether the windpipe and gullet are cut through according to the
requirements of the Law; then of the various vital organs, especially the lungs. If they are found to be in any way tainted with disease, the animal is unfit to be eaten. The act of slaughtering is accom-
ppanied by benedictions. Length, 25 inches. (Plate LXXVIII, fig. 3, Cat. No. 154619, U.S.N.M.)

Gift of Mr. David Sulzberger.

147. Brass Tray, pewtered.—In the center is, in hammered work, a representation of the candlestick (menorah), with the inscription in Hebrew: “To kindle the light of Hanukah, of Sabbath and the fes-
tivals of the entire year, 5580” (1820), surrounded by a floral de-
sign. On the rim are the signs of the zodiac with their Hebrew names and those of the Hebrew months. Made in Russia. Diameter, 14\(\frac{3}{4}\) inches. (Cat. No. 4828, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.

148. Brass Plate, pewtered.—In the center is, in hammered work, the representation of a building, with the inscription on the rim in Hebrew: “This is the home for the aged in the city of Prague, 5585” (1825). Made in Russia. Diameter, 8\(\frac{3}{4}\) inches. (Cat. No. 4829, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.

149. Brass Plate, pewtered.—In the center is, in hammered work, the representation of a synagogue, with the inscription in Hebrew on the rim: “Synagogue of Jerusalem, 5565” (1805). Made in Rus-
sia. Diameter, 8\(\frac{3}{4}\) inches. (Cat. No. 4830, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.

150. Tray made of lead, coppered.—Inscribed in Hebrew with the passages: “The blessing of the Lord it maketh rich,” and “The righteous eateth to the satisfying of his soul, but the belly of the wicked shall want,” Proverbs x. 22; xiii. 25, and the name of Isaac Beruro. Diameter, 3 feet 3\(\frac{1}{2}\) inches. (Cat. No. 3717, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.

151. Mizrahi.—Manuscript, inscribed with Psalm lxvii arranged in the form of the candlestick (menorah), with the Decalogue, and other Biblical passages, and illuminated with the three crowns of the Law, priesthood and kingdom, the “shield of David,” and with flowers. Mizrahi, that is, east, properly the place of the rising sun, is used to designate an ornamental picture, hung on the eastern wall of a house or in front of the praying desk in the synagogue, to indi-
cate the direction of the face when at prayer, so as to be turned toward Jerusalem. The custom of facing east while at prayer, ob-
served by the Jews living west of Palestine, is already mentioned, Daniel vi, 11. Compare I Kings viii, 38. East of Jerusalem the west direction would be chosen: north of Jerusalem the south. (See No. 157.) Height, 16\(\frac{1}{2}\) inches; width, 11 inches. (Plate C. Cat. No. 3683, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.
152. Mizrah.—Manuscript, inscribed with Psalm lxvii in form of the candlestick (menorah), the Decalogue, the names of the planets and zodiac, with the names of God and of angels, and illuminated with the "Shield of David," the crowns of the Law, the priesthood, and the kingdom. Height, 14½ inches; width, 12½ inches. (Cat. No. 3685, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.

153. Mizrah.—Manuscript, inscribed with Psalm lxvii and prayers and illuminated in colors. Height, 13½ inches; width, 10 inches. (Cat. No. 3684, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.

154. Mizrah.—Manuscript, inscribed with various names of God and prayers. Height, 11¾ inches; width 12¾ inches. (Cat. No. 3686, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.

155. Mizrah.—Print on cardboard. (Cat. No. 154417, U.S.N.M.)

156. Mizrah.—Panel of cream-colored silk, embroidered with the figures of Abraham and Isaac, and Biblical passages. Height, 15½ inches; width, 20¼ inches. (Cat. No. 4560, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.

157. Darom, that is, "South."—Panel of cream-colored silk, embroidered with the figures of Joseph and Phineas (as the representatives of chastity. Genesis xxxix. and Numbers xxv). Height, 15½ inches; width, 20¼ inches. (Cat. No. 4561, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.

