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The scientific publications of the National Museum include two series, known, respectively, as *Proceedings* and *Bulletin*.

The *Proceedings*, begun in 1878, is intended primarily as a medium for the publication of original papers, based on the collections of the National Museum, that set forth newly acquired facts in biology, anthropology, and geology, with descriptions of new forms and revisions of limited groups. Copies of each paper, in pamphlet form, are distributed as published to libraries and scientific organizations and to specialists and others interested in the different subjects. The dates at which these separate papers are published are recorded in the table of contents of each of the volumes.

The present volume is the seventy-second of this series.

The *Bulletin*, the first of which was issued in 1875, consists of a series of separate publications comprising monographs of large zoological groups and other general systematic treatises (occasionally in several volumes), faunal works, reports of expeditions, catalogues of type-specimens, special collections, and other material of similar nature. The majority of the volumes are octavo in size, but a quarto size has been adopted in a few instances in which large plates were regarded as indispensable. In the *Bulletin* series appear volumes under the heading *Contributions from the United States National Herbarium*, in octavo form, published by the National Museum since 1902, which contain papers relating to the botanical collections of the Museum.

ALEXANDER WETMORE,
Assistant Secretary, Smithsonian Institution.

WASHINGTON, D. C., *August 3, 1928.*

TABLE OF CONTENTS

[1] Date of publication.

[1] Date of publication.

[1] Date of publication.

[1] Date of publication.

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[1] Date of publication.

LIST OF ILLUSTRATIONS

PLATES

ADDITIONS TO THE UPPER CRETACEOUS INVERTEBRATE FAUNAS OF THE CAROLINAS

By Lloyd W. Stephenson

FOSSIL AND RECENT BRYOZOA OF THE GULF OF MEXICO REGION

By Ferdinand Canu and Ray S. Bassler

THE AUSTRALIAN LAND SHELL, THERSITES BIPARTITA AND ITS ALLIES

By William B. Marshall

THE RODENTS OF THE GENUS PLAGIODONTIA

By Gerrit S. Miller, jr.

MILLIPEDS OF THE ORDER COLOBOGNATHA, WITH DESCRIPTIONS OF SIX NEW GENERA AND TYPE SPECIES, FROM ARIZONA AND CALIFORNIA

By O. F. Cook and H. F. Loomis

FORAMINIFERA OF THE GENUS SIPHONINA AND RELATED GENERA

By Joseph A. Cushman

ON NEWLY DISCOVERED METEORIC IRONS FROM THE WALLAPAI (HUALAPAI) INDIAN RESERVATION, ARIZONA

By George P. Merrill

THE FLORA OF THE ESMERALDA FORMATION IN WESTERN NEVADA

By Edward W. Berry

TEXT FIGURES

FOSSIL AND RECENT BRYOZOA OF THE GULF OF MEXICO REGION

By Ferdinand Canu and Ray S. Bassler

On some terrestrial Isopods in the United States National Museum

By Hans Lohmander

MILLIPEDS OF THE ORDER COLOBOGNATHA, WITH DESCRIPTIONS OF SIX NEW GENERA AND TYPE SPECIES, FROM ARIZONA AND CALIFORNIA

By O. F. Cook and H. F. Loomis

THE GREEN PIT VIPER, TRIMERESURUS GRAMINEUS, IN CHINA

By Leonhard Stejneger

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DESCRIPTION OF ANCYLOSTOMA PLURIDENTATUM, A HOOKWORM OF CARNIVORES, AND A REVIEW OF THE GENUS ANCYLOSTOMA

By Benjamin Schwartz

Of the Zoological Division, Bureau of Animal Industry, United States Department of Agriculture

INTRODUCTION

Ancylostoma pluridentatum was described by Alessandrini (1905) under the name *Uncinaria pluridentatum* from the intestine of *Felis mitis*, in Brazil. The special characteristics of this worm, as noted by that writer, are the two unequal pairs of teeth in the anterior and ventral portion of the mouth capsule, the inner or median pair being described as very small—in fact, almost rudimentary—and the presence of three small projections or teeth on each side of the dorsal edge of the mouth capsule. Alessandrini also noted in this species a small process with a rugged surface on each side of the cloacal aperture in the male.

Ancylostoma pluridentatum was not reported again for 17 years, and then Vevers (1922) reported it from the intestine of *Felis tigris*, in the Malay States, noting certain minor differences between his specimens and Alessandrini's description of this species. Two years later Chapin (1924) recorded it from a South American carnivore (*Felis tigrina*), which had died in the National Zoological Park in Washington, D. C. Chapin merely noted the presence of this species in the United States, but did not discuss the morphology of the worm.

In the opinion of Lane (1918) this species should be made the type of a new genus. Lane has also considered the possibility that Alessandrini may have misinterpreted the structures on the dorsal edge of the mouth capsule as well as the two rugged structures near the cloacal aperture of the male, in which case the question of the possible identity of *Ancylostoma pluridentatum* with *Ancyclostoma* *braziliense* deserved serious consideration. Lane concluded, however, that: "The doubt can only be cleared up by the reexamination of Alessandrini's original material, if this be still in existence." Darling (1923) appears to accept the view that *A. pluridentatum* is probably identical with *A. braziliense*, basing this view on Alessandrini's statement that the inner pair of teeth is almost rudimentary, a feature noted by Darling as well as by other investigators with reference to the corresponding teeth of *A. braziliense*. Darling states further that there is a possibility that the three dorsal teeth on each side of the mouth capsule as noted by Alessandrini may have been the result of some pathological condition.

In view of the doubt expressed by Lane and Darling concerning the present status of *Ancylostoma pluridentatum* the writer examined the specimens collected by Chapin from *Felis tigrina* as well as specimens of this species from two other lots present in the Helminthological collections of the United States National Museum. One lot was collected about a year ago from the intestine of a South American carnivore (*Felis eyra*) that had died in the National Zoological Park, the specimens having been determined by Chapin and the writer. The second lot was discovered by the writer in the course of examinations of various specimens of hookworms from carnivores present in the helminthological collections of the United States National Museum. The lot in question was collected in January, 1905, from *Felis* species by Dr. Albert Hassall in the course of a post-mortem examination of the animal which had died in the National Zoological Park. These specimens were later examined by Dr. C. W. Stiles, of the hygienic laboratory of the United States Public Health Service, who labeled them "*Ancylostoma*, new species." It should be noted in this connection that Doctor Stiles's determination was made before Alessandrini's description of *A. pluridentatum* was published.

The observations recorded in this paper not only confirm the specific validity of *A. pluridentatum*, based on a study of specimens from the type locality, but also clear up certain points in the morphology of these worms that led Darling to the view that *Ancylostoma pluridentatum* and *Ancylostoma braziliense* are probably identical.

DESCRIPTION OF ANCYLOSTOMA PLURIDENTATUM

The features of the mouth capsule that differentiate *Ancylostoma pluridentatum* from all other species of the genus *Ancylostoma* are the structure of the two pairs of teeth in the anterior and ventral portion of the mouth capsule, coupled with the presence of three small teeth on each side of the dorsal wall of the mouth. (Fig. 1.) As has already been said these features were noted and emphasized by

Alessandrini who described the inner ventral teeth as being very small in comparison with the large outer teeth. So far as concerns the relative size of the pair of inner teeth, the writer has not been able to confirm Alessandrini's findings, as the inner pair of teeth in the specimens examined was found to be of good size. However, Alessandrini's interpretation of the size of the inner teeth may have been due to his study of imperfectly cleared specimens or to an interpretation of the tips of the teeth as teeth with the remaining broad portion regarded as a basal plate to which they were attached, instead of regarding the entire structure as a tooth in each case as the writer has regarded them. In specimens imperfectly cleared only the tips of the inner teeth which point caudad are visible, since they protrude beyond the margin of the outer teeth, the remaining portion of these teeth, which lie in a more or less horizontal plane, being covered by the outer teeth. When the buccal capsule is viewed through the ventral surface, however, the inner teeth which are more ventrally placed than the outer teeth, stand out quite distinctly in well cleared specimens, and are seen to be discrete structures, and of good size. The tips of the outer teeth are relatively large and conspicuous, and have the shape of a triangle.

In certain specimens from *Felis tigrina* the tips of the outer teeth were found to be truncated in a number of specimens (fig. 4), resembling in this respect the corresponding teeth of *Ancylostoma braziliense*, in which similar malformations of the outer teeth are by no means uncommon. In *A. pluridentatum* the abnormality in the outer teeth is sometimes unilateral and sometimes bilateral. In some specimens the tip of the tooth appears to be cut off cleanly whereas in other specimens it presents the appearance of an uneven surface suggestive of erosion. Abnormalities were also observed in the three pairs of small dorsal teeth in specimens from *Felis tigrina*. The middle tooth on one or both sides is the one affected, and appears to be eroded in certain specimens. In some specimens the tips of the teeth are almost entirely absent, the characteristically pointed tooth being replaced by a slightly concave or by a more or less irregularly flattened cuticular elevation. Normally the dorsal teeth end in sharp points. No abnormalities of the teeth were observed in specimens from *Felis eyra* and from *Felis* species.

The cephalic papillae are very conspicuous and are located anterior to the nerve ring. Their position with respect to the middle of the esophagus is by no means constant, being either slightly anterior or posterior to the middle of the esophagus. The position of the excretory pore is slightly posterior to the nerve ring.

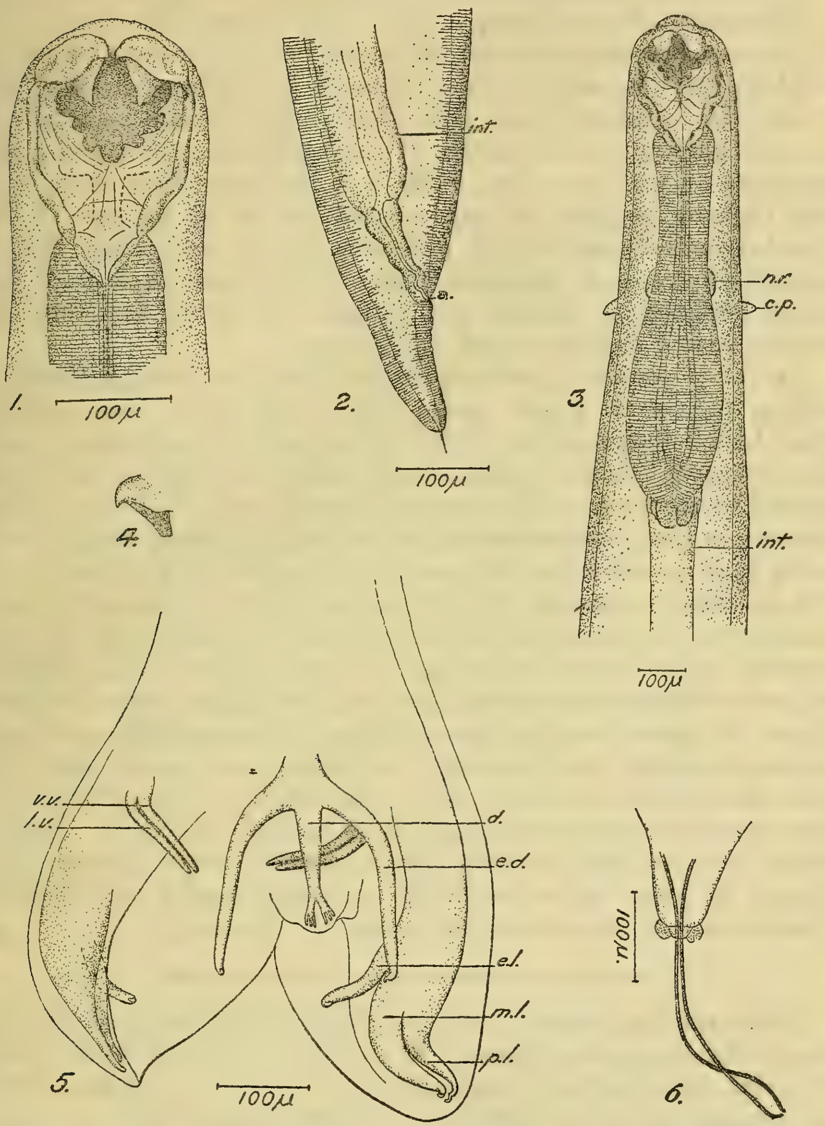
Male.—The males are from 7 to 8 mm. long by about 294μ wide in the middle of the body. The maximum width of the body is immediately in front of the bursa which has a diameter of from 302 to

310μ. The buccal capsule is from 131 to 178μ wide. The esophagus (fig. 3) is from 638 to 740μ long by 168μ in maximum width. The nerve ring is located anterior to the middle of the esophagus, dividing the latter into two parts having an approximate ratio of 4 to 6. In a specimen from *Felis tigrina* the cervical papillae divide the esophagus into two parts, the ratio of the anterior part to the posterior part being 17 to 13, whereas in a specimen from *Felis eyra* this ratio is 25 to 17.

The spicules are long and slender (fig. 6), and are from 1.15 to 1.17 mm. long. The short gubernaculum is from 60 to 74μ long by 10μ wide. The bursa (fig. 5) is from 470 to 554μ wide when spread out. The ventro-ventral ray is a little longer and also somewhat wider than the latero-ventral ray. The tips of these rays extend to within a short distance from the margin of the bursa. The externo-lateral ray, which terminates at a considerable distance from the edge of the bursa, is much smaller than the medio-lateral and postero-lateral rays from which it diverges. The medio-lateral and postero-lateral rays are large and parallel, their tips extending almost to the posterior margin of the lateral lobes of the bursa. The distance between the tips of the externo-lateral rays when the bursa is viewed from the dorsal aspect is 180μ. The dorsal ray is from 151 to 168μ long and divides into two branches at a distance of about 35μ from the posterior end. Each branch of the dorsal ray is tridigitate. The prebursal papillae are located at a distance of 504μ from the posterior margin of the lateral lobes of the bursa. As noted by Alessandrini, a rugged structure is present on each side near the anogenital opening (fig. 6), the surface of which appears granular in optical section.

Female.—The females are from 10 to 11 mm. long by 344 to 378μ wide in the region of the vulva. The maximum diameter of the buccal capsule varies from 168 to 210μ. The esophagus is from 739 to 806μ long by 185 to 210μ in maximum width. The cephalic papillae divide the esophagus into two unequal parts, the ratio of the portion anterior to the papillae to that posterior to the papillae being 26:20 in a specimen from *Felis tigrina*, whereas in a specimen from *Felis eyra* the ratio is 22:23. The nerve ring is anterior to the cephalic papillae, the excretory pore being in a position intermediate between the nerve ring and cephalic papillae.

The vulva is located near the beginning of the posterior third of the body. In an immature specimen about 8 mm. long the vulva is located at a distance of 2.8 mm. from the tip of the tail. In a specimen about 11 mm. long the distance from the vulva to the tip of the tail is 3.3 mm. The tail (fig. 2) is from 126 to 176μ long and is gradually attenuated. The slender bristle that is inserted in the tip of the tail is from 17 to 25μ long.



FIGS. 1–6.—ANCYLOSTOMA PLURIDENTATUM ALESSANDRINI, 1905. 1, BUCCAL CAPSULE; 2, POSTERIOR END OF FEMALE; 3, ANTERIOR PORTION OF WORM; 4, PAIR OF VENTRAL TEETH; 5, BURSA OF MALE (SOMEWHAT DIAGRAMMATIC); 6, REGION OF CLOACAL OPENING SHOWING SPICULES. *a.*, ANUS; *c. p.*, CERVICAL PAPILLAE; *d.*, DORSAL RAY; *e. d.*, EXTERNO-DORSAL RAY; *e. l.*, EXTERNO-LATERAL RAY; *int.*, INTESTINE; *l. v.*, LATERO-VENTRAL RAY; *m. l.*, MEDIO-LATERAL RAY; *n. r.*, NERVE RING; *p. l.*, POSTERO-LATERAL RAY; *v. v.*, VENTRO-VENTRAL RAY

DISCUSSION

It will be noted from the description that there are certain slight differences in the morphology of the worms from *Felis tigrina* and *Felis eyra*, the most important differences being in the position of the cephalic papillae and in what appear to be malformations of the teeth. In specimens from *Felis tigrina* the cephalic papillae are located anterior to the middle of the esophagus and but slightly posterior to the nerve ring, whereas in specimens from *Felis eyra* the cephalic papillae are located posterior to the middle of the esophagus and considerably posterior to the nerve ring. Other minor differences in specimens from the two hosts were noted but these were rather variable, and possibly due to the fact that the worms from *F. tigrina* are not fully grown.

So far as concerns Lane's suggestion that *Ancylostoma pluridentatum* represents a new genus, the writer is of the opinion that Lane's judgment was sound in not actually proposing a new generic name, that the special differentiating characters of this worm should be regarded at this time as of specific rank, and that for the present, at least, these parasites may be left in the genus *Ancylostoma* since they possess all of the essential characters of this genus. If for no other reason than that of convenience, the creation of a new genus for *A. pluridentatum* is avoided in this paper as not justified at the present time owing to the comparatively small number of easily differentiated species now assigned to the genus *Ancylostoma*. In general we feel that dividing a comparatively small and coherent genus to form from one of its species a new genus containing only that species frequently adds unwarrantably to the already burdensome nomenclature with which the taxonomist must cope. Should other forms be found to share with *A. pluridentatum* characters not shared by other species assignable to *Ancylostoma*, it will then be time to consider the proposal of a genus for this group.