158. Mezuzah.—The mezuzah consists of the passages Deuteronomy vi. 4-9, and xi. 13-21, written on parchment in the same manner as the Torah scroll and the phylacteries, and inserted in a wooden or metal case or glass tube. On the outer side is written the Hebrew name of God, Shaddai, "Almighty," and a small opening is left in the case opposite this word. The case is fastened in a slanting position to the right-hand side of the doorpost (hence its name, mezuzah, which means "doorpost"). in compliance with the words: "And thou shalt write them (the words of the Lord) on the doorposts of thy house and within the gates" (Deuteronomy vi. 9: xi. 20). Pious Jews touch and kiss the mezuzah as they pass through the door. In the Orient the entire Decalogue enclosed in a tin case is sometimes nailed to the doorway. Some people attribute a protective power, especially in warding off evil spirits, to the mezuzah. The custom has been widely adopted by other peoples of the East, particularly by Mohammedans, who write passages from the Koran over the doors and windows of their homes. (Plate CI. fig. 1. mezuzah, encased in a quill: fig. 2. mezuzah in a tin case: fig. 3. mezuzah in a glass tube: fig. 4. mezuzah unfolded. (Cat. No. 154584, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.
159. **Mezuzah in silver case of chased work, made in Russia.**—
Inscribed in Hebrew with the words: A fruitful bough, even a fruitful bough by a well (Genesis xlix, 22). Height, 3½ inches. (Cat. No. 4564, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.

160. **Miniature mezuzah in silver case, attachable to a chain.**—
Supposed to have been worn as a talisman. Height, 1½ inches. (Cat. No. 4565, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.

161. **Mezuzah.—Parchment manuscript. Measurements. 5 by 4½ inches.** (Cat. No. 4566, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.

162. **Mezuzah.—Parchment manuscript from Palestine. Measurements, 6 by 5½ inches.** (Cat. No. 216161, U.S.N.M.)

Lent by Mr. S. S. Howland.

163. **Mezuzah in metal case.—Height. 3 inches.** (Cat. No. 158353, U.S.N.M.)

Gift of Miss Ottenberg.

164. **Scriptural motto.—Made of red silk and embroidered in gold, with the Hebrew passages:** "Let thy garments be always white, and let not thy head lack ointment" (Ecclesiastes ix. 8), and "I will dwell in thy tabernacle forever; I will take refuge in the covert of thy wings. Selah." (Psalms lixi, 4). Made in Smyrna, Asia Minor, at the beginning of the nineteenth century. Length, 27½ inches; width, 7½ inches. (Cat. No. 491, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.

165. **Piece of Olivewood from Jerusalem.**—Engraved in relief with a representation of the Tomb of the Prophet Zechariah. Height, 9 inches; width, 7 inches. (Cat. No. 3618, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.

166. **Silver medal.**—Struck in commemoration of the edict of Emperor Francis Joseph I of February 18, 1860, granting the Israelites of his Empire the right to own real estate. On the obverse are in relief, to the right, a crowned female figure holding a scroll inscribed in Hebrew: "One people and one nation:" to the left, the figure of a boy holding in his right hand a wreath, in his left a palm branch. Between the figures are, above, two tablets, inscribed in Hebrew: "One law for us all:" beneath, the bust of the Emperor and the double eagle of the imperial standard. The margin and bottom of the medal have appropriate German legends, expressive of the gratitude of the Israelites. The reverse is inscribed with the paragraphs of the edict bearing on the subject. Diameter, 2½ inches; thickness, one-fourth inch. (Cat. No. 154615, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.
167. Delegate’s card of the first Zionsists’ Congress.—Engraved with the Shield of David, symbolical figures, and the words in Hebrew: “Oh that the salvation of Israel were come out of Zion!” (Psalm xiv. 1.) “Zionism” is the name given to the movement among the Jews which aims at establishing for their people a publicly and legally secured home in Palestine. It was organized and held its first congress in 1897, in Basle, Switzerland. Measurements. 5 1/4 inches by 3 2/8 inches. (Cat. No. 158458. U.S.N.M.) Basle, Switzerland.

168. Delegate’s card of the second Zionsists’ Congress.—Engraved with the Shield of David, symbolical figures, and the words in Hebrew: “Behold, I will take the children of Israel from among the nations, and bring them into their own land” (Ezekiel xxxvii, 21). Measurements. 5 1/2 by 5 2/8 inches. Basle, Switzerland. (Cat. No. 158459. U.S.N.M.)


VI. AMULETS.

Amulets are charms, or preservatives against evil spirits, witchcraft, the evil eye, or disease. They are made of stone, metals, animal products, etc.; in fact, of any substance. The most common consists of words, characters, or sentences ranged in a particular order and written on parchment, or engraved upon wood, stone, or metal, and worn about the neck or some other part of the body. Amulets are found in use among nearly all peoples and religions of ancient and modern times.

170. Amulet on parchment.—Written for Hadji Ephriam Benguiat when he was sick in childhood. Length, 9 1/4 inches; width, 1 3/4 inches. (Plate CI, fig. 5, Cat. No. 154611, U.S.N.M.)

Lent by Hadji Ephriam Benguiat.

171. Silver medallion, used probably as an amulet.—Filigree work. On one side is, in gilt relief, the Hebrew name of God, Shaddai (“Almighty”); on the other the figure called “Shield of David” (Magen David), with a fleur-de-lis inside. Height, 2 5/8 inches; width, 1 5/8 inches. (Plate CI, fig. 6, Cat. No. 154613, U.S.N.M.)

Lent by Hadji Ephriam Benguiat.

172. Two silver rings, used as amulets.—Engraved with the name of the owner, “Ephriam Benguiat,” and cabalistic words. Diameter, three-fourths inch. (Cat. No. 154612. U.S.N.M.)

Lent by Hadji Ephriam Benguiat.

173. Silver coin.—On the obverse is, in relief, a seated female figure laying her right hand in blessing upon the head of a boy stand-
ing in front of her. The margin is inscribed with part of the Aaronite blessing in German, "The Lord bless thee and keep thee," while the chair on which the female figure is seated is adorned with the monogram of Christ (_above_the_cross). At the bottom is the name "Abramson." On the reverse is, on the top, the name of God, "Jehovah," in Hebrew characters, with rays of the sun going out from it, surrounded by the inscription in German, "Light and truth." It may have originated with some cabalistic sect and have been used as a talisman. Diameter, 1\(\frac{1}{2}\) inches. (Cat. No. 1288, U.S.N.M.)

Lent by Hadji Ephraim Benguiaut.

174. **Amulet.**—Manuscript, written on paper and illuminated in colors. The amulet is used by some Jews on the occasion of childbirth, when it is put up over the doors and windows of the room to protect the mother and newly-born child against evil influences, especially of Lilith, who is mentioned in Isaiah xxxiv, 14 (rendered in the authorized version by screech owl, in the revised version by night monster), and in later Hebrew literature is depicted as a female demon roaming in the night. The amulet contains various passages from the Scriptures, names of God, angels, Lilith, and invocations against her. Measurements, 17\(\frac{1}{2}\) by 14\(\frac{1}{2}\) inches. Tunis, North Africa. (Plate CII, Cat. No. 217693, U.S.N.M.)

175. **Two Amulets.**—Printed on paper. Used for protection in childbirth. The amulets contain in Hebrew Psalm cxxi, names of God, of angels, and of Lilith, and invocations against her. Vienna, Austria. (Cat. No. 214452–3, U.S.N.M.)

Gift of Dr. Fr. S. Krauss.

176. **Amulet.**—Manuscript, written on parchment. Contains Psalm lxvii arranged in form of the candlestick (menorah), various other passages from the Scriptures, names of God and angels, and prayers for protection from evil spirits and various physical and mental ailments. Measurements, 13\(\frac{1}{2}\) by 8\(\frac{1}{2}\) inches. Tunis, North Africa. (Cat. No. 217688, U.S.N.M.)

177. **Amulet.**—Manuscript, written on vellum. Contains Psalm lxvii arranged in shape of the candlestick (menorah) and Psalm xci, with various other passages from the Scriptures, names of God and angels, with invocations for the protection of Daniel, son of Berukah, against evil. Measurements, 14\(\frac{1}{2}\) by 6\(\frac{1}{2}\) inches. Tunis, North Africa. (Cat. No. 217689, U.S.N.M.)

178. **Amulet.**—Manuscript, written on vellum. Inscribed with the names of God and angels, and invocations for the protection of Daniel, son of Berukah, against evil spirits, witchcraft, and other misfortunes. Measurements, 9\(\frac{1}{2}\) by 5 inches. Tunis, North Africa. (Cat. No. 217690, U.S.N.M.)

179. **Amulet.**—Manuscript, written on parchment. Contains passages from the Scriptures, names of God and angels, and invocations
for the cure of Deborah, daughter of Rachel, from bodily and mental
cal'adies and protection from evil influences. Measurements, 9\frac{1}{2} by
9\frac{1}{2} inches. Tunis, North Africa. (Cat. No. 217691, U.S.N.M.)