SPECIES OF THE GENUS ANCYLOSTOMA

Yorke and Maplestone (1926) list the following species as belonging to the genus *Ancylostoma: A. duodenale* (Dubini, 1843) Creplin, 1845, type species of the genus; *A. braziliense* de Faria, 1910; *A. caninum* (Ercolani, 1859); *A. conepati* (Solanet, 1911); *A. gilsoni* Gedoelst, 1917; *A. malayanum* (Alessandrini, 1905); *A. minimum* (Linstow, 1906); *A. mucronatum* (Molin, 1861); *A. mycetes*, new name, Yorke and Maplestone, 1926 (=*Diploodon quadridentatum* Molin, 1861); *A. pluridentatum* (Alessandrini, 1905). Molin's two species are inadequately described, but his figures indicate quite clearly that they belong to the genus *Ancylostoma*. His figure of *A. mucronatum* shows two equal spicules nearly one-fourth as long as the total length of the male. In this connection it is interesting to note that the males of *A. conepati*, which have an average length of 8.8 mm., have long spicules, their average size being 2 mm., the ratio of the length of the spicules to the total length of the body being practically the same in this species as in *A. mucronatum*. The fact that both of these species occur in South America is of further interest in connection with their possible identity. It may be noted, however, that *A. mucronatum* is from an edentate, *Dasypus gilvipes*, whereas *A. conepati* is from a carnivore, *Conepatus suffocans*. However, owing to the paucity of morphological data regarding *A. mucronatum* the question of the possible identity of this form with *A. conepati* is left open. Both of these species appear to be closely related to *A. caninum*, differing from the latter primarily in the lengths of the spicules. Molin's figure of *Diploodon quadridentatum* (=*A mycetis*) shows two pairs of well-developed teeth in the anterior portion of the mouth capsule. Male specimens of this species were not available to Molin, his description and figure being based on a female. Whether this form, collected from a primate (*Mycetes coraya*), is *A. duodenale* or whether it represents a distinct species can not be decided on the basis of Molin's description. *A. minimum* is inadequately described, there being no reference to teeth in the anterior portion of the buccal capsule. Von Linstow's figure of the bursa suggests that the species may belong to the genus *Ancylostoma*, although the possibility that he was dealing with a species of *Uncinaria* must also be taken into consideration. So far as can be judged from the arrangement of the bursal rays, this species is related to forms such as *A. braziliense* and other species of this genus, which have but two pairs of teeth in the anterior portion of the buccal capsule. *A. gilsoni* Gedoelst, 1917, from *Sciurus prevosti*, is regarded by the writer as a synonym of *A. braziliense*, since the figures and measurements of this species given by Gedoelst agree in practically all respects with available figures and descriptions of *A. braziliense* and with the writer's observations on that species based on a study of specimens from the United States, South America, and various parts of Asia. Gedoelst has apparently created *A. gilsoni* largely on the basis of host relationship and does not point out in what respects this species differs from *A. braziliense*. Our present knowledge of host relationships of species of the genus *Ancylostoma* does not appear to justify the erection of a new species on this basis alone, since certain species of this genus are known to occur in aberrant hosts. This is especially true with reference to *A. braziliense*, which occurs not only in species of carnivores but also occasionally in man, in which host it attains fertile maturity.

Lane (1916) has called attention to the fact that in species of the genus *Ancylostoma* which contain three pairs of teeth in the anterior ventral portion of the mouth capsule, the medio-lateral and postero-lateral rays are divergent, the cleft between these rays being deeper than that between the externo-lateral and medio-lateral rays, whereas in forms having two pairs of teeth in the anterior ventral portion of the buccal capsule the medio-lateral and postero-lateral rays lie close together and parallel, the cleft formed between these rays not being deeper than that formed between the externo-lateral and medio-lateral rays.

The following key will serve to differentiate the species of *Ancylostoma*[1] and to indicate their relationships.

I. Three pairs of teeth in anterior ventral portion of buccal capsule; medio-lateral and postero-lateral rays divergent.
  1. Inner pair of teeth small or rudimentary ---------- **A. duodenale.**
  2. Inner pair of teeth well developed.
    A. Species inadequately described; from an edentate (*Dasypus gilvipes*) ---------- **A. mucronatum.**
    B. Species adequately described; from carnivores.
      a. Spicules 600–900 μ long ---------- **A. caninum.**
      b. Spicules 1.8–22 mm. long ---------- **A. conepati.**

II. Two pairs of teeth in anterior ventral portion of buccal capsule; medio-lateral and postero-lateral rays close together and parallel.
  1. Inner pair of teeth small or rudimentary.
    A. Three pairs of small toothlike projections present on dorsal wall of buccal capsule ---------- **A. pluridentatum.**
    B. Toothlike projections not present on dorsal wall of buccal capsule ---------- **A. braziliense.**
  2. Inner pair of teeth well developed.
    A. Species inadequately described; from a primate (*Mycetes coraya*) ---------- **A. mycetis.**
    B. Species adequately described; from carnivores (*Ursidae*). **A. malayanum.**

In connection with the above key it is worth noting that the teeth in the anterior ventral portion of the buccal capsule of species of *Ancylostoma* show a series of stages which may be interpreted as being either progressive or regressive in nature. In *A. caninum*, *A. conepati*, and *A. mucronatum* three pairs of well-developed teeth are present in the anterior ventral portion of the buccal capsule; in *A. duodenale* the inner of the three pairs of teeth is very small, in fact, almost rudimentary; in *A. malayanum* and, so far as can be judged from Molin's figure, in *A. mycetis*, only two pairs of well-developed teeth are present in the anterior ventral portion of the buccal capsule; in *A. pluridentatum* and in *A. braziliense* two pairs of teeth are present, the inner pair of teeth being reduced in size, the

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[1] *A. minimum* is not included in this key owing to the absence of knowledge regarding the presence of teeth in the anterior ventral portion of the buccal capsule. Assuming that von Linstow's species belongs to the genus *Ancylostoma*, it has affinities with the forms in Group II so far as can be judged from his figure of the bursa.

buccal capsule containing in the anterior ventral portion one pair of well-developed teeth and one pair of small or rudimentary teeth. In certain specimens of *A. braziliense* collected by the writer from a cat which was shipped from Florida the inner pair of small teeth was found to be entirely absent, whereas in other specimens from the same host it was present. This observation suggests the possibility of the occurrence of a variety of *Ancylostoma braziliense* containing but a single pair of teeth. Such variation, if germinal in character and not due merely to external causes, undoubtedly represents an incipient species. It is suggested, purely as an interesting speculation, that the various species of *Ancylostoma* containing less than three pairs of well-developed teeth in the anterior oral margin may have arisen from forms containing three pairs of teeth, each species representing a mutation.

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UNDESCRIBED CRANE FLIES FROM THE HOLARCTIC REGION IN THE UNITED STATES NATIONAL MUSEUM

By Charles P. Alexander

Of the Massachusetts Agricultural College, Amherst

The crane flies (Tipulidae) described at this time were included in large series sent to me for determination by Dr. J. M. Aldrich and Dr. H. G. Dyar, the majority having been collected by them in the Western States and Canada. The material from western China was collected by the Rev. D. C. Graham and presented by him to the national collection. I wish to express my thanks to these gentlemen for their kind cooperation in making known these neglected flies. The types are preserved in the collection of the National Museum, with the exception of that of *Dicranoptycha occidentalis*, new species.

PALAEARCTIC SPECIES

BRITHURA NYMPHICA, new species

General coloration rich brown; antennal flagellum yellow; dorsopleural region of thorax conspicuously ochreous; ventral portion of the pleurotergite produced into a flattened lobe, the cephalic side of which is densely velvety; femora yellow, the tips conspicuously blackened; wings brown, sparsely variegated with yellow; Sc_1 lacking; *r–m* reduced; *m–cu* long and sinuous, longer than the distal section of Cu_1.

Female.—Length about 38 mm.; wing, 24 mm.; abdomen alone, 25 mm.; its greatest width, 6.4 mm.

Frontal prolongation of the head long, dark chestnut brown, the nasus long and powerfully developed; basal segments of palpi dark brown, the third segment paler, the last segment black with the extreme tip brightened. Antennae with the first scapal segment dark reddish brown, the second segment fulvous; flagellum pale yellow, the basal enlargement of the individual segments scarcely darker; verticils all basal in position, very long and conspicuous, including those of the reduced terminal segment. Head dark brown, the orbits paler; vertical tubercle conspicuous, the tip slightly decurved.

Pronotum dark clove brown, the lateral margins paler, the scutellum brighter, narrowly margined anteriorly with black. Mesonotal praescutum brown with four barely evident brighter brown stripes, the posterior sclerites of the mesonotum generally of this same bright brown. Pleura brown, the dorso-pleural region extensively and conspicuously pale ochreous; ventral sclerite of the pleurotergite produced laterad into a conspicuous triangular flattened lobe, the cephalic face of which is densely covered with a cream-colored velvety pile. Halteres brownish yellow, the knobs dark brown. Legs with the coxae and trochanters dark cinnamon brown; femora yellow, the tips rather broadly (2 mm.) and conspicuously blackened; tibiae brownish yellow, the tips narrowly infuscated; tarsi light brown, the outer segments darker. Wings of the usual *Brithura* type, the membrane yellowish, extensively variegated with darker, or brown, sparsely variegated with yellow; prearcular region largely pale; cell *C* darker brown, *Sc* more yellowish; stigma relatively pale, with brighter yellow markings before and beyond it; a small darker brown spot at origin of *Rs*, preceded and followed by the yellow markings described; anterior cord a little seamed with darker; a small yellow area near outer end of cell R_3; similar yellow marginal areas in cells R_5 to M_4, inclusive, with two similar markings in the first anal and another in the second anal cells, these latter areas lying not far from the veins; a small brown cloud in cell *Cu* not far from midlength; a pale yellow, gently arcuated transverse area across the outer end of cell *M;* vein Cu_1 beyond this mark, as well as *m–cu* conspicuously seamed with dusky; outer end of cell *first* M_2, fork of *M* and marginal spots at the ends of the veins, as well as the wing apex in the radial field, and the posterior margin of the wing in the anal cells, more dusky. Venation (fig. 1): Sc_1 lacking; Sc_2 ending just before *r*, the latter close to the fork of R_{2+3}; *r–m* reduced; cell *first* M_2 pentagonal; petiole of cell M_1 a little longer than *m; m–cu* strongly arcuated, longer than the distal section of Cu_1 inserted on M_4, shortly beyond its origin; Cu_2 attaining the margin at the end of Cu_1; cell *second A* wide.

Abdomen rich cinnamon brown, the lateral region of the tergites broadly darker brown; caudal margins of the segments narrowly and obscurely, the extreme caudo-lateral angles more brightly yellowish, most conspicuous on segments two and three; sternites somewhat darker brown, the caudal margins more sooty brown, the extreme lateral angles of the segments again with yellow triangles. Dorsal shield of ovipositor obscure yellow, the conspicuous tergal valves dark chestnut horn color.

Habitat.—China (Szechuen). *Holotype*, female, Shin Kai Si, Mount Omei, altitude 4,400 feet, September 10, 1922 (D. C. Graham).

Type.—Female, Cat. No. 40317, U.S.N.M.

The species is readily distinguished from all described forms by the coloration of the antennae and legs.

ERIOCERA GRAHAMI, new species

Head and thorax velvety black, the scutellum orange; abdomen with tergites one to four orange, all except the first with a narrow black border along the caudal margin; remaining tergites black; wings blackish; cell M_1 present.

Female.—Length, 20 mm.; wing, 17 mm., the greatest width, 5.4 mm.

Rostrum and palpi black. Antennae brownish black throughout, if bent backward not attaining the wing root. Thorax velvety black, the scutellum orange. Halteres and legs black. Wings relatively broad, blackish, the base and costal region darker; veins a little darker than the ground color. Venation (fig. 2) : Rs long, about one-third longer than R; Sc_1 ending beyond the fork of R_{2+3+4}, the latter equal to the basal section of R_5; basal section of R_2 transverse, R_{2+3} equal to one-half R_{1+2}; cell M_1 present, shorter than its petiole; $m–cu$ at about two-fifths the lower face of cell *first* M_2, straight, about one-third longer than the gently arcuated distal section of Cu_1; cell Cu at wing margin about two-fifths as wide as cell M_4.

Abdominal tergites 1 to 4 orange, the lateral margins weakly infuscated, segments 2 to 4 with a very narrow but conspicuous black line across the caudal margin, the segments without shiny bands; tergites 5 to 8, velvety black; sternites similar, but the black caudal margins of the basal segments lacking. Ovipositor with the dorsal shield brownish black dorsally; tergal valves of ovipositor broken.

Habitat.—China (Szechuen). *Holotype*, female, Shin Kai Si, Mount Omei, altitude 4,400 feet, July 1–30, 1925 (D. C. Graham).

Type.—Female, Cat. No. 40318, U.S.N.M.

This interesting crane-fly is named in honor of the collector, the Rev. David C. Graham, who has added greatly to our knowledge of the zoology of western China. By Edwards's key to the Old World species of *Eriocera*[1] this species runs to *E. umbripennis* Edwards (Penang), an entirely distinct species.

ERIOCERA FUMIDIPENNIS, new species

General coloration dull gray, the praescutum with three blackish stripes; legs black, elongate; wings relatively long and narrow, strongly blackish, the costal margin darker; R_{1+2} about one-half longer than R_2; R_{2+3} and R_3 subequal; R_{2+3+4} shorter than the basal section of R_5; cell M_1 present.

Male.—Length about 17.5–18 mm.; wing, 16.5–18 mm.

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[1]Ann. Mag. Nat. Hist., ser. 9, vol. 8, pp. 67–78, 1921.

Rostrum and palpi brownish black. Antennae relatively short, brownish black throughout, if bent backward, scarcely attaining the wing root. Head dull brownish gray, the vertical tubercle low and relatively inconspicuous, blackish. Mesonotum blackish, with a dull brownish gray pruinosity, the praescutum with three blackish stripes. Pleura gray, variegated with blackish areas. Halteres brownish black, the base narrowly brightened. Legs with the coxae gray; trochanters brownish gray; remainder of legs black, elongate (hind leg, femur, 13 mm.; tibia, 14 mm.; tarsus, 11.6 mm.). Wings relatively long and narrow, strongly blackish, the costal margin darker; stigma small, oval, darker brown than the ground color; veins dark. Venation: Sc_1, ending about opposite three-fourths R_{2+3}, Sc_2 some distance from its tip; *Rs* long, strongly angulated at origin; R_{2+3+4} shorter than basal section of R_5; R_{1+2} about one-half longer than the basal section of R_2, or a little less; R_{2+3} subequal to R_3; *r–m* in alignment with the inner end of cell *first* M_2; cell M_1 present, a little shorter than its petiole; *m–cu* not far beyond the fork of *M*, about one-third longer than the distal section of Cu_1.

Abdomen blackish, sparsely pruinose, the hypopygium concolorous.

Habitat.—China (Szechuen). *Holotype*, male, Suifu, May–June, 1921 (D. C. Graham). *Paratopotype*, male.

Type.—Male, Cat. No. 40319, U.S.N.M.

By Edwards's key to the Old World *Eriocera*[2] this fly would run to *E. rubrescens* Walker (Borneo), a very different species.

ERIOCERA CYBELE, new species

Velvety black; abdominal tergites 1, 2, 4, and 5 with basal glabrous rings; genital segment of female fulvous; wings black with a long, narrow, white, transverse band before the cord; R_2 oblique.

Male.—Length, about 13 mm.; wing, 11.5 mm.

Female.—Length, 19 mm.; wing, 16 mm.

Head and appendages velvety black.

Thorax entirely velvety black, including the halteres and legs. Wings black, the anal cells somewhat paler; a long, narrow, transverse, discal, white area, extending from vein R_1, before the cord, nearly to the posterior margin of the wing in cell *Cu.* Venation: Basal section of R_2 oblique to subtransverse in position, less oblique than in *E. obliqua;* cell R_3 longer and narrower than in the last-named species.

Abdomen velvety black, the segments relatively short; tergites 1 and 2 with shiny glabrous basal rings of silvery gray; segments 4 and 5 similar but the rings opaque; tergite 3 uniformly black except for a very narrow glabrous basal ring. Male hypopygium entirely

[2] Ann. Mag. Nat. Hist., ser. 9, vol. 8, 1921.

black. Female with the genital segment bright fulvous, the elongate valves of the ovipositor more horn-colored.

Habitat.—China (Szechuen). *Holotype*, male, Shin Kai Si, Mount Omei, altitude 4,400 feet, July 1–30, 1921 (D. C. Graham). *Allotopotype*, female. *Paratopotype*, female.

Type.—Male, Cat. No. 40320, allotype, female, U.S.N.M.

Eriocera cybele is another of the numerous recently discovered species of the genus that run to *E. hilpa* Walker, by Edwards's key to the Old World species of the genus.[3] It is most closely allied to *E. obliqua* Alexander, of Macao,[4] differing in the longer and narrower white crossband of the wing and the slightly different venation. The ovipositor has the genital segment bright fulvous, the valves only a little duller in color. In *E. obliqua*, the genital segment is black, the valves dark horn color.

ERIOCERA ARROGANS, new species

Head black; antennae short; thorax dull black with three shiny blackish gray stripes; legs dark brown; wings gray, the veins before the cord broadly margined with rich yellowish brown, beyond the cord similarly margined with darker brown; cell M_1 present, deep; abdomen black, including the genital shield.

Female.—Length, about 12 mm.; wing, 11 mm.

Rostrum and palpi black. Antennæ brownish black, the outer flagellar segments somewhat paler; antennæ short, if bent backward not attaining the wing root. Head dull black, the vertical tubercle not conspicuous.

Mesonotum intense dull black, the praescutum with three broad shiny blackish gray stripes that are virtually confluent behind, restricting the ground color to the humeral triangles and broad lateral margins; remainder of notum of the same shiny blackish gray as the praescutal stripes. Pleura shiny blackish gray. Halteres black, the knobs broken. Legs with the coxae and trochanters black; remainder of legs dark brown, the femoral bases a trifle paler; legs relatively short (fore leg, femur, 5.6 mm.; tibia, 7 mm.; tarsus about 5.8 mm.). Wings with the very restricted ground-color gray, the base and costal region darker; all veins before the cord broadly margined with rich yellowish brown, restricting the ground color to median streaks in the principal cells; beyond the cord the color changes abruptly to darker brown, with similar pale centers to the cells; anal sells more extensively grayish; vein *second A* conspicuously seamed with brown; veins dark brown, *C* and *Sc* paler brown. Venation (fig. 3): Sc_1 ending opposite the fork of R_{2+3+4}, Sc_2 just

[3] Ann. Mag. Nat. Hist., ser. 9, vol. 8, 1921.
[4] Proc. Hawaiian Ent. Soc., vol. 5, pp. 255–256, 1923.

beyond the fork of *Rs; Rs* angulated and weakly spurred at origin; R_{2+3+4} a little longer than R_{2+3}; R_{1+2} twice the length of R_2, or a little more; R_{2+3} about one-half longer than R_2; R_4 deflected rather conspicuously toward the wing-tip at outer end; cells R_3 and R_4 with inner ends acute; cell M_1 present, relatively deep, nearly twice its petiole; *m–cu* beyond one-third the length of cell *first* M_2, a little shorter than the distal section of Cu_1.

Abdomen dull black, including the genital shield; valves of the ovipositor horn colored; tergal valves slender, gently upcurved to the acute tips.

Habitat.—China (Szechuen). Holotype, female, Mount Omei (D. C. Graham).

Type.—Female Cat. No. 40321, U.S.N.M.

A very distinct species of the genus, without any very close allies among the described species.

NEARCTIC SPECIES

LIMONIA NITIDIUSCULA, new species

Antennae dark brown throughout, the flagellar segments with elongate verticils; last flagellar segment very long, nearly as long as the combined twelfth and thirteenth segments; praescutum obscure yellow, with a broad dark brown median stripe; femora brown, the tips narrowly yellowish; wings with a strong brownish tinge, the stigma darker, with a paler spot before and beyond it; male hypopygium with the dorsal dististyle a powerful chitinized rod, the apex with a flattened black plate that terminates in a comb of about nine blunt teeth.

Male.—Length about 5 mm.; wing, 6.5 mm.

Rostrum and palpi black. Antennae dark brown throughout; basal flagellar segments shorter, gradually increasing in length and decreasing in diameter outwardly, the segments with a short apical and similar basal glabrous portion, forming a short pedicel; all segments with verticils of unusual length, much exceeding the segments, except those of the unusually long terminal segment; this segment very long and slender, only a little shorter than the two preceding segments taken together. Head dark colored, the anterior vertex more silvery.

Mesonotum obscure yellow, the praescutum with a broad dark brown median stripe and less distinct lateral stripes, the lateral margins and humeral region shiny yellow; scutal lobes yellow, extensively marked with brown; scutellum and postnotum largely dark. Pleura obscure shiny yellow with a very broad, conspicuous, longitudinal brown stripe and a less distinct brown mark on the sternopleurite, the remainder of the sternum of the ground color. Halteres with the unusually long knobs dark brown, the base of the stem narrowly paler. Legs with the coxae and trochanters obscure yellow; femora brown, paler basally, the color deepening outwardly, the tips narrowly but conspicuously light yellow; tibiae and tarsi dark brown. Wings with a strong brownish tinge, the stigma oval, darker brown; a paler spot before and beyond the stigma; veins darker brown, the obliterative areas at end of *Rs* and across cell *first* M_2 conspicuous; vein R_{4+5} dark and equally developed throughout its length. Venation: Sc_1, ending about opposite one-third to one-fourth the length of *Rs*, Sc_2 at its tip; *Rs* gently arcuated; basal section of R_{4+5} strongly arcuated; cell *first* M_2 relatively wide, only about one-half longer than wide; *m–cu* at the fork of *M*.

Abdominal tergites dark brown, the basal sternites obscure brownish yellow, the bases of the segments darker; segments eight and nine abruptly paler yellow; remainder of hypopygium dark. Male hypopygium (fig. 4) with the ninth tergite (*t*) gently emarginate posteriorly, the lateral portions provided with a few very long setae. Basistyle (*b*) relatively elongate, the mesal lobe large, densely setiferous. Dorsal dististyle a powerful, nearly straight, chitinized rod, at the apex with a blackened flattened plate that terminates in a comb of about nine blunt teeth. Ventral dististyle (*d*) small, fleshy, densely setiferous, the rostral prolongation a long, sinuous rod, at near midlength bearing two long black spines from elongate swollen papillae. Gonapophyses (*g*) with the mesal apical angle greatly produced into a long flattened blade, the apex very shallowly bifid.

Habitat.—Oregon. *Holotype*, Marshfield (J. M. Aldrich).

Type.—Male. Cat. No. 40322, U.S.N.M.

The present species appears to be closely allied to *L. adjecta* (Doane), but I can not reconcile the descriptions of the two. The present species has the anterior vertex silvery, the praescutum with a broad median stripe and the wings strongly infumed, with pale areas before and beyond the stigma. Vein R_1 does not behave at all as described and figured by Doane for *adjecta*, but bends at a right angle into the costa, immediately opposite R_2. The very elongate last segment of the antenna, the long flagellar verticils, the conspicuous yellow terminal ring of the femora and the very peculiar structure of the hypopygium are all noteworthy features of the present species.

DICRANOMYIA PENICILLATA, new species

Related to *D. haeretica* Osten Sacken, from which it is distinguished especially by the structure of the male hypopygium; dorsal dististyle slender, sickle shaped; base of ventral dististyle on inner face with a low lobe bearing two conspicuous pencils of long yellow setae.

Male.—Length about 6.2 mm.; wing, 6.8 mm.

Rostrum and palpi dark brown. Antennae brownish black throughout; flagellar segments oval. Head dark.

Pronotum obscure yellow, with a narrow median brown line. Mesonotal praescutum with three brown stripes, the ground color well concealed by yellowish gray pollen; scutal lobes dark, the median area obscure yellow; scutellum obscure yellow; postnotal mediotergite dark brown, sparsely pruinose, the lateral margins narrowly paler. Color of the pleura obscured by glue but apparently largely pale. Halteres short, pale, the knobs infuscated. Legs with the coxae and trochanters pale brown, the latter more yellowish; femora obscure yellow, the tips infuscated, especially the fore femora; tibiae brownish yellow, the tips becoming darker; tarsi passing into dark brown. Wings with a strong yellowish tinge, the stigma oval, very slightly darker than the ground color; veins dark brown. Venation: *Sc* short, Sc_1 ending just beyond the origin of *Rs; Sc_2* not visible in the type, due to the flexing of the wings at this point, but presumably not far removed from the tip of Sc_1, as in the related *haeretica; Rs* about one and one-half times as long as the basal section of R_{4+5}; *m–cu* before the fork of *M*.

Abdominal tergites dark brown, the sternites yellow. Male hypopygium (fig. 5) relatively large and complicated in structure. Basistyle (*b*) darkened outwardly, the ventro-mesal lobe elongate, the apex truncated and provided with setiferous tubercles, with a few other setae on the mesal edge of the lobe; mesal face of basistyle near apex with a low squat tubercle densely set with setae. Dorsal dististyle (*d*) a slender curved hook, the apex acute. Ventral dististyle (*d*) large, widened distally, sparsely provided with long coarse setae; rostral prolongation stout, the two spines relatively short, separated from one another by a distance about equal to one-half the length of one, placed more than their own length from the apex of the prolongation; basad and ventrad of the rostrum a conspicuous low lobe, each outer angle of which bears a conspicuous pencil of long yellow setae. Gonapophyses (*g*) with the mesal apical prolongation slender. Aedeagus (*a*) subtended on either side by a flattened, shell-like apophysis.

Habitat.—North Dakota. *Holotype*, male, Minot, July 16, 1921 (H. G. Dyar).

Type.—Male, Cat. No. 40323, U.S.N.M.

DICRANOMYIA NEGLIGENS, new species

General coloration gray, the praescutum with three brown stripes, the median stripe narrowly split by a capillary pale line; halteres pale yellow, the knobs dark brown; femora yellow, the tips broadly dark brown, preceded by a slightly narrower ring of clearer yellow;

wings whitish subhyaline, with four conspicuous brown costal areas and sparse markings elsewhere on the wing.

Female.—Length, 6.5–7.5 mm.; wing, 8.2–10 mm.

Rostrum and palpi black. Antennae black, the basal half of the first flagellar segment yellow; flagellar segments oval, becoming smaller outwardly. Head gray, the center of the vertex marked with black.

Mesonotal praescutum gray with three conspicuous brown stripes, the median stripe narrowly split by a capillary pale line, the cephalic end of the stripe entire; scutum gray, the lobes variegated with brown; scutellum gray; postnotum brown, sparsely pruinose. Pleura gray. Halteres relatively short, pale yellow, the knobs dark brown. Legs with the coxae brown, darker basally; trochanters yellow; femora yellow, a little darker outwardly, the tips broadly dark brown, preceded by a slightly narrower clearer yellow ring; tibiae light brown, the extreme bases and the slightly broader tips infuscated; basitarsi light brown, passing into darker brown, the remaining tarsal segments dark brown. Wings whitish to whitish subhyaline, sparsely variegated with brown, including four larger costal blotches, the second at the supernumerary cross vein in cell *Sc*, the third at the tip of Sc_1 and origin of *Rs*, the fourth the stigmal area, barely confluent with a circular spot at the fork of *Rs;* cord and outer end of cell *first* M_2 narrowly seamed with darker brown; paler gray marginal clouds on vein M_3 and all veins beyond, largest and most conspicuous on the anal veins; smaller but darker marginal spots at ends of veins R_3 and R_{4+5}; a few scattered brown dots in cells *M*, *Cu*, and the *anal* cells, not more than four or five in a single cell, none in the radial field; veins dark brown, *C*, *Sc*, and *R* more yellowish in the interspaces. Venation: *Sc* relatively short, Sc_1 ending about opposite one-fourth the length of *Rs*, Sc_2 lacking, unless considered as being represented by the so-called supernumerary cross vein at midlength of cell *Sc; Rs* nearly straight; cell *first* M_2 gently widened outwardly, longer than vein M_3 beyond it; *m–cu* before the fork of *M*, approximately equal to or shorter than the distal section of Cu_1. One paratype has an adventitious cross vein in cell R_3 of both wings.

Abdominal tergites brownish yellow, variegated with dark brown. In other specimens the segments are dark brown, narrowly margined caudally with obscure yellow. Ovipositor with the basal half of the genital segment dark, the apical half obscure yellow. Valves horn color, the tergal valves relatively small, slender, gently upcurved, the tips acute.

Habitat.—Colorado. *Holotype*, female, Tennessee Pass, July 24, 1917 (J. M. Aldrich). *Paratopotypes*, 2 females.

Type.—Female, Cat. No. 40324, U.S.N.M.

Dicranomyia negligens is most closely allied to *D. nelliana* Alexander,[5] likewise from Colorado. The wing-pattern is much more restricted in the present species and *Sc* is slightly longer. Both species bear a great resemblance to members of the *simulans* group of the genus *Limonia*.

DICRANOPTYCHA OCCIDENTALIS, new species

Generally similar to *D. sobrina* Osten Sacken; costal fringe of male short; male hypopygium with the terminal spine of the outer dististyle long and straight.

Male.—Length about 8 mm.; wing, 9 mm.

Rostrum dark gray, the palpi brownish black. Antennae with the scapal segments yellow, the flagellum dark brown, with long verticils. Head brownish gray.

Mesonotum dark gray, the praescutum with a scarcely indicated darker gray median area, the surface of the disk with a sparse yellow pollen, the lateral margins clearer gray. Pleura gray. Halteres pale, the knobs weakly infuscated. Legs with the coxae brownish yellow; trochanters yellow; remainder of legs brownish yellow, the tips of the femora and tibiae a little darkened; terminal tarsal segments dark brown. Wings with the costal fringe (male) short, the membrane strongly suffused with yellowish; *Rs* and cell *first* M_2 relatively short.

Abdomen generally dark brown, the subterminal segments somewhat darker. Male hypopygium about as in *D. quadrivittata* Alexander, but the outer dististyle longer and more slender, with the terminal spine long and straight, the spines on the outer face of the style more erect and conspicuous. Inner dististyle with the tip broadly rounded. Aedeagus blunt, not terminating in two rods, the subtending plates less broadly flattened apically. Lateral processes slender, each terminating in a more chitinized beak, without apical denticles.

Habitat.—California. *Holotype*, male, Alpine, April 10, 1915 (M. C. Van Duzee). *Paratypes*, a broken male, Muir Woods, Marin Co., May 19, 1915 (M. C. Van Duzee); a broken male Berkeley, May 14, 1915 (M. C. Van Duzee). The type is preserved in the writer's collection, through the kindness of Mr. M. C. Van Duzee.

The species mentioned above as *Dicranoptycha quadrivittata* Alexander was first described[6] as a variety of *sobrina* Osten Sacken, but is now known to be amply distinct. It has the following distribution, as known:

Colorado: Peaceful Valley, August 25, 1917 (Cockerell); type.

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[5] Proc. Acad. Nat. Sci. Philadelphia, 1914, pp. 579–580, pl. 27, fig. 22.

[6] Can. Ent., vol. 51, p. 191, 1919.

Idaho: Sandpoint, July 3, 1917 (H. G. Dyar); Lake Pend Oreille, July 4, 1917 (H. G. Dyar).

Montana: Glacier Park Station, altitude 4,800 feet, July 24, (J. M. Aldrich).

Alberta: Banff, July 10, 1918 (H. G. Dyar).

The species is told by the four usually distinct praescutal stripes. The male hypopygium has the outer dististyle unusually short and stout, strongly arcuated, blackened on the distal half, the apical spine relatively short, both the upper and lower faces of the style roughened but more especially the outer or convex face where the spines are large and conspicuous but strongly appressed. Inner dististyle short and stout, the apex blunt. Aedeagus terminating in two small parallel rods, subtended on either side by very broad flattened plates. Lateral process slender, carinate, the apex with microscopic denticles and roughenings.

LIMNOPHILA (EPHELIA) ALDRICHI, new species

General coloration dark brownish gray, the praescutum with four slightly darker brown stripes; halteres light yellow; femora and tibiae yellowish, the tips darkened; wings subhyaline, with a heavy brown pattern that is restricted to the vicinity of the veins; male hypopygium with the outer dististyle bearing a small triangular wing on outer margin at near two-thirds the length.

Male.—Length about 5.8–6.4 mm.; wing, 7.5–7.8 mm.

Female.—Length about 7 mm.; wing, 8.5 mm.

Rostrum and palpi dark. Antennae with the scapal segments dark; basal segments of the flagellum yellow, the outer segments passing into brown. Head brownish gray.

Mesonotal praescutum dark brownish gray with four slightly darker brown stripes, the intermediate pair narrowly separated from one another; pseudosutural foveae conspicuous, subcircular, black; remainder of mesonotum dark, heavily pruinose. Pleura dark brown, scarcely variegated with brighter. Halteres light yellow. Legs with the coxae brownish yellow, the middle coxae darker brown; trochanters obscure yellow; femora yellow, the tips rather broadly but not abruptly infuscated; tibiae yellow, the tips narrowly infuscated; tarsal segments obscure yellow, their tips narrowly darkened, the terminal tarsal segments uniformly darkened. Wings subhyaline, with a heavy brown pattern, as in the group; a series of seven costal marks, the third at the origin of *Rs*, the fifth, largest, at the stigma, the sixth and seventh at the ends of veins R_3 and R_4; conspicuous brown seams along the cord and outer end of cell *first* M_2; a broad seam on the supernumerary crossvein in cell *M;* a cloud at the fork of M_{1+2}; marginal clouds on all the longitudinal veins caudad of R_{4+5}, becoming larger posteriorly, that at the second anal vein large, subcircular; that of the first anal vein very small; veins yellow, brown in the infuscated areas. Venation: Supernumerary crossvein in cell *M* lying just beyond the level of the end of vein *second A*, so the marks are not in alignment.