180. Amulet.—Manuscript, written on parchment. Contains
passages from the Scriptures, names of God and angels, and invoca-
tions, artistically strung together, for the cure and protection of
Hannah, daughter of Rachel. Measurements, 7\frac{1}{2} by 7\frac{1}{2} inches. Tunis,
North Africa. (Cat. No. 217692, U.S.N.M.)

181. Round Bronze Amulet.—On the obverse is the figure of Mars,
in relief, as symbol of the planet of the same name, surrounded by
an inscription in French and Hebrew, reading: “To serve according
to the intention of G. W. L. D. Corson, with the name of Jehovah”;
the reverse is inscribed with a magic square and various cabalistic
names of angels. Diameter, 3\frac{1}{4} inches. (Plates CHI and CIV, fig.
1, Cat. No. 3610, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.

182. Round Bronze Amulet.—On the obverse is the figure of
Mercury in relief, as symbol of the planet of the same name, sur-
rounded by an inscription in French and Hebrew, reading: “To serve
according to the intention of G. W. L. D. Corson, with the name of
Jehovah”; the reverse is inscribed with a magic square and various
abalistic names of angels. Diameter, 3\frac{1}{4} inches. (Plates CHI and
CIV, fig. 2, Cat. No. 3611, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.

183. Silver Amulet.—Repoussé work. Made in form of a vase.
On one side are represented the tables of the Law, or Decalogue,
in Hebrew, and the candlestick; on the other the perpetual lamp
and a cup. On either side is the Hebrew name of God, Shaddai,
or “Almighty.” Measurements, 5\frac{1}{2} by 3\frac{1}{2} inches. (Cat. No. 3608,
U.S.N.M.)

Lent by Hadji Ephraim Benguiat.

184. Silver Amulet.—Repoussé work in Louis XV style. Made
in form of a flower vase. Between the flowers arising from it are
two gilded tablets engraved on one side with the Decalogue, on the
other with the Hebrew name of God, Shaddai, or “Almighty.”
Surmounted by a gilded crown, while the bottom is fringed with
small gilded bells. Measurements, 6\frac{1}{2} by 3\frac{1}{2} inches. (Cat. No.
4832, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.

185. Gold Disk.—On the obverse is a representation of the Tem-
ple, surrounded by the inscription, in Hebrew: “May Jerusalem, the
holy city, and the Temple be rebuilt and established soon, Amen”; on
the reverse is seen the candlestick with the legend: “Of beaten work
shall the candlestick be made: his shaft, and his branches, his bowls,
his knops, and his flowers, shall be of the same” (Exodus xxv, 31).
Mr. Benguiat thinks that the disk originated soon after the destruc-
tion of the Temple, and that only two copies of it are known to be in existence. It was perhaps intended for an amulet. Diameter, $2\frac{1}{8}$ inches. (Cat. No. 3639, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.

186. Silver Medal.—On the obverse bust of Moses; on the reverse these words, in Hebrew: "Thou shalt have no other Gods before me" (Exodus xx, 3). Probably used as an amulet. Diameter, 1 $\frac{1}{4}$ inches. (Plates CIII and CIV, Cat. No. 3640, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.

187. Bronze Medal.—The same as the foregoing, No. 3640. (Cat. No. 3641, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.

188. Silver Amulet.—Plaque engraved in two columns with cabalistic words. Measurements, $2\frac{1}{4}$ by $1\frac{3}{8}$ inches. (Cat. No. 3613, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.

189. Silver Amulet.—Plaque engraved with the Hebrew names of the four rivers of Paradise—Pison, Gihon, Hiddekel, and Euphrates—mentioned in Genesis ii, 11-14, in various mutations and positions of the words and letters. Measurements, $2\frac{1}{4}$ by $1\frac{3}{8}$ inches. (Cat. No. 3614, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.

190. Silver Amulet.—The same as the foregoing. Measurements, $1\frac{1}{2}$ by $2\frac{1}{2}$ inches. (Cat. No. 3615, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.

191. Silver Amulet.—Plaque with the Hebrew name of God, "Jehovah," in repoussé work (fragment). Measurements, $1\frac{1}{4}$ by $1\frac{1}{4}$ inches. (Cat. No. 3616, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.