Abdominal tergites dark brownish black, the bases of the segments broadly paler. Male hypopygium with the outer dististyle (fig. 6) relatively short and broad, the outer margin at near two-thirds the length with a small triangular flattened wing that is microscopically toothed; the end of the style terminates in a slender chitinized point; before this point, on the outer margin with numerous subappressed spines; inner or lower margin of the style in the angle of the apical spine microscopically denticulate.

Habitat.—Alberta, Montana. *Holotype*, male, Glacier Park Station, Montana, altitude 4,800 feet, July 24 (J. M. Aldrich). *Allotype*, female, Banff, Alberta, July 7, 1922 (C. B. Garrett). *Paratypes*, two males with allotype, July 28–30, 1922. Allotype in the Canadian National Collection.

Type.—Male, Cat. No. 40325, U.S.N.M.

This interesting *Limnophila* is named in honor of Dr. J. M. Aldrich, to whom I am greatly indebted for very many kindnesses in the past.

LIMNOPHILA (PHYLIDOREA) COLUMBIANA, new species

Male.—Length about 9 mm.; wing, 9.5 mm.

Closely allied to *L.* (*P.*) *adusta* Osten Sacken, differing especially in the coloration and structure of the male hypopygium.

Rostrum and palpi dark brown. Antennae with the basal segment dark brown, the succeeding three segments obscure brownish yellow, the remainder of the flagellum passing into brown. Head dark, grayish pruinose.

Pronotum and mesonotum dark brown, the sides of the sclerites paler, the surface with a sparse pollen; scutellum and postnotum paler with a narrow dark brown median line. Pleura brown, with a distinct microscopic pruinosity. Halteres pale, the knobs dark brown. Legs with the coxae pale brown, sparsely pollinose; trochanters obscure yellow; femora obscure yellow, the tips rather narrowly and vaguely infuscated; tibiae obscure yellow, the tips vaguely darkened; tarsi pale brown, the tips of the individual segments narrowly darker; terminal segment uniformly dark. Wings subhyaline, the costal region slightly more yellowish; stigma oval, dark brown; cord narrowly and very indistinctly seamed with darker; wing apex not darkened; veins dark brown. Venation: Sc_1 ending shortly before the fork of *Rs*, Sc_2 much longer, ending just beyond this fork; *Rs* angulated and short spurred at origin;

cell M_1 longer than its petiole. The right wing of the type shows an adventitious cross vein in the axil of *Rs*.

Abdominal tergites dark brown, the sternites somewhat paler; hypopygium with the basistyles dark brown, the dististyles yellow. Male hypopygium of the general type of *L. adusta*. Outer dististyles appearing as flattened blades, the outer apical angle of each being further produced into a long, gently curved, finger-like point that lies along the longitudinal axis of the style. Inner dististyle broad based, the distal two-thirds strongly narrowed, thence reduced in diameter to the tip, without a conspicuous shoulder on the outer margin near midlength, as in *adusta*. Aedeagus and the subtending gonapophyses very long and slender, as in the group.

Habitat.—British Columbia.

Holotype.—Male, Prince Rupert, June 17, 1919 (H. G. Dyar).

Type.—Male, Cat. No. 40326, U. S. N. M.

LIMNOPHILA (PHYLIDOREA) MICROPHALLUS, new species

General coloration shiny ferruginous, the abdomen of the male without a dark subterminal ring; femora almost uniformly yellow, the tips very vaguely darkened; male hypopygium with the aedeagus and subtending apophyses small and slender.

Male.—Length about 8 mm.; wing, 9.5 mm.

Rostrum and palpi brown. Antennae with the basal segment dark brown, the second segment brownish yellow; basal segments of the flagellum yellow, the terminal segments slightly more infuscated. Head dark, presumably gray pruinose in fresh specimens.

Thorax shiny ferruginous, without markings, the surface very sparsely pruinose. Halteres pale, the knobs slightly infuscated. Legs with the coxae and trochanters reddish ferruginous; remainder of legs yellow, the tips of the femora and tibiae very insensibly darkened; terminal tarsal segments dark brown. Wings with a yellowish tinge, the stigma elongate oval, dark brown; distal three-fourths of cell *C* infumed; wing apex distinctly darkened; narrow and ill-defined seams along the cord and vein Cu_1; veins brown, paler in the costal region. Venation: Cell M_1 about equal to its petiole; cell *first* M_2 elongate.

Abdomen yellowish ferruginous, without darker markings. Male hypopygium of the same general structure as *L. fumidicosta* Alexander. Outer dististyle broadly flattened, the apical portion suddenly narrowed and blackened, the tip weakly bifid. Inner dististyle with the curved apical portion short. Bifid gonapophyses with the lateral spine long and slender, acute, the axial spine a little longer but slender, the blackened tip acutely pointed. Aedeagus and subtending apophyses relatively short and very slender, the former a little the longer.

Habitat.—Montana.

Holotype.—Male, Big Timber, July 14, 1917 (H. G. Dyar).

Type.—Male, Cat. No. 40327, U.S.N.M.

LIMNOPHILA NIGROFEMORATA, new species

Male.—Length about 10.5 mm.; wing, 10.8 mm.

Closely allied to *L. mcdunnoughi* Alexander (Alberta), differing as follows:

Tuberculate pits appearing as barely evident linear impressions at the cephalic margin of the praescutum, one each on the inner margin of the two intermediate praescutal stripes. Dorso-pleural membrane brown, buffy surrounding the spiracles. Legs with the coxae scarcely paler apically; fore femora black, with about the basal fourth yellow; middle femora black, with approximately the basal third yellow; posterior femora as in *mcdunnoughi;* fore and middle tibiae almost black, the posterior tibiae paler. Wings with *Rs* angulated and spurred at origin.

Abdominal tergites dark brown, variegated with obscure yellow immediately beyond the dark basal ring and transverse impressions of each segment; a blackish subterminal ring; hypopygium brownish yellow. Male hypopygium with the basistyle (fig. 7) relatively stout, the dorsal lobe short and broad, with conspicuous setiferous tubercles. Outer dististyle flattened but not as broadly so as in *mcdunnoughi*, the distal half narrowed into a blackened apex that terminates in two conspicuous teeth, the subapical one shorter and straighter; surface of style with abundant microscopic setae. Inner dististyle a very small, stout fleshy lobe. Gonapophyses and aedeagus relatively small and inconspicuous.

Habitat.—Montana. *Holotype*, male, Summit Station, altitude 5,200 feet, July 25 (J. M. Aldrich).

Type.—Male, Cat. No. 40328, U.S.N.M.

In *L. mcdunnoughi*, the gray of the mesonotum is duller and darker. The fore femur has the darkened apex of about the same degree as in the other legs, but when specimens are fully colored there is a distinct darkened ring beyond the midlength of the segment, followed by an ill-defined dull yellow annulus. Abdomen uniformly darkened. Male hypopygium with the outer dististyle even broader than in *nigrofemorata*, greatly flattened; gonapophyses more elongate, much exceeding the aedeagus. *L. mcdunnoughi* is still known only from Alberta (Nordegg, July 14, 1921, Mc Dunnough; Banff, July 18–25, 1922, Garrett).

ULOMORPHA ARIDELA, new species

Head dark, pruinose; mesonotum obscure brown with three shiny black stripes; scutal lobes similarly blackened; wings fulvous-yellow, the stigma barely indicated; cell M_1 present; abdominal tergites brown, the sternites obscure yellow.

Female.—Length, 14 mm.; wing, 12 mm.

Rostrum obscure yellow, the palpi dark brown. Antennae very long and slender (for this sex), if bent backward extending to beyond the wing root; basal segments brown, paler ventrally; flagellar segments beyond the second uniform brownish black; flagellar segments cylindrical, becoming very elongate cylindrical on the outer segments, with the limits between segments difficult to determine; all flagellar segments with very long verticils, as in the genus. Head dark, heavily gray pruinose, brighter adjoining the eyes, the anterior vertex and front more yellowish.

Pronotum dark brown, yellow laterally. Mesonotum obscure brown, the praescutum with three shiny black stripes that are virtually confluent, the interspaces being a trifle paler, sparsely pruinose; median stripe more intensely black than the lateral stripes; humeral region more yellowish, including a very small brighter yellow spot behind the pseudosutural foveae; scutum reddish brown, the lobes largely shiny black, the posterior lateral regions obscure yellow; scutellum and postnotal mediotergite black, the latter dulled basally, the extreme lateral margins of the cephalic half yellow; pleura mostly yellow, indistinctly variegated with reddish brown on the anepisternum and sternopleurite, producing ill-defined longitudinal stripes; dorso-pleural region more yellowish. Halteres brown, the extreme base of the stem narrowly yellowish. Legs with the coxae and trochanters brownish yellow; femora brown, the bases yellow, the tips insensibly passing into darker brown; tibiae brown, the tips narrowly darker brown; tarsi dark brown. Wings with a strong fulvous-yellow tinge, the stigma barely evident; veins brown. Macrotrichiae of cells abundant, continued basad beyond the level of the origin of *Rs*, in cells *C*, *R*, *M*, and *first A* considerably basad of this level; cell *Sc* devoid of trichiae except at extreme outer end. Venation; Sc_1, ending shortly before the fork of *Rs*, Sc_2 at its tip; cell R_3 sessile; R_{1+2} nearly three times R_2 alone; R_{2+3} and R_3 subequal; cell M_1 present, a little more than twice its petiole; cell *first* M_2 large, pentagonal, *m–cu* not far from midlength.

Abdominal tergites brown, with a narrow darker dorso-median line; sternites obscure yellow. Ovipositor with the tergal valves very long and slender, gently upcurved to the acute tips, horn colored, darker basally.

Habitat.—Oregon. *Holotype*, female, Marshfield, June 27 (J. M. Aldrich).

Type.—Female, Cat. No. 40329, U.S.N.M.

Ulomorpha aridela is the second species of the genus to be discovered having cell M_1 present. It is readily told from *U. quinquecellula* Alexander by the large size and coloration of the mesonotum.

TRICYPHONA STENOPTERA, new species

Antennae 15-segmented; legs long and slender; wings reduced to long ribbonlike strips.

Male.—Length about 6 mm.; wing, 3.2 mm., its greatest width, 0.2 mm.

Rostrum obscure yellow, the palpi darker. Antennae brownish black throughout, 15 segmented, the second scapal segment large, as long as or longer than the first flagellar segment; flagellar segments beyond the first decreasing in length and diameter outwardly, passing into short oval and then subglobular. Head light gray. Eyes densely hairy.

Pronotum buffy, a little infuscated medially. Mesonotum uniformly pale buffy yellow, without distinct markings. Pleura yellow, the anepisternum and sternopleurite a little more grayish. Halteres pale yellow, the knobs infuscated. Legs unusually long and slender for such extreme stenoptery (fore leg, femur, 5 mm.; tibia, 5.4 mm.; tarsus, 7.9 mm.); coxae long and slender, obscure yellow, sparsely pruinose; femora obscure yellow, the tips vaguely darkened; tibiae light brown, the tips narrowly dark brown; tarsi dark brown. Wings reduced to long, ribbonlike strips, strongly tinged with brownish yellow, clearer yellow basally; veins pale, the macrotrichiae very well preserved. Although the wing is so degenerate, the venation of the radial field is well preserved and shows *Rs* arising at shortly beyond two-thirds the wing length, pale, without macrotrichiae; upper fork of the sector, R_{2+3+4}, bears two long branches, both with conspicuous macrotrichiae for almost their entire length; the basal section of R_2 is not preserved, there being no connection between R_1 and the branches of the sector; R_5 with macrotrichiae for its entire length.

Abdominal tergites light yellowish brown with a vague darker brown dorso-median vitta; sternites more uniformly colored, reddish brown, darker outwardly, the caudal margins of the segments narrowly obscure yellow; subterminal segments uniformly darkened; hypopygium obscure yellow. Male hypopygium (fig. 8) with the tergite (*t*) greatly produced medially into a conspicuous base that divides further into two divergent setiferous arms, the setae on the surface erect, on the ventral surface more spinous and recurved.

Basistyle (*b*) relatively large, the mesal margin with a dense patch of short spines and longer setæ, and a smaller group of very long slender setae. Outer dististyle (*d*) broadly flattened, dilated distally, the outer angle a blunt point, the inner angle produced into a slender fleshy lobe that is set with small black spines, as common in the tribe. Inner dististyle longer and more slender, gently curved, the lower margin with small spinous setae. What appear to be the interbases are broad, flattened curved plates, narrowed distally, terminating in two powerful, unequal spines.

Habitat.—Colorado. *Holotype*, male, Tennessee Pass, July 23, 1917 (J. M. Aldrich).

Type.—Male, Cat. No. 40330, U.S.N.M.

EXPLANATION OF PLATE

(SYMBOLS: The venation used is the Comstock-Needham system, with the cubital field as modified by Tillyard and the radial field as modified by Alexander.—*A*=Anal veins; *C*=Costa; *Cu*=Cubitus; *M*=Media; *R*=Radius; *Sc*=Subcosta.

The terminology of the hypopygium is that of Cramton (1923).—*a*=aedeagus; *b*=basistyle; *d*=dististyle; *g*=gonapophysis; *t*=9th tergite.)

FIG. 1. *Brithura nymphica;* wing.
2. *Eriocera grahami;* wing.
3. *Eriocera arrogans;* wing.
4. *Limonia nitidiuscula;* male hypopygium.
5. *Dicranomyia penicillata;* male hypopygium.
6. *Limnophila* (*Ephelia*) *aldrichi;* outer dististyle.
7. *Limnophila nigrofemorata;* styli.
8. *Tricyphona stenoptera;* male hypopygium.

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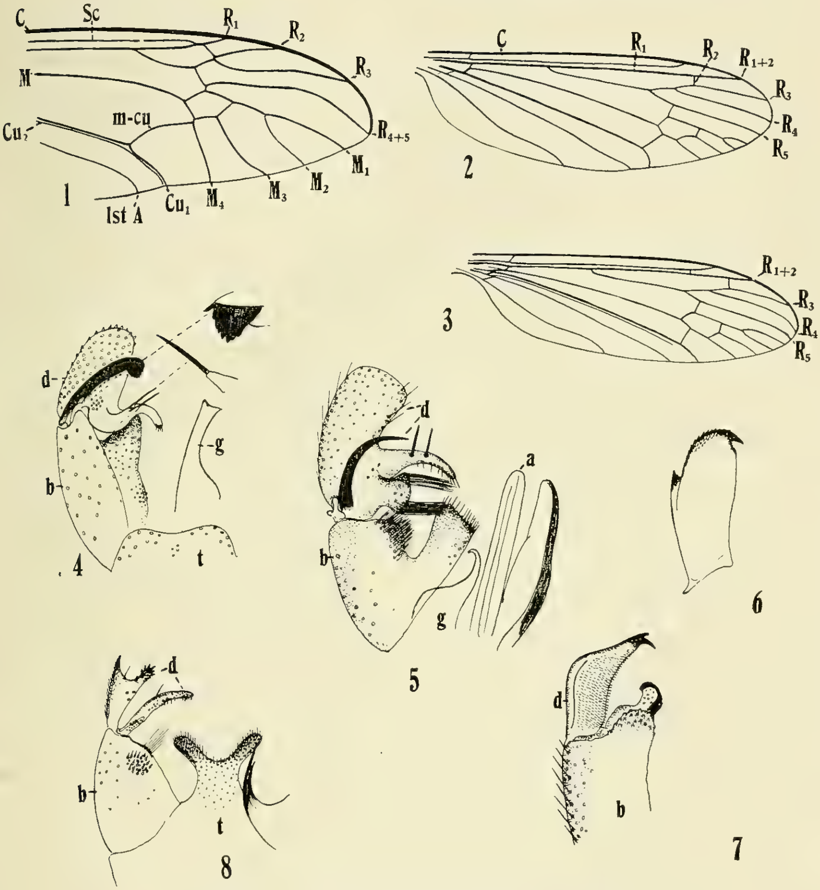

Wings and other parts of Crane Flies

For explanation of plate see page 17

NEW SPECIES OF MOLLUSKS OF THE GENUS CORBICULA FROM URUGUAY AND BRAZIL

By William B. Marshall,

Assistant Curator, Division of Mollusks, United States National Museum

In my paper "New Uruguayan Mollusks of the Genus Corbicula"[1] I described:

Corbicula (*Cyanocyclas*) *circularis.*
Corbicula (*Cyanocyclas*) *compacta.*
Corbicula (*Cyanocyclas*) *delicata.*
Corbicula (*Cyanocyclas*) *exquista.*
Corbicula (*Cyanocyclas*) *felipponei.*
Corbicula (*Cyanocyclas*) *fortis.*
Corbicula (*Cyanocyclas*) *oleana.*
Corbicula (*Cyanocyclas*) *paysanduensis.*

Specimens from Brazil, which were already in the Museum collection, and many specimens, all of them from the Department of Colonia, Uruguay, and nearly all from the Bay of Colonia in the Rio de la Plata, lately received from Prof. Auguste Teisseire, Directeur du Lycee Departemental de Colonia, make it necessary to describe six new species.

In many specimens of *Corbicula* there are radiating splashes of purple along the interior edge of the ventral margin. When these occur there should be a corresponding ray, usually of reddish, on the outer surface and often such rays will be revealed by careful examination although at first their presence may be unsuspected. In same specimens in which there are rays it is impossible to detect them, because of a thickening of the periostracum which makes it nontranslucent. In such cases if the periostracum be removed the rays will show clearly on the white background; or if a longitudinal section of the shell be made dots of color will show where the rays were cut. When radiating splashes of purple occur along the ventral inner edge they are a sure sign that rays, even though invisible, are present on the outside, and it is unnecessary to remove the

[1] 1924, Proc. U. S. Nat. Mus., vol. 66, art. 15, pp. 1–12.

periostracum or to section the shell to determine the fact. On the outside the rays are single, narrow "clear-cut" and reddish, but on the inner margin many of them are double, broad, blurred, purple, or deep lavender. A section across the rays near the ventral margin shows that there they go entirely through the calcareous portion of the shell. In sections made nearer the beaks they go at least part way through.

Several of the specimens received from Professor Teisseire contained young. When collected, these specimens were not cleaned, and the young of various ages are included in the dried flesh of the females. The young are in perfect condition.

A fine specimen of *C. felipponei* (Cat. No. 365390) from the Bay of Colonia contained embryonic and nepionic shells. The latter were probably not yet developed to the age of extrusion, as they are smaller than one would expect from the size of the adult. In these young, which are very pale straw color, there is a splash of purple on the anterior area and one on the posterior. Immediately after the close of the embryonic stage fine radiating lines of lavender make their appearance. Such lines occur in specimens not more than a millimeter in length.

CORBICULA (CYANOCYCLAS) TEISSEIREI, new species

Plate 1, figs. 1, 2

Shell rather thin, nearly elliptic, rounded and slightly narrower in front, more broadly rounded at the rear; a little inflated, beaks rather low, situated at the middle of the dorsal line, which is well arched. Ventral line regularly curved. Posterior and anterior ridges not well defined, the descent to the margin more abrupt at the rear than in front. Periostracum generally clothlike and dull, but slightly glossy on the convexity of the shell. Sculpture of numerous concentric striae, which develop into fine ribs on the anterior area. Color brownish with an olivaceous cast and with three obscure broad fuscous rays in the vicinity of the posterior ridge, and with faint radiating lines of color over the general surface. The shell being "dead" the color of the interior has changed to nearly uniform purple. (Fresh specimens have the interior gay with pink, lavender, and purple, with three broad purple interrupted rays indicating the location of the three fuscous rays of the exterior—a number of fine lavender rays unequally distributed.) In the right valve the middle and posterior cardinal teeth are distinctly grooved on the summit, the anterior cardinal small and thin. In the left valve none of the cardinals is grooved, and the posterior one is small and thin. In both valves the cardinals are widely divergent. In the right valve the two posterior laterals are rather distant from the beak, the inner lateral being finely crenulated on its upper surface. In this valve the two anterior laterals begin near the beak, the inner one being finely crenulated on its upper surface. Left valve with one anterior and one posterior lateral, both crenulated on the edge. Anterior adductor scar deep; posterior scar not so deep, but well marked.

The type (Cat. No. 365382, U.S.N.M.) measures: Length, 27.5 mm.; height, 23 mm.; diameter, 14 mm. It comes from Arroyos in the Department of Colonia, Uruguay, and was collected and presented by Prof. Auguste Teisseire.

The finest specimen of all (Cat. No. 365380, U.S.N.M.) measuring: Length, 28 mm.; height, 23 mm.; diameter, 15 mm.; has the teeth abnormal and therefore could not be used as type. The abnormality consists in having the two posterior cardinals of each valve fused into a single tooth. The interior of this specimen is especially gay with mixed colors of white, pink, lavender, and purple. Other specimens which retain the true coloring of the interior show these gay colors to be usual with the species. Younger and weathered shells are greenish, or pinkish on the outside and show several radiating fine lines.

CORBICULA (CYANOCYCLAS) SIMPLEX, new species

Plate 1, figs. 3, 4

Shell rather thin, somewhat inflated, nearly round, but broader at the rear than front, posteriorly subtruncate, anteriorly slightly extended. Dorsal margin well arched, beaks a little behind the middle, anterior dorsal margin very oblique, posterior dorsal margin gently sloping and shorter. Ventral margin regularly curved, rounding gradually into the anterior margin and suddenly into the posterior margin. Posterior ridge high but rounded; anterior ridge indistinct; sculpture of fine concentric striae, more marked in front than in the rear. Rest periods distinctly marked by deeper lines and blackish color. Color olive green with a broad darker green ray on the posterior ridge and two similar rays on the posterior dorsal area. Interior purple with a white edging around the margin, the exterior rays indicated by purple rays in the interior. In right valve the anterior cardinal is minute and oblique, the middle cardinal thick and deeply bifid, the posterior cardinal thick and moderately bifid and oblique. In the left valve the anterior cardinal is moderately thick, the middle cardinal is thick and deeply bifid, the posterior cardinal long and thin. Right valve with two anterior and two posterior laterals which are rather low and short, the inner ones crenulated. Left valve with a single lateral in front and one at the rear, both rather high and both crenulated. Adductor scars deeply impressed, pallial sinus well marked.

The type (Cat. No. 365385, U.S.N.M.) measures: Length, 24.5 mm.; height, 21.5 mm.; diameter, 18.5 mm. It and a single valve (Cat. No. 365386, U.S.N.M.) come from Arroyos in the Department of Colonia, Uruguay, and were collected and presented by Prof. Auguste Teisseire.

This species is closely related to *C. teisseirei*, but differs in the shortened posterior end and in the greenish color.

Two specimens (Cat. Nos. 365387 and 365388) from Arroyos in the Department of Colonia, Uruguay, sent by Professor Teisseire, contain young in the dried flesh of the mother. The largest of these young is 4½ mm. long. The parent shell has a length of 21½ mm. In the young the tips of the beaks are glassy, tinged with lavender, followed by a broad splash of white, which is surrounded by an irregular circle of violet, then a whitish, concentric band and the ventral portion purplish. The posterior area shows three purple rays. These are the beginnings of the three external fuscous rays and internal purple rays of the adult.

CORBICULA (CYANOCYCLAS) GUAHYBENSIS, new species

Plate 1, figs. 9, 10

Shell small, rather compressed, nearly elliptic, slightly narrower in front than behind. Dorsal margin regularly curved, beaks a little in front of the middle, anterior dorsal margin slightly more oblique than the posterior. Ventral margin lightly curved, rounding gradually into the anterior margin and somewhat more sharply into the posterior. Anterior and posterior ridges rounded, not well defined. Sculpture of numerous fine concentric striae, stronger on the anterior and posterior areas; the rest periods emphasized. Most of the shell glossy, very light straw color, becoming darker with distance from the beaks. Surface with a number of narrow, unequal reddish rays, three of which are more prominent than the others. Interior mostly white with a large spot of lavender in the upper part. In right valve the anterior and posterior cardinals are oblique and thin, the latter larger than the former, the middle tooth thick and slightly bifid on its summit. In left valve the anterior cardinal is thicker and shorter than the posterior; the middle tooth thick and distinctly bifid. In right valve the two pairs of laterals are short and stout, the groove between each pair wide and deep, and the inner ones finely and sharply crenulated. In left valve there is one anterior and one posterior lateral, both of which are rather thick and finely crenulated. Adductor scars deep; the sinus in the pallial line wide, obtusely pointed, and unusually well marked.

The type (Cat. No. 171426, U.S.N.M.) measures: Length, 15 mm.; height, 13 mm.; diameter, 8½ mm. It and 28 paratypes (Cat. No.

122321, U.S.N.M.) come from the Guahyba River, Rio Grande do Sul, Brazil, and were presented by Dr. H. von Ihering. Almost any one of the specimens might have been selected for the type as the variation among them as to form, color, and sculpture is very slight, while in size most of them approximate the type.

This species is related to *C. limosa* but is distinguished at once by the smaller size, the slightly more elongate form, and especially by the very pale color.

CORBICULA (CYANOCYCLAS) UNDULATA, new species

Plate 1, figs. 5, 6

Shell rather thick, subtriangular, inflated, obliquely truncated posteriorly, rounded and slightly extended anteriorly, dorsal line much arched, ventral margin evenly rounded, curving regularly into the anterior margin, and more sharply into the posterior margin. Posterior aspect wedge shaped, wide, and nearly at right angles with the convexity of the shell. Beaks high and moderately narrow, pointing forward. Posterior ridge high and abrupt; anterior ridge low and not well defined. Sculpture consisting of numerous concentric ribs on the upper part of the shell which become less marked near the ventral margin; on the posterior area there are indications of obscure radiating ridges. Color dark yellowish olive, with a number of green radiating lines which are not uniform in width nor evenly spaced. Interior mainly dark purple, with lighter area in the middle and along the margins. Each of the radiating lines on the outer surface is marked by a dark purple spot on the inner margin; pallial line and adductor scars well marked, and the pallial sinus deep and wide. In each valve there are three cardinal teeth, widely divergent. In right valve the anterior cardinal is thin and platelike, the middle cardinal thick and slightly bifid, the posterior cardinal medium thick and long and bifid throughout its length. In left valve the anterior cardinal is thick, the middle one like the one in the right valve, and the posterior one thin. The right valve has two laterals anteriorly and two posteriorly, rather short and stout and crenulated. The left valve with a short, thick, crenulated lateral anteriorly and posteriorly.

The type (Cat. No. 365392, U.S.N.M.,) measures: Length, 19 mm.; height, 17 mm.; diameter, 13 mm. It comes from the Bay of Colonia, Rio de la Plata, Uruguay, and was collected and presented by Prof. Auguste Teisseire.

This species differs from *coloniensis* chiefly in the strong concentric ribs. Its proportions, too, are different, as it is more inflated.

CORBICULA (CYANOCYCLAS) IHERINGI, new species

Plate 1, figs. 11, 12

Like *C. coloniensis* in color and to a great extent in form, but the posterior ridge not so marked, the posterior area less wedge shaped, the cardinal teeth relatively smaller and the lateral teeth relatively longer and thinner.

The type (Cat. No. 171423, U.S.N.M.) consists of a single valve. It measures: Length, 22 mm.; height, 18.5 mm.; diameter (if both valves were present) would be 12 mm. It comes from S. Leopols, Rio Grande do Sul, Brail, and was presented by Dr. H. von Ihering.

This may prove to be a subspecies of *C. coloniensis*, its variation from type due to a distant habitat.

CORBICULA (CYANOCYCLAS) PLATENSIS, new species

Plate 1, figs. 7, 8

Shell subequitrangular, thick, inflated, obliquely truncate posteriorly extended and sharply rounded anteriorly, dorsal line much arched, ventral margin evenly rounded, curving regularly into the anterior margin and angularly into the posterior margin. Both the anterior and posterior aspects wedge shaped, wide, and rounding into the convexity of the shell. Beaks high, located at the middle of the dorsal line, pointing forward. Posterior ridge high but rounded, the descent to the posterior margin rapid. Anterior ridge gradually rounded. Posterior end of shell slightly nasute. Beaks eroded, white at the tips and then deep purple. General color dark chestnut on a clothlike periostracum, the dorsal area slightly lighter. Several scarcely visible dark radiating lines. Interior mostly purplish, the cardinal teeth white, the lateral teeth and an area at the front and one at the rear delicate pink. Concavity pale purple, area between ventral border and pallial line deep rich purple rayed with white; a wide purple ray marking the posterior angle. In the right valve the anterior cardinal tooth is thin, platelike and very oblique; the middle tooth is thick and deeply bifid; the posterior tooth moderately thick, indistinctly bifid and oblique. In the left valve the anterior tooth is thicker than in the right valve, the middle tooth thick and slightly bifid, the posterior tooth thin. In right valve there are two anterior and two posterior lateral teeth, the inner ones crenulated. The left valve with one anterior and one posterior lateral tooth, the former the smaller, the latter very high, and both of them very sharply crenulated. Adductor scars not very prominent, sinus well marked, deep, and sharply pointed.

The type (Cat. No. 365393, U.S.N.M.) measures: Length, 26.5 mm.; height, 23.5 mm.; diameter, 17.5 mm. It comes from the Bay of Colonia, Rio de la Plata, Uruguay, and was collected and presented by Prof. Auguste Teisseire.

This species belongs in the same group with *C. felipponei* and *coloniensis*. The clothlike periostracum and the more nasute form and greater inflation serve to differentiate it from them. It is a connecting link between *C. coloniensis* and *C. fortis*, distinct from both and yet partaking of the characteristics of each.

EXPLANATION OF PLATE

All figures multiplied by 1¼ diameters

FIGS. 1 and 2. *Corbicula* (*Cyanocyclas*) *teisseirei*, new species.
3 and 4. *Corbicula* (*Cyanocyclas*) *simplex*, new species.
5 and 6. *Corbicula* (*Cyanocyclas*) *undulata*, new species.
7 and 8. *Corbicula* (*Cyanocyclas*) *platensis*, new species.
9 and 10. *Corbicula* (*Cyanocyclas*) *guahybensis*, new species.
11 and 12. *Corbicula* (*Cyanocyclas*) *iheringi*, new species.

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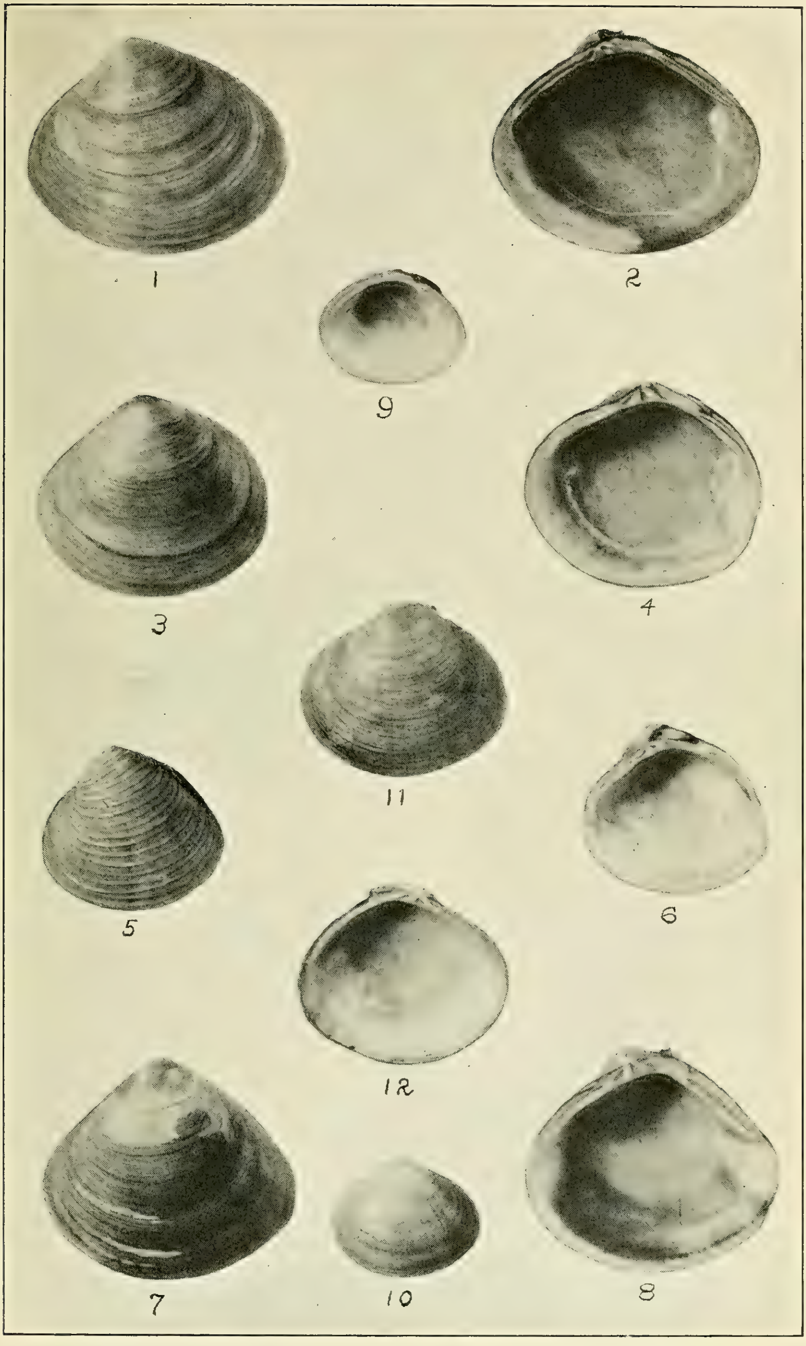

NEW FRESH-WATER SHELLS FROM URUGUAY AND BRAZIL

FOR EXPLANATION OF PLATE SEE PAGE 7

HERETOFORE UNDESCRIBED METEORIC IRONS FROM [1] BOLIVIA, SOUTH AMERICA, [2] WESTERN ARKANSAS, AND [3] SENECA TOWNSHIP, MICHIGAN

By George P. Merrill
Head Curator of Geology, United States National Museum

The recently received F. A. Canfield bequest of minerals contained representatives of seven falls of meteorites one of which (that of Nanjemoy, Md.) was a stone, one a pallasite, and the remaining five irons. Among these last were two with localities quite too indefinite to make them of great value or consequence, but which should nevertheless be recorded. These are as follows:

[1] *Bolivia* (*Cat. No. 793*).—This is a complete individual in form of a flattened oval (see pl. 1) without deep pittings or unusual surface markings, quite fresh, and weighing 21.25 kilograms (46.75 lbs.). The only information regarding it is given in Canfield's own hand in a leaf from an old letter of which the first page and date are missing. It reads: "A friend has given me a mass of meteoric iron which weighs 47 pounds and has never been cut. It was found 30 years ago and purchased by a priest, who thinking it was silver paid $600 in gold for it."