192. Silver Amulet.—Plaque with names of God scratched on it. Measurements, $2\frac{1}{4}$ by $2\frac{1}{2}$ inches. (Cat. No. 3617, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.

193. Parchment Amulet.—Inscribed with the Hebrew name of God, "Jehovah," in various mutations of the position of the letters. In metal frame. Measurements, $4\frac{1}{3}$ by $3\frac{1}{4}$ inches. (Cat. No. 3609, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.

194. Gilded Nickel Signet Ring.—Engraved, in Hebrew, with the name of "Solomon, son of Napthali," and the sign of pisces. Diameter, seven-eighths of an inch. (Cat. No. 4833, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.

195. Silk Cap.—Embroidered in gold with the Hebrew name of God, Shaddai, "Almighty," and cabalistic names of angels. (Cat. No. 3632, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.

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196. Piece of silk brocade in form of a badge.—Embroidered in gold and silver with the Hebrew name of God, Shaddai, "Almighty," and cabalistic names of angels. Measurements, 23 by \(\frac{1}{2}\) inches. (Cat. No. 3630, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.

197. Amulet.—Consisting of a golden hand, engraved with the Hebrew name of God, Shaddai, "Almighty." Length, 2 inches. (Cat. No. 154436, U.S.N.M.)

198. Amulet.—Lead disk containing on the obverse the words, in Hebrew: "May this boy grow up for the Law, marriage, and good works," with an abbreviation of the name of God, "Jehovah," in the center. On the reverse is, likewise in Hebrew, a prayer for the protection of the child against the evil eye and the croup. Diameter, \(1\frac{1}{2}\) inches. (Cat. No. 211943, U.S.N.M.)

Collected by Mr. Edward Lovett, 1901.

199. Parchment Amulet.—Inscribed with the names of God and angels, and prayers for protection from evil and for success. Diameter, 3 inches. (Cat. No. 154453, U.S.N.M.)

VII. ILLUSTRATIONS OF BIBLE NARRATIVES, MOSTLY TEXTILES.

200. The Sacrifice of Isaac.—As related in Genesis, chapter xxii. Silk embroidery on linen, made in Greece, Gothic period. Length, 22 inches; width, 7\(\frac{1}{2}\) inches. (Cat. No. 154607, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.

201. The Defeat of Goliath by David.—As described in I Samuel, chapter xvii. Silk embroidery on linen, made in Greece, Gothic period. Length, 5 feet 5 inches; width, 11 inches. (Cat. No. 154608, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.

202. The Story of David and Bathsheba.—As related in II Samuel, chapter xi. English petit point silk tapestry of the Elizabethan period. Length, 29 inches; width, 10\(\frac{1}{2}\) inches. (Cat. No. 154609, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.

203. Eight embroidered Pictures, illustrating the story of Joseph.—The background and bodies of the figures are executed in variegated silk threads, while the heads, arms, and feet are hand painted. In gilded frames. The episodes from the history of Joseph depicted are: (1) Joseph is drawn out of the pit (Genesis xxxvii, 28); (2) Joseph is sold to the Ishmaelites (xxxvii, 28); (3) Joseph's coat of many colors is brought to his father (xxxvii, 32); (4) Joseph's temptation (xxxix, 12); (5) Joseph in prison (xxxix, 20); (6) Joseph's brothers come to Egypt to buy grain (xlii, 8); (7) The finding of Joseph's cup in the sack of Benjamin (xlv, 12); (8)
Joseph embraces his father, Jacob, in Egypt (xlvi, 29). Measurements, 11 by 13 inches. (Cat. No. 248927, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.

204. Joseph and the wife of Potiphar.—As related in Genesis xxxix, 7. Oil painting on copper. Height, 21 $\frac{1}{2}$ inches; width, 18 inches. (Cat. No. 1296, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.

205. Joseph in the royal chariot in Egypt, as related in Genesis, chapter xli.—French embroidery of the Louis XV period. Height, 3 feet 4 inches; width, 6 feet 11 inches. (Cat. No. 4551, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.

206. Moses. Silk tapestry in frame.—Height, 23 inches; width, 13 $\frac{3}{4}$ inches. (Cat. No. 3679, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.

207. The passing of the Israelites through the Red Sea.—As described in Exodus xiv, 15. Lithograph. Height, 20 $\frac{1}{2}$ inches; width, 30 inches. (Cat. No. 1289, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.