The iron is soft and malleable, and etches but poorly (pl. 2, lower), showing irregular somewhat wavy kamacite bands with little or no plessite and taenite in minute, almost microscopic films; schreibersite is present in scattered granules. The kamacite bands show under a low power a very fine granular structure. A representative piece submitted to E. V. Shannon was reported on as follows:

The piece of the iron which, ground free from scale, was used for the analysis weighed 22.1325 grams. Except insoluble matter, copper, and platinum, the determinations were made upon aliquot portions of this solution equivalent to 1.1066 grams each. Copper and platinum were determined in the residuum of the solution equivalent to 15.4929 grams of the iron. The results of the analysis are as follows:

	Per cent
Insol	0.042
Fe	94.212
Ni	5.626
Co	.320
Cu	.0004
Mn	None.
S	.014
P	.261
Pt	Trace.
	100.4754

The insoluble matter, very small in amount, was examined under the microscope and found to consist of fine quartz and carborundum grains and a little opaque dust. It is probably all extraneous.

The reaction for platinum is of special interest. A portion of the hydrochloric acid solution of the iron equivalent to 15.4929 grams was saturated with hydrogen disulphide (H_2S) and filtered. The separated sulphur was filtered out together with the platinum (Pt) and copper (Cu) as sulphides, and ignited in a porcelain crucible. The residue, consisting in considerable part of iron oxide, was digested overnight in strong hot hydrochloric acid, diluted and filtered through a very small filter. The filter paper showed a visible black residue (PtS?). This was returned to the porcelain crucible, ignited and treated with aqua regia in the crucible and evaporated to dryness. After several evaporations to dryness with hydrochloric acid to expel free chlorine and nitrates the residue was several times evaporated to dryness with water, taken up in water and a few drops of potassium iodide were added. The red color characteristic of platinum immediately appeared. The procedure was repeated and the result was the same. This composition taken in connection with the structure would relegate the mass to the class of kamacite octahedrites.

[2] *Western Arkansas* (*Cat. No. 794*).—This is a somewhat rounded triangular mass, polished and etched on one side and weighing 1.75 kilograms. It was labeled in Canfield's hand "Meteor found in Arkansas, presented by I. Price Wetherill, (?) June, 1890," and on the obverse "Mr. Wilkins said a native mountaineer brought this specimen to him in Joplin." With so little of its history known the iron would have not been considered worthy of investigation but for peculiarities noted below.

The iron etches very poorly, yielding a dull lusterless surface on which the taenite plates are so thin as to be scarcely distinguishable but by the aid of a lens. The kamacite bands are rarely over 1 millimeter in thickness and are very finely granulated throughout. Two very thin dull black wavy lines or veins the nature of which can not be determined traverse this face diagonally. Numerous very small glistening points are assumed to be schreibersite. On account of lack of information regarding it further investigation was not attempted. Mr. Shannon has, however, made an analysis, the results of which are given in column I below.

The iron was analyzed by the usual methods on a piece, ground free from scale or inclusions, weighing 11.0383 grams. The composition is shown in column I below:

	I	II
	Per cent	Per cent
Insoluble	.013	
Iron	94.858	94.07
Nickel	5.121	5.02
Cobalt	.353	.38
Copper	.013	Trace.
Platinum	None.	
Manganese	Trace.	
Phosphorous	.020	.06
Sulphur	.009	
Chromium	None.	Sn .09
	100.387	99.62

There is nothing striking in this result, but by a singular coincidence Prof. S. W. McCallie (of the Georgia State Survey) has but recently reported an iron found at a locality called Social Circle in his State that presents an almost identical appearance and granulated etched surface. The composition (column II above) agrees so closely that both analyses might have been thought made from the same mass except for the 0.09 per cent of tin, which is perhaps open to question.

[3] *Seneca Township, Lenawee County, Michigan (Cat. No. 786).*—This iron was brought to my attention by Stuart H. Perry, of the Adrian Daily Telegram, with the statement that it was found in July, 1923, and that it is supposed to be the result of a fall seen at Seneca Township in 1914. The evidence thus far submitted can not, however, be considered as altogether confirmatory.

As shown in the plate (pl. 2, upper), the mass is in the form of a flattened oval, and though oxidized and scaling somewhat on the outer surface still shows traces of the larger original thumb markings. That it has lain exposed for some years is unmistakable. The present weight is 11.5 kilograms. An analysis by E. V. Shannon in the Museum laboratories yielded:

	Per cent
Iron	87.77
Nickel	11.41
Cobalt	0.26
Copper	0.01
Sulphur	0.05
Phorphorus	0.15
	99.65

No platinum was detected, as the amount of material furnished was insufficient for a satisfactory test.

An etched surface shows the iron to be a medium octahedrite, the content of nickel places it with the rodeo group.

DESCRIPTION OF PLATES

Plate 1

Two views of the Bolivian meteoric iron in the Canfield Collection.

Plate 2

Upper: Meteoric iron from Seneca Township, Michigan.

Lower: Etched slice of Bolivian meteoric iron shown in plate 1.

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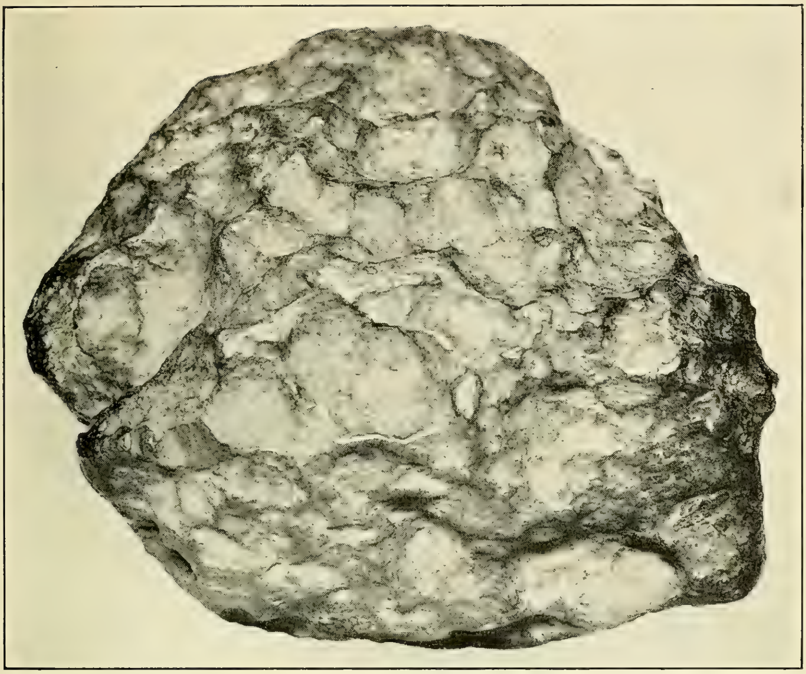

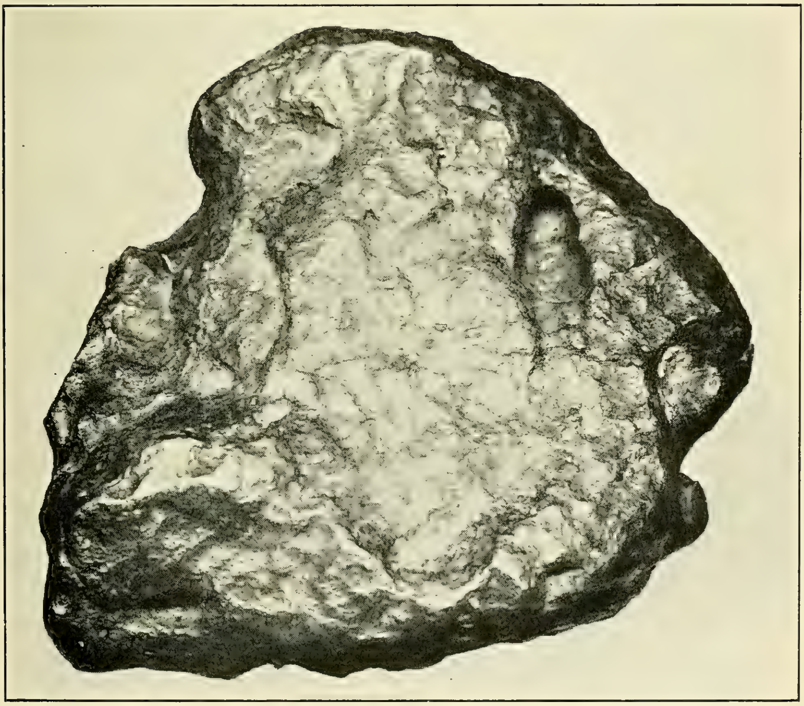

BOLIVIAN METEORIC IRON

FOR EXPLANATION OF PLATE SEE PAGE 4

METEORIC IRON FROM SENECA TOWNSHIP, MICHIGAN

ETCHED SLICE OF BOLIVIAN METEORIC IRON

FOR EXPLANATION OF PLATE SEE PAGE 4

A BIBLIOGRAPHY OF THE CONODONTS WITH DESCRIPTIONS OF EARLY MISSISSIPPIAN SPECIES

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INTRODUCTION

The present contributions to the study of the conodonts was prepared at the suggestion of Dr. R. S. Bassler and under his direction in the paleontological laboratory of the United States National Museum where extensive collections of these toothlike structures were available. As Doctors Ulrich and Bassler had just completed their paper on the classification of the conodonts and had applied their new classification in the description of an Upper Devonian fauna of western New York and an early Mississippian one from Tennessee, it was thought best that my work should carry these studies to the Mississippian rocks of Alabama and also include for the ready reference by students illustrations of previously described species, with exception of three publications, and a bibliography of the group. The exceptions mentioned refer to the work of Bryant in 1921, Ulrich and Bassler in 1926, and Roundy in 1926, copies of which are still available to the student.

ZOOLOGICAL AFFINITIES OF THE CONODONTS

The affinities of the conodonts have been a subject of controversy almost since their discovery by Pander in 1856. That there was no doubt in Pander's mind as to their relationship may be ascertained from the title of his monograph. He studied the internal as well as the external structure of the fossils and saw in their formation fishlike characters somewhat of the Selachian type.

The question concerning the affinities of these fossils seems to have had its birth in the mind of Dr. J. S. Newberry, of Ohio, who after studying specimens found in the Cleveland shales remained undecided for some years whether they were Marsipobranchii (Cyclostomata) or Annelids.

Hinde, who made the most comprehensive study of conodonts of any paleontologist up to Bryant's work of 1921, classified them as primitive vertebrates, probably Myxinoids. He based his conclusions upon two facts: First, no gastropods which possessed such teeth were found in the same formations nor did any crustaceans have such spines; and, secondly, the annelid jaws which he found in the same beds are composed of chitin, while the conodont teeth contain both calcium carbonate and calcium phosphate. He was of the same opinion in 1900, namely, that the teeth belonged to fish rather than to some invertebrate.

In 1886 Rohon and Zittel decided that "the conodonts have structurally nothing in common either with the dentine of Selachia and other fishes, the horny teeth of Cyclostomi, the lingual teeth of the Mollusca, the hooklets of the Cephalopoda, or the broken segment spines of the Crustacea; on the other hand, both in form and in structure, they agree remarkably with the masticatory apparatus of the Annelida and Gephyrea." They came to the conclusion that since there is this agreement, all these microscopic teeth, those acknowledged by Hinde to be annelids and those which he called conodonts, are the oral or oesophageal teeth of worms.

In reviewing the literature on conodonts it will be found that the most thorough students of these fossils believe they are the remains of primitive vertebrates, probably some simple fish. In neither of John Smith's papers on conodonts of Scotland can one find a suggestion that these are not fish teeth, but an exception is found when Asser Hadding places them in the phylum Annelida.

In Grabau's Text-Book of Geology, conodonts are described as horny, jawlike, or toothed structures developed within the body—the oesophageal jaws of worms.

Bryant in 1921 remarks: " On the whole, the longer I have studied these organisms the more have I become convinced that the true conodonts have hardly anything really diagnostic in common with annelid jaws. If, as I shall hereinafter try to demonstrate, certain of the leaflike forms are of the nature of pavement teeth, then the conclusion seems almost unavoidable that the conodonts must be considered as the dentition of some primitive type of fishes."

In the recent publication on the subject of conodonts by Ulrich and Bassler they are regarded as teeth and plates of primitive fish. Their classification is as follows:

Class PISCES

TYPICAL CONODONTS (teeth of primitive fishes)

Family DISTACODIDAE Ulrich and Bassler

Distacodus Hinde, 1879 (*Machairodus* Pander, 1856, preoccupied; *Machairodia* Smith, 1907); *Acodus* Pander, 1856; *Acontiodus* Pander, 1856; *Drepanodus* Pander, 1856; *Scolopodus* Pander, 1856; *Oistodus* Pander, 1856; *Paltodus* Pander, 1856.

Family PRIONIODIDAE Ulrich and Bassler

Prioniodus Pander, 1856; *Subprioniodus* Smith, 1907; *Cordylodus* Pander, 1856; *Belodus* Pander, 1856; *Ligonodina*, Ulrich and Bassler.

Family PRIONIODINIDAE Ulrich and Bassler

Cornuramia Smith, 1907; *Hindeodella*, Ulrich and Bassler; *Pachysomia* Smith, 1907; *Lonchodina*, Ulrich and Bassler; *Prioniodina*, Ulrich and Bassler; *Prioniodella*, Ulrich and Bassler; *Bryantodus*, Ulrich and Bassler; *Euprioniodina*, Ulrich and Bassler; *Hibbardella*, Ulrich and Bassler; *Lonchodus* Pander, 1856; *Valentia* Smith, 1907; *Prionognathus* Pander, 1856; *Palmatodella*, Ulrich and Bassler; *Diplododella*, Ulrich and Bassler; *Synprioniodina*, Ulrich and Bassler.

FISH PLATES (dermal plates)

Family POLYGNATHIDAE Ulrich and Bassler

Polygnathus (Hinde) Bryant, 1921; *Ancyrodella* Ulrich and Bassler; *Palmatolepis* Ulrich and Bassler; *Panderodella* Ulrich and Bassler; *Polygnathellus* Ulrich and Bassler; *Gnathodus* Pander, 1856; *Ctenognathus* Pander, 1856.

BIBLIOGRAPHY OF CONODONT LITERATURE

1856. Pander, C. H., Monographie der Fossilen Fische des Silurischen Systems der Russich-Baltischen Gouvernements, St. Petersburg, 91 pages, 9 plates. (Contains original definition of conodonts with description of numerous genera and species.)

1861. Harley, J., Geological Society, London, Quarterly Journal, volume 17, pages 543–552, plate 17. (Discusses zoological position. Probably several of his specimens described are not conodonts.)

1861. Owen, Richard, Paleontology, Second Edition, Edinburgh, page 117. (Brief discussion of position.)

1863. Von Eichwald, C. E., Bulletin de la Societe Imperiale des Naturalistes de Moscou, volume 36, page 375. (Brief discussion of systematic position.)

1870. Moore, Charles, British Association for the Advancement of Science. Report of the 39th Meeting, 1869, pages 375–377. (Conodonts discussed but no specific description or figures.)

1875. Newberry, J. S., Geological Survey, Ohio, Report, volume 2, part 2, Paleontology, pages 41–44, plate 57. (Illustrates various specimens without generic or specific names and discusses systematic position.)

1878. Ulrich, E. O., Journal Cincinnati Society of Natural History, volume 1, pages 87–91, plate 4. (Briefly discusses conodonts.)

1879. Hinde, G. J. Quarterly Journal, Geological Society, London, volume 35, pages 351–369, plates 15–17. (A general review of conodonts, with discussion of zoological relations and description of new forms.)

1880. YOUNG, JOHN, Glasgow Natural History Society, Proceedings, volume 4, pages 5 and 74. (Notice of occurrence of conodonts in Silurian and Devonian strata in England.)

1881. MASON, ROBERT, Glasgow Natural History Society, Proceedings, volume 4, page 190. (Records discovery of conodonts at a new locality in Scotland.)