208. The story of the Golden Calf.—As related in Exodus, xxxii. On the top to the right is seen Moses on Mount Sinai holding the two tables of the Law; to the left is the calf mounted on a column; below are the people dancing around it, and Aaron with his arms outstretched in depreciation. Silk embroidery. Made in Italy in the seventeenth century. Height, 11 $\frac{3}{4}$ inches; width, 14 $\frac{1}{2}$ inches. (Cat. No. 158349, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.

209. The judgment of Solomon.—As related in I Kings iii, 16. English petit point silk tapestry of the Elizabethan period. Height, 18 $\frac{3}{4}$ inches; width, 21 $\frac{1}{2}$ inches. (Cat. No. 158350, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.

210. The Prophet Elijah provided with food by ravens.—As related in I Kings xvii, 6. Silk embroidery, with the face of Elijah painted. Made in Spain in the eighteenth century. Height, 11 $\frac{3}{4}$ inches; width, 9 $\frac{1}{2}$ inches. (Cat. No. 154616, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.

211. Susanna and the Elders.—As related in the "History of Susanna" (the apocryphal chapter xiii of the Book of Daniel). Flemish tapestry of the Renaissance period. Height, 3 feet 8 $\frac{1}{4}$ inches; width, 2 feet 2 inches. (Cat. No. 154610, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.

212. The story of Judith and Holofernes.—As related in the (apocryphal) book of Judith, chapters x–xiii. Green silk embroidery on linen. Made in Greece. Gothic period. Height, 14 $\frac{1}{2}$ inches; width, 18 inches. (Cat. No. 154807, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.
213. The story of Judith and Holofernes.—Oil painting in gilded frame. Height, 19 inches; width, 22 inches. (Cat. No. 3682, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.

VIII. MANUSCRIPTS AND PRINTS.

In addition to the liturgical books described in connection with the several festivals, the following manuscripts and editions of Jewish works are in the collection:

214. Hebrew Manuscript of the Pentateuch.—Written in Samaritan characters. Probably dated from the fifteenth century A. D. The Samaritan writing is a modification of the ancient Hebrew and Phenician alphabet as preserved on the Moabite stone and the Siloam inscription and Jewish coins and seals, while the Jews subsequent to the Exile gradually adopted the so-called square or Assyrian script, which is of Aramaic origin, and is still in use among them. Height, 4 1/2 inches; width 3 1/2 inches. Palestine. (Cat. No. 216164, U.S.N.M.)

Lent by Mr. S. S. Howland.

215. Hebrew Manuscript of the Pentateuch (fragment).—The manuscript contains the book of Genesis, and Exodus to xl, 33, and is written, with the exception of a few leaves, on vellum. The original text is accompanied by the Aramaic version of Onkelos and the commentary of Rashi. Height, 11 inches; width, 5 3/8 inches. Smyrna, Asia Minor. (Cat. No. 2320, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.

216. The Old Testament in the Hebrew Language and the New Testament in Greek.—Printed by Christopher Plantin at Antwerp in 1533 A. M. (1573 A. D.). The Hebrew text is unpointed. Bound in leather, with gilt edge. Measurements, 7 inches long, 4 3/4 inches wide, and 1 inch thick. (Cat. No. 1292, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.

217. Manuscript Containing the Psalms and Various Propitiatory Prayers.—Written in a quaint, Arabizing cursive script by Abraham Zarfati at Smyrna, Asia Minor, in the year 5522 A. M. (1762 A. D.). The Psalter, besides contributing extensively to the synagogal liturgy, constitutes in itself a prayer book of the Jews. It is recited in part or in its entirety by pious Jews as a means of prayer and devotion. Measurements, 6 inches long, 4 inches wide, 3 1/2 inch thick. (Plate CV, Cat. No. 1293, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.

218. The Zohar, that is, cabalistic or mystical commentary on the Pentateuch.—Printed in Livorno (Leghorn), Italy, in 5611 A. M. (1851 A. D.). Bound in 77 parts. (Cat. No. 3706, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.
219. Manuscript entitled *Mikwaoth ha-mayim*, "Gathering of the Waters."—Containing the references in the Rabbinical writings to passages of the Old Testament. Written on paper in three columns. Height, 13 inches; width, 8\(\frac{3}{4}\) inches. (Cat. No. 3694, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.