1882. ROLLE, FR., Handwörterbuch der Mineralogie, Geologie, und Paleontologie, volume 1, page 408. (Short discussion.)

1884. JAMES, U. P., Cincinnati Society Natural History Journal, volume 7, pages 143–149, plate 7. (Describes two conodonts.)

1886. ROHON J. V., and ZITTEL, V., Sitzungsberichte der mathematische-physikalischen Classe der k. Akademie der Wissenschaften zu München, volume 16, pages 108–136, plates 1, 2. (Discussion of zoological position from a chemical and physical standpoint.)

1887. CLARKE, J. M., New York State Geologist, Sixth Annual Report for 1886, pages 30–33, plate A1. (Description and figures of conodonts and annelid jaws from the Devonian of New York.)

1898. GIRTY, GEORGE H., American Journal of Science, series 4, volume 6, pages 384–395. (Describes and illustrates a species from the Upper Devonian of Kentucky.)

1899. GRABAU, A. W., Bulletin Buffalo Society Natural Sciences, volume 6, pages 150–158. (Reproduces Hinde's figures with condensed descriptions.)

1900. SMITH, JOHN, Natural History Society, Glasgow, Transactions, new series, volume 5, pages 336–338. (Discusses occurrence of Scotch Carboniferous conodonts.)

1900. HINDE, G. J., Natural History Society, Glasgow, Transactions, new series, volume 5, pages 338–346, plates 9, 10. (Describes and figures 13 species of Scotch Carboniferous conodonts.)

1907. SMITH, JOHN, Natural History Society, Glasgow, Transactions, new series, volume 7, part 3, pages 235–252, plates 5–9. (Discusses occurrence of conodonts in Silurian rocks of Scotland and describes about 40 species and 4 new genera.)

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1913. HADDING, ASSAR, Lunds University Arsskrift, new series, volume 9, No. 15. Kongl. Fysiografiske Sällskapets Handlingar, new series, volume 24, No. 15, pages 30–32. (Describes eight new species of conodonts.)

1921. BRYANT, WILLIAM L., Buffalo Society Natural Science Bulletin, volume 13, No. 2, pages 1–58, plates 1–16. (Reviews the literature and discusses zoological position of conodonts. (Describes fauna of Genundewa limestone of western New York.)

1921. GRABAU, AMADEUS W., A Textbook of Geology, Part 2, Historical Geology, pages 140 and 584. (Notes occurrence of conodonts in Upper Ordovician and Upper Devonian. Mentions probable zoological position.)

1923. PARKS, W. A., assisted by Madeline Fritz. The Stratigraphy and Paleontology of Toronto and vicinity, part 3, Gastropods, Cephalopods, and Vermes. Thirty-first Annual Report, Ontario, Department of Mines, volume 31, part 9, pages 1–45, plates 1–6. (Hinde's work on annelids and conodonts of Toronto region copied.)

1923. DEAN, BASHFORD A., Bibliography of Fishes, volume 3, American Museum on Natural History. (Mentions that the zoological position of conodonts is disputed.)

1924. CLARK, THOMAS H., Bulletin American Paleontology, volume 10, No. 41, pages 67–70, plate 6. (Describes seven supposed species of conodonts.)

1925. ROUNDY, P. V., Bibliography of Conodont and Paleozoic annelid jaw literature, 4 pages. (Mimeographed; distributed by the Division of Geology and Geography, National Research Council, Washington, D. C.)

1926. ULRICH E. O. and BASSLER R. S., A classification of the tooth-like fossils conodonts, with descriptions of American Devonian and Mississippian species. Proceedings U. S. National Museum, volume 68, pages 1–63, plates 1–11. (Digest of classification in Bulletin Geological Society of America, 1925, vol. 36, pp. 218–220.)

1926. ROUNDY, P. V. The microfauna in Mississippian Formations of San Saba County, Texas. Professional Paper 146, U. S. Geological Survey, pages 5–17 plates 1–4. (Describes 10 species and varieties of conodonts, seven of which are new.)

1926. BUTTS, CHARLES. Geology of Alabama. Geological Survey of Alabama, Special Rept. No. 14, plate 48. (Gives illustrations of sixteen species figured in the present article.)

BIBLIOGRAPHIC LIST OF CONODONTS

In this condensed bibliographic list of conodonts only the page and plate citations are given since the title of the work can be determined from the foregoing bibliography of literature. For the proper generic references, I have followed the work of Ulrich and Bassler.

Acodus PANDER, 1856 (p. 21). Genotype (first species): *Acodus erectus* Pander, 1856.

Acodus acutus PANDER, 1856 (p. 21, pl. 1, fig. 12). Lower Ordovician, Baltic Provinces.

Acodus crassus PANDER, 1856 (p. 22, pl. 1, fig. 10; pl. 2, fig. 13). Lower Ordovician, Baltic Provinces.

Acodus erectus PANDER, 1856 (p. 21, pl. 1, fig. 1). Lower Ordovician, Baltic Provinces.

Acodus planus PANDER, 1856 (p. 22, pl. 1. fig. 9). Lower Ordovician, Baltic Provinces.

Acodus sigmoideus PANDER, 1856 (p. 21, pl. 1, fig. 11). Lower Ordovician, Baltic Provinces.

Acontiodus PANDER, 1856 (p. 28). Genotype (first species): *Acontiodus latus* Pander, 1856.

Acontiodus gracilis PANDER, 1856 (p. 28, pl. 2, figs. 2*a–c*). Lower Ordovician, Baltic Provinces.

Acontiodus latus PANDER, 1856 (p. 28, pl. 2, figs. 1*a–c*). Lower Ordovician, Baltic Provinces.

Acontiodus triangularis PANDER, 1856 (p. 28, pl. 2, figs. 35*a–d*). (*Acontiodus triangulosis* on plate). Lower Ordovician, Baltic Provinces.

Ancyrodella ULRICH and BASSLER, 1926 (p. 48). Genotype: *Ancyrodella nodosa* ULRICH and BASSLER, 1926.

Ancyrodella hamata ULRICH and BASSLER, 1926 (p. 48, pl. 7, fig. 7). Mississippian, Hardin sandstone at base of Chattanooga shale, Mount Pleasant, Tenn.

Ancyrodella malleus ULRICH and BASSLER, 1926 (p. 49, pl. 7, figs. 1, 2). Mississippian, Hardin sandstone at base of Chattanooga shale, Mount Pleasant, Tenn.

Ancyrodella nodosa Ulrich and Bassler, 1926 (p. 48, pl. 1, figs. 10–13). Devonian, Rhinestreet shale of the Portage group, Shaleton, Erie County, N. Y.

Ancyrodella symmetrica Ulrich and Bassler, 1926 (p. 49, pl. 8, fig. 1). Mississippian, Hardin sandstone at base of Chattanooga shale, Mount Pleasant, Tenn.

Belodus Pander, 1856 (p. 30). Genotype and only species: *Belodus gracilis*, Pander, 1856.

Belodus gracilis Pander, 1856 (p. 30, pl. 2, fig. 21). Lower Ordovician, Baltic Provinces.

Bryantodus Ulrich and Bassler, 1926 (p. 21). Genotype: *Bryantodus typicus* Ulrich and Bassler, 1926.

Bryantodus coalescens Ulrich and Bassler, 1926 (p. 25, pl. 4, fig. 28). Upper Devonian, Rhinestreet shale of Portage group, Shaleton, Erie County, N. Y.

Bryantodus conjunctus Ulrich and Bassler, 1926 (p. 24, pl. 4, figs. 8, 9). Upper Devonian, Rhinestreet shale of Portage group, Shaleton, Erie County, N. Y.

Bryantodus crassidens Ulrich and Bassler, 1926 (p. 23, pl. 6, figs. 17, 18). Upper Devonian, Rhinestreet shale of Portage group, Shaleton, Erie County, N. Y.

Bryantodus crassus Ulrich and Bassler, 1926 (p. 27, pl. 10, fig. 14). Mississippian, Hardin sandstone at base of Chattanooga shale, Mount Pleasant, Tenn.

Bryantodus cristatus Bryant, 1921. *Prioniodus cristatus* Bryant, 1921 (p. 20, pl. 3, fig. 9; pl. 6, fig. 7). Upper Devonian, Genundewa limestone at base of Genesee, North Evans, Eighteen Mile Creek, N. Y.

Bryantodus curvatulus Ulrich and Bassler, 1926 (p. 28, pl. 9, fig. 13). Mississippian, Hardin sandstone at base of Chattanooga shale, Mount Pleasant, Tenn.

Bryantodus curvatus Ulrich and Bassler, 1926 (p. 26, pl. 4, figs. 19, 20). Upper Devonian, Rhinestreet shale of Portage group, Shaleton, Erie County, N. Y.

Bryantodus dubius Smith, 1900. *Polygnathus dubius* Smith, 1900. (Not Hinde, 1879), (p. 341, pl. 9, fig. 1). Carboniferous, Lower limestone, Birkhead, etc., west Scotland.

Bryantodus duplicatus Hinde, 1879. *Polygnathus duplicatus* Hinde, 1879 (p. 364, pl. 16, fig. 19). "Genesee, Bear Creek, Ontario."

Bryantodus germanus Ulrich and Bassler, 1926 (p. 25, pl. 10, fig. 18). Mississippian, Hardin sandstone at base of Chattanooga shale, Mount Pleasant, Tenn.

Bryantodus gracilis Ulrich and Bassler, 1926 (p. 27, pl. 10, fig. 10). Mississippian, Hardin sandstone at base of Chattanooga shale, Mount Pleasant, Tenn.

Bryantodus immersus Hinde, 1879, *Polygnathus immersus* Hinde, 1879 (p. 364, pl. 16, fig. 21). *Prioniodus immersus* Bryant, 1921 (p. 19, pl. 6, fig. 2). "Genesee, Kettle Point, Ontario." Reported by Bryant from the Genundewa limestone.

Bryantodus incertus Ulrich and Bassler, 1926 (p. 27, pl. 10, fig. 8). Mississippian, Hardin sandstone at base of Chattanooga shale, Mount Pleasant, Tenn.

Bryantodus inequalis Ulrich and Bassler, 1926 (p. 22, pl. 6, fig. 14). Upper Devonian, Rhinestreet shale of the Portage group, Shaleton, Erie County, N. Y.

Bryantodus insolens Ulrich and Bassler, 1926 (p. 25, pl. 10, fig. 17). Mississippian, Hardin sandstone at base of Chattanooga shale, Mount Pleasant, Tenn.

Bryantodus macrodentatus BRYANT, 1921, *Prioniodus macrodentatus* BRYANT, 1921 (p. 18, pl. 8, fig. 10). Upper Devonian, Genundewa limestone at base of Genesee, North Evans, Eighteen Mile Creek, N. Y.

Bryantodus minutus ULRICH and BASSLER, 1926 (p. 27, pl. 10, fig. 6). Mississippian, Hardin sandstone at base of Chattanooga shale, Mount Pleasant, Tenn.

Bryantodus multidens ULRICH and BASSLER, 1926 (p. 22, pl. 6, figs. 15, 16). Upper Devonian, Rhinestreet shale of the Portage group, Shaleton, Erie County, N. Y.

Bryantodus muricatus BRYANT, 1921, *Prioniodus muricatus* BRYANT, 1921 (p. 18, pl. 5, fig. 7). Upper Devonian, Genundewa limestone at base of Genesee, North Evans, Eighteen Mile Creek, N. Y.

Bryantodus nelsoni ULRICH and BASSLER, 1926 (p. 28, pl. 10, fig. 9). Mississippian, Hardin sandstone at base of Chattanooga shale, Mount Pleasant, Tenn.

Bryantodus nitidus ULRICH and BASSLER, 1926 (p. 24, pl. 4, figs. 12–14). Upper Devonian, Rhinestreet shale of Portage group, Shaleton, Erie County, N. Y.

Bryantodus normalis ULRICH and BASSLER, 1926 (p. 24, pl. 4, figs. 25–27). Upper Devonian, Rhinestreet shale of the Portage group, Shaleton, Erie County, N. Y.

Bryantodus obliquus ULRICH and BASSLER, 1926 (p. 23, pl. 6, figs. 19, 21). Upper Devonian, Rhinestreet shale of the Portage group, Shaleton, Erie County, N. Y.

Bryantodus obtusus BRYANT, 1921, *Prioniodus obtusus* BRYANT, 1921 (p. 20, pl. 3, fig. 6, pl. 6, fig. 1). Upper Devonian, Genundewa limestone at base of Genesee, North Evans, Eighteen Mile Creek, N. Y.

Bryantodus parvulus BRYANT, 1921, *Prioniodus parvulus* BRYANT, 1921 (p. 20, pl. 9). Upper Devonian, Genundewa limestone at base of Genesee, North Evans, Eighteen Mile Creek, N. Y.

Bryantodus pergracilis ULRICH and BASSLER, 1926 (p. 27, pl. 10, fig. 11). Mississippian, Hardin sandstone at base of Chattanooga shale, Mount Pleasant, Tenn.

Bryantodus politus HINDE, 1879, *Prioniodus politus* HINDE, 1879 (p. 358, pl. 15, figs. 11, 12); Parks, 1922 (p. 37, pl. 6, figs. 26, 27). Upper Cincinnatian, Lorraine-Dundas, Garrison Common, Ontario.

Bryantodus pravus BRYANT, 1921, *Prioniodus pravus* BRYANT, 1921 (p. 18, pl. 8, fig. 5). Upper Devonian, Genundewa limestone at base of Genesee, North Evans, Eighteen Mile Creek, N. Y.

Bryantodus radiatus HINDE, 1879, *Polygnathus radiatus* HINDE, 1879, (p. 364, pl. 16, fig. 20). *Prioniodus radiatus* BRYANT, 1921 (p. 16, pl. 4, figs. 10–12; pl. 5, figs. 1–5, 8; pl. 6, fig. 5; pl. 7, figs. 1, 2, 4, 6, 8; pl. 14, fig. 1). "Genesee, Kettle Point, Ontario". Identified by Bryant from Genundewa limestone of western New York.

Bryantodus retusus BRYANT, 1921, *Prioniodus retusus* BRYANT, 1921 (p. 17), pl. 4, figs. 8, 9; pl. 5, figs. 9, 11; pl. 8, fig. 3). Upper Devonian, Genundewa limestone at base of Genesee, North Evans, Eighteen Mile Creek, N. Y.

Bryantodus semiseparatus ULRICH and BASSLER, 1926 (p. 24, pl. 4, fig. 16). Upper Devonian, Rhinestreet shale of the Portage group, Shaleton, Erie County, N. Y.

Bryantodus sinuatus, ULRICH and BASSLER, 1926 (p. 23, pl. 6, figs. 22–24). Upper Devonian, Rhinestreet shale of the Portage group, Shaleton, Erie County, N. Y.

Bryantodus spatulatus BRYANT, 1921, *Prioniodus spatulatus* BRYANT, 1921 (p. 18, pl. 8, fig. 9). Upper Devonian, Genundewa limestone at base of Genesee, North Evans, Eighteen Mile Creek, N. Y.

Bryantodus subbrevis ULRICH and BASSLER, 1926 (p. 28, pl. 10, figs. 15, 16). Mississippian, Hardin sandstone at base of Chattanooga shale, Mount Pleasant, Tenn.

Bryantodus subradiatus ULRICH and BASSLER, 1926 (p. 26, pl. 10, figs. 12, 13). Mississippian, Hardin sandstone at base of Chattanooga shale, Mount Pleasant, Tenn.

Bryantodus tenuis ULRICH and BASSLER, 1926 (p. 26, pl. 10, fig. 7). Mississippian, Hardin sandstone at base of Chattanooga shale, Mount Pleasant, Tenn.

Bryantodus transitans ULRICH and BASSLER, 1926 (p. 26, pl. 4, figs. 10, 11). Upper Devonian, Rhinestreet shale of the Portage group, Shaleton, Erie County, N. Y.

Bryantodus tridentatus ULRICH and BASSLER, 1926 (p. 22, pl. 6, fig. 13). Upper Devonian, Rhinestreet shale of Portage group, Shaleton, Erie County, N. Y.

Bryantodus typicus ULRICH and BASSLER, 1926 (p. 21, figs. 11, 12). Upper Devonian, Rhinestreet shale of Portage group, Shaleton, Erie County, N. Y.

Centrodus PANDER, 1856. See *Lonchodus* PANDER, 1856.

Centrodus convexus PANDER, 1856. See *Lonchodus convexus.*

Centrodus distans SMITH, 1907. See *Lonchodus distans.*

Centrodus duplicatus HINDE, 1900. See *Hindeodella duplicata.*

Centrodus erectus SMITH, 1907. See *Lonchodus erectus.*

Centrodus invalidus BRYANT, 1921. See *Prioniodella invalida.*

Centrodus lineatus HINDE, 1900. See *Hindeodella lineata.*

Centrodus obliquus SMITH, 1907. See *Lonchodus obliquus.*

Centrodus princeps BRYANT, 1921. See *Lonchodus princeps.*

Centrodus simplex PANDER, 1856. See *Lonchodus simplex.*

Cordylodus PANDER, 1856 (p. 33). Genotype (first species): *Cordylodus angulatus* PANDER, 1856.

Cordylodus angulatus PANDER, 1856 (p. 33, pl. 2, figs. 26–31, 34). Lower Ordovician, Baltic Provinces.

Cordylodus ramosus HADDING, 1913 (p. 31, pl. 1, fig. 6). Ordovician Dicellograptus zone, southern Norway.

Cordylodus rotundatus PANDER, 1856 (p. 33, pl. 2, figs. 32, 33). Lower Ordovician, Baltic Provinces.

Cornuramia SMITH, 1907 (p. 246); ULRICH and BASSLER, 1926 (p. 41). Genotype: *Cornuramia monodonta* SMITH, 1907.

Cornuramia bicornua SMITH, 1907 (p. 251, pl. 9, fig. 49). Ordovician, Arenig-Llandeilo, southern uplands of Scotland.

Cornuramia diplodonta SMITH, 1907 (p. 246, pl. 5, fig. 25). Ordovician, Arenig-Llandeilo, Ravengill, Scotland.

Cornuramia monodonta SMITH, 1907 (p. 246, pl. 6, fig. 20). Ordovician, Arenig-Llandeilo, Ravengill, etc., Scotland.

Ctenognathus PANDER, (1856, p. 32); ULRICH and BASSLER, 1926 (p. 54) ROUNDY, 1926 (p. 16). Genotype: *Ctenognathus murchisoni* PANDER, 1856.

Ctenognathus kayserlingii PANDER, 1856 (p. 32, pl. 2A, fig. 15). Carboniferous limestone, Tula, Russia.

Ctenognathus murchisoni PANDER, 1856 (p. 32, pl. 4, fig. 17; pl. 6, figs. 18*a*, *b*). Silurian, Rootsiküllе, Russia.

Ctenognathus obliquus PANDER, 1856. See *Hindeodella obliqua.*

Ctenognathus verneuilli PANDER, 1856 (p. 32, pl. 4, fig. 18; pl. 2A, figs. 13, 14, 16, 17). Devonian, Wells on the Wolchow, Russia. Species of *Valentia*, *Prioniodina*, and *Hindeodella* are represented by these illustrations.

Diplododella ULRICH and BASSLER, 1926 (p. 41). Genotype: *Diplododella bilateralis* ULRICH and BASSLER, 1926.

Diplododella bilateralis ULRICH and BASSLER, 1926 (p. 41, text fig. 21, p. 16). Mississippian, Hardin sandstone at base of Chattanooga shale, Mount Pleasant, Tenn.

Distacodidae ULRICH and BASSLER, 1926 (p. 6).

Distacodus HINDE, 1879 (p. 357). Proposed for *Machairodus* PANDER, 1856 (p. 22) preoccupied. *Machairodia* SMITH, 1907 (p. 246), also proposed in place of *Machairodus* PANDER. Genotype: *Distacodus* (*Machairodus*) *incurvus* PANDER, 1856.

Distacodus angustus PANDER, 1856. *Machairodus angustus* PANDER, 1856 (p. 23, pl. 1, fig. 35). Lower Ordovician, Baltic Provinces.

Distacodus canaliculatus PANDER, 1856. *Machairodus canaliculatus* PANDER, 1856 (p. 24, pl. 1, fig. 23). Lower Ordovician, Baltic Provinces.

Distacodus dilatatus PANDER, 1856. *Machairodus dilatatus* PANDER, 1856 (p. 22, pl. 1, fig. 14; pl. 2, fig. 14). Lower Ordovician, Baltic Provinces.

Distacodus ensiformis PANDER, 1856. *Machairodus ensiformis* PANDER, 1856 (p. 23, pl. 1, figs. 25–28; pl. 2, fig. 36). Lower Ordovician, Baltic Provinces.

Distacodus inaequalis PANDER, 1856. *Machairodus inaequalis* PANDER, 1856 (p. 23, pl. 2, fig. 38). Lower Ordovician, Baltic Provinces.

Distacodus incurvus PANDER, 1856. *Machairodus incurvus* PANDER, 1856 (p. 23, pl. 1, fig. 22). Lower Ordovician, Baltic Provinces; HINDE, 1879 (p. 357, pl. 15, fig. 9), and PARKS, 1922 (p. 36, pl. 6, fig. 23). Upper Ordovician, Lorraine-Dundas, Garrison Common near Toronto, Ontario.

Distacodus planus PANDER, 1856. *Machairodus planus* PANDER, 1856 (p. 24, pl. 2, fig. 39). Lower Ordovician, Baltic Provinces.

Distacodus rectus ULRICH and BASSLER, 1926 (p. 6, pl. 9, fig. 22). Mississippian, Hardin sandstone at base of Chattanooga shale, Mount Pleasant, Tenn.

Distacodus rhombeus SMITH, 1907. *Machairodia rhombeus* (Pander ?) SMITH, 1907 (p. 246, pl. 6, fig. 19). Ordovician, Arenig-Llandeilo, Ravengill, etc., southern uplands of Scotland.

Distacodus rhomboideus PANDER, 1856. *Machairodus rhomboideus* PANDER, 1856 (p. 22, pl. 2, figs. 10–12). Lower Ordovician, Baltic Provinces.

Distacodus solidus PANDER, 1856. *Machairodus solidus* PANDER, 1856 (p. 23, pl. 2, fig. 15). Lower Ordovician, Baltic Provinces.

Distacodus sulcatus SMITH, 1907. *Machairodus sulcata* SMITH, 1907 (p. 246, pl. 6, fig. 17). Ordovician, Arenig-Llandeilo, Ravengill, southern uplands of Scotland.

Drepanodus PANDER, 1856 (p. 20). Genotype (first species): *Drepanodus inflexus* PANDER, 1856.

Drepanodus acutus PANDER, 1856 (p. 21, pl. 2, fig. 9). Lower Ordovician, Baltic Provinces.

Drepanodus arcuatus PANDER, 1856 (p. 20, pl. 1, figs. 2, 4, 5, 17, 30, 31). Lower Ordovician, Baltic Provinces; HINDE, 1879 (p. 357, pl. 15, figs. 7, 8); GRABAU and SHIMER, 1910 (p. 245, figs. 1537 *d*, *e*); PARKS, 1922 (p. 36, pl. 6, figs. 21, 22). Ordovician, Lorraine-Dundas, Toronto, Canada.

Drepanodus falcatus HADDING, 1913 (p. 30, pl. 1, fig. 3). Ordovician, Dicellograptus zone, southern Norway.

Drepanodus flexuosus PANDER, 1856 (p. 20, pl. 1, figs. 6–8). Lower Ordovician, Baltic Provinces; SMITH, 1907 (p. 246, pl. 6, fig. 18). Ordovician, Arenig-Llandeilo, southern uplands of Scotland.

Drepanodus inflexus PANDER, 1856 (p. 20, pl. 1, fig. 3; pl. 2, fig. 16). Lower Ordovician, Baltic Provinces.

Drepanodus obtusus PANDER, 1856 (p. 21, pl. 2, fig. 11). Lower Ordovician, Baltic Provinces.

Drepanodus robustus HADDING, 1913 (p. 31, pl. 1, fig. 5). Ordovician, Dicellograptus zone, southern Norway.

Drepanodus verutus HADDING, 1913 (p. 31, pl. 1, fig. 4). Ordovician, Dicellograptus zone, southern Norway.

Euprioniodina ULRICH and BASSLER, 1926 (p. 29). Genotype: *Euprioniodina deflecta* ULRICH and BASSLER, 1926.

Euprioniodina acicularis HINDE, 1879, *Prioniodus acicularis* HINDE, 1879 (p. 360, pl. 15, figs. 18, 19). Devonian, Genesee, Kettle Point, Ontario; GRABAU, 1899 (p. 151, fig. 33E).

Euprioniodina ? alata HADDING, 1913, *Prioniodus alatus* HADDING, 1913 (p. 32, pl. 1, figs. 9, 10). Ordovician, Dicellograptus zone, southern Norway.

Euprioniodina bryanti ULRICH and BASSLER, 1926 (p. 29, pl. 3, figs. 13, 14; pl. 1, fig. 21). Upper Devonian, Rhinestreet shale of the Portage group Shaleton, Erie County, N. Y.

Euprioniodina conferta ULRICH and BASSLER, 1926 (p. 29, pl. 3, fig. 13, 14; pl. 1, fig. 21). Upper Devonian, Rhinestreet shale of the Portage group, Shaleton, Erie County, N. Y.

Euprioniodina conferta ULRICH and BASSLER, 1926 (p. 29, pl. 3, fig. 17). Upper Devonian, Rhinestreet shale of the Portage group, Shaleton, Erie County, N. Y.

Euprioniodina curvata SMITH, 1907, *Prioniodus curvatus* SMITH, 1907 (p. 249, pl. 8, fig. 40). Ordovician, Arenig-Llandeilo, southern uplands of Scotland.

Euprioniodina deflecta ULRICH and BASSLER, 1926 (p. 29, pl. 3, figs. 11, 12). Upper Devonian, Rhinestreet shale of the Portage group, Shaleton, Erie County, N. Y.

Euprioniodina ? discedens HADDING, 1913, *Prioniodus discedens* HADDING, 1913 p. 32, pl. 1, fig. 11). Ordovician, Dicellograptus zone, southern Norway.

Euprioniodina ? furcata HINDE, 1879, *Prioniodus furcatus* HINDE, 1879 (p. 358, pl. 15, fig. 13); PARKS, 1923 (p. 37, pl. 6, fig. 27). Upper Ordovician, Lorraine-Dundas, Garrison Common near Toronto, Ontario.

Euprioniodina ? lanceolata SMITH, 1907, *Polygnathus lanceolatus* SMITH, 1907 (p. 245, pl. 5, fig. 16). Ordovician, Arenig-Llandeilo, southern uplands of Scotland.

Euprioniodina peculiaris ULRICH and BASSLER, 1926 (p. 30, pl. 10, fig. 3). Mississippian, Hardin sandstone at base of Chattanooga shale, Mount Pleasant, Tenn.

Euprioniodina perangulata ULRICH and BASSLER, 1926 (p. 30, pl. 3, fig. 10). Upper Devonian, Rhinestreet shale of the Portage group, Shaleton, Erie County, N. Y.

Euprioniodina ? radicans HINDE, 1879, *Prioniodus radicans* HINDE, 1879 (p. 356, pl. 15, figs. 1–6; GRABAU and SHIMER, 1910 (p. 244, figs. 1538 *a–c*). Lower Ordovician (Chazy) Grenville, Quebec.

Gnathodus PANDER, 1856 (p. 33). Genotype (first species): *Gnathodus mosquensis* PANDER, 1856. See also HINDE, 1879 (p. 365); BRYANT, 1921 (p. 22); ULRICH and BASSLER, 1926 (p. 54), and ROUNDY, 1926 (p. 12).

Gnathodus americanus BRYANT, 1921 (p. 22, pl. 7, fig. 5). Upper Devonian, Genundewa limestone at base of Genesee, North Evans, Eighteen Mile Creek, N. Y.; ULRICH and BASSLER, 1926 (p. 54, pl. 1, fig. 5). Upper Devonian, Rhinestreet shale of the Portage group, Chaleton, Erie County, N. Y.

Gnathodus ? crassus HINDE, 1879, *Polygnathus crassus* HINDE, 1879 (p. 365, pl. 17, fig. 3); GRABAU, 1899 (p. 155, fig. 38); GRABAU and SHIMER, 1910 (p. 243, fig. 1535*c*). Genesee, Genundewa limestone, North Evans, Eighteen Mile Creek, N. Y. Possibly a side view of a *Polygnathus*.

Gnathodus ? curvatus HINDE, 1879, *Polygnathus ? curvatus* HINDE, 1879 (p. 366, pl. 17, fig. 7). "Genesee shale, Bear Creek, Ontario."

Gnathodus ? eriensis HINDE, 1879, *Polygnathus ? eriensis* HINDE, 1879 (p. 366, pl. 17, fig. 6). "Erratic boulder of black Genesee shale, north shore of Lake Erie, Ontario."

Gnathodus mosquensis PANDER, 1856 (p. 34, pl. 2A, fig. 10*a*, *b*, *c*). Carboniferous, Moscow, Russia, *Polygnathus* (*Gnathodus*) *mosquensis* HINDE, 1879 (p. 342, pl. 9, figs. 2–4). Carboniferous limestone, Dalry, etc., West Scotland.

Gnathodus texanus ROUNDY, 1926 (p. 12, pl. 2, figs. 7, 8). Barnett shale of Mississippian, San Saba County, Tex.

Gnathodus texanus, var. *bicuspidus* ROUNDY, 1926 (p. 12, pl. 12, fig. 9). Barnett shale of Mississippian, San Saba County, Tex.

Hibbardella ULRICH and BASSLER, 1926 (p. 37). Genotype: *Prioniodus angulatus* HINDE, 1879.

Hibbardella angulata HINDE, 1879, *Prioniodus angulatus* HINDE, 1879 (p. 360, pl. 15, fig. 17); GRABAU, 1899 (p. 151 fig. 33D); GRABAU and SHIMER, 1910 (p. 244, fig. 1537*h*); BRYANT, 1921 (p. 17). Upper Devonian, Rhinestreet shale of the Portage group, western New York. ? *Prioniodus angulatus* HINDE, 1900 (p. 343, pl. 10, figs. 18, 19). Carboniferous lower limestone. Dalry, etc., West Scotland; *Hibbardella angulata* (Hinde) ULRICH and BASSLER, 1926 (p. 37, pl. 3, figs. 1–4). Upper Devonian, Rhinestreet shale of the Portage group, Shaleton, Erie County, N. Y.

Hibbardella ? confertissima ULRICH and BASSLER, 1926 (p. 38, pl. 3, fig. 5). Upper Devonian, Rhinestreet shale of the Portage group, Shaleton, Erie County, N. Y.

Hibbardella multidens ULRICH and BASSLER, 1926 (p. 38, pl. 3, figs. 8, 9). Upper Devonian, Rhinestreet shale of the Portage group, Shaleton, Erie County, N. Y.

Hibbardella subaequalis ULRICH and BASSLER, 1926 (p. 38, pl. 3, figs. 6, 7). Upper Devonian, Rhinestreet shale of the Portage group, Shaleton, Erie County, N. Y.

Hindeodella ULRICH and BASSLER, 1926 (p. 38). Genotype: *Hindeodella subtilis* ULRICH and BASSLER, 1926.

Hindeodella alternata ULRICH and BASSLER, 1926 (p. 40, pl. 1, figs. 14, 15). Upper Devonian, Rhinestreet shale of the Portage group, Shaleton, Erie County, N. Y.

Hindeodella decurrens ULRICH and BASSLER, 1926 (p. 40, pl. 8, fig. 13). Mississippian, Hardin sandstone at base of Chattanooga shale, Mount Pleasant, Tenn.

Hindeodella dubia SMITH, 1907. *Polygnathus dubius* SMITH, 1907, not Hinde, 1879 (p. 245, pl. 5, fig. 15). Ordovician, Arenig-Llandeilo, southern uplands of Scotland.

Hindeodella duplicata PANDER, 1856, *Lonchodus* (*Centrodus*) *duplicatus* PANDER, 1856 (p. 31, pl. 2A, figs. 7, 8). Carboniferous limestone, Tula, Russia. *Centrodus duplicatus* (Pander) HINDE, 1900 (p. 341, pl. 9, fig. 12). Carboniferous, upper limestone, Monkcastle, Kilwinning, west Scotland.

Hindeodella lineata PANDER, 1856, *Lonchodus* (*Centrodus*) *lineatus* PANDER, 1856 (p. 31, pl. 2A, fig. 9). Carboniferous limestone, Tula, Russia. *Centrodus lineatus* (Pander) HINDE, 1900 (p. 341, pl. 9, figs. 13, 14). Carboniferous, upper limestone, Monkcastle, Kilwinning, west Scotland. *Lonchodus ? lineatus* ROUNDY, 1926 (p. 15, pl. 3, figs. 6–8). Barnett shale of Mississippian, San Saba County, Tex.

Hindeodella longidens Ulrich and Bassler, 1926 (p. 40, pl. 8, figs. 14, 15). Mississippian, Hardin sandstone at base of Chattanooga shale, Mount Pleasant, Tenn.

Hindeodella obliqua Pander, 1856, *Centrodus obliquus* Pander, 1856 (p. 33, pl. 2A, figs. 11, 12). Devonian, Gostinopolskoi, Pristan on the Wolchow River; Hinde, 1900 (p. 344, pl. 10, figs. 27–29). Carboniferous, lower limestone, Birkhead, Dalry, west Scotland.

Hindeodella recta Ulrich and Bassler, 1926 (p. 40, pl. 8, fig. 16). Mississippian, Hardin sandstone at base of Chattanooga shale, Mount Pleasant, Tenn.

Hindeodella similis Ulrich and Bassler, 1926 (p. 39, pl. 8, fig. 20). Mississippian, Hardin sandstone at base of Chattanooga shale, Mount Pleasant, Tenn.

Hindeodella subequalis Ulrich and Bassler, 1926 (p. 41, pl