220. Manuscript of the Prayer Book (fragment).—Written in black and red on vellum. On the margin are mystical comments on the prayers. Height, 4 inches; width, 3 inches. (Cat. No. 3704, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.

221. Manuscript containing prayers for special seasons and occasions and the haftaroth, i.e., the portions from the prophetic books of the Old Testament read with the pericopes of the Pentateuch in the services of the synagogue. Written on paper. Height, 9 inches; width, 6\(\frac{1}{2}\) inches. (Cat. No. 3696, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.

222. Manuscript containing the Formulas used for the Absolution from Vows hastily or unconsciously made, and Prayers recited at the Cemetery, and on the eve of New Year's and Atonement Day.—Written in Hebrew square characters in black ink with the rubrics in red. Bound in leather with pressed covers and red edge. Measurements, 7 by 5 inches. (Cat. No. 1294, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.

223. Manuscript written on paper containing homilies on the Book of Deuteronomy.—Height, 8 inches; width, 5\(\frac{1}{2}\) inches. (Cat. No. 3698, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.

224. The Book of Canticles and the Saying of the Fathers (*Pirke Abot*), with Spanish Translation and Commentary.—Printed at Amsterdam, Holland, in 5424 A. M. (1664 A. D.). The book of Canticles is one of the five Rolls (*Megilloth*), and is read on the eve of Sabbath and on Passover. The sayings of the Fathers, which is a collection of moral maxims and sentences by the Rabbinical sages, are read by some Jews on every Sabbath. (Cat. No. 3692, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.


Lent by Hadji Ephraim Benguiat.

226. Manuscript containing Comments on the Talmudic Tract Megillah.—Which treats of the feast of Esther or Purim. Written
on paper and bound in leather. Height, $7\frac{3}{4}$ inches; width, $5\frac{1}{2}$ inches. (Cat. No. 3695, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.

227. **Manuscript containing extracts from the Rabbinical Writings.**—Written on paper. Height, 8 inches; width, $5\frac{1}{2}$ inches. (Cat. No. 3698, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.

228. **Manuscript containing Comments on several portions of the Talmud.**—Written on parchment. Height, $8\frac{1}{2}$ inches; width, $6\frac{3}{4}$ inches. (Cat. No. 3700, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.

229. **Manuscript containing Mystical Meditations on the Festivals and some of the ordinances in the Pentateuch.**—Written on parchment. Height, $9\frac{1}{4}$ inches; width, $6\frac{3}{4}$ inches. (Cat. No. 3701, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.

230. **Manuscript containing Mystical Arrangements of the Letters of the Hebrew alphabet in connection with the name of the stones on the Breastplate of the High Priest as described in Exodus xxviii, 15ff.**—Written on paper and bound in leather. Height, $7\frac{1}{2}$ inches; width, $5\frac{1}{2}$ inches. (Cat. No. 3697, U.S.N.M.)

Lent by Hadji Ephraim Benguiat.
Top Piece of the Holy Ark in the Synagogue.

For reference to plate see page 704.
Veil of the Holy Ark (Parocheth).
For reference to plate see page 704.
Veil of the Holy Ark (Parocheth).

For reference to plate see page 705.
Veil of the Holy Ark (Parocheth).

For reference to plate see page 705.
Veil of the Holy Ark (parocheth).

For reference to plate see page 705.
EXPLANATION OF PLATE LXV.

Fig. 1. Torah Scroll with mantle and silver bells.
Fig. 2. Silver Pointer (yad).
Fig. 3. Silver Pointer (yad).
TORAH SCROLL WITH POINTERS.

For reference to plate see pages 707 and 709.
EXPLANATION OF PLATE LXVI.

Fig. 1. Wrapper for the Torah Scroll.
Fig. 2. Wrapper for the Torah Scroll.
Wrappers for the Torah Scroll.

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Breastplate of the Torah.

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Breastplate of the Torah.

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Hanging Lamp and Candleholder.

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Figs. 2. Phylacteries (Tefillin).
Fig. 3. Bag for Phylacteries.
Phylacteries and Prayer Book.

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EXPLANATION OF PLATE LXXVI.

Figs. 1. Phylacteries unfolded.
Fig. 2. Velvet Bag of Phylacteries.
Prayer Shawl (Tallith).

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Fig. 2. Hanukah Lamp.
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For reference to plate see page 717.
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Passover Plate.

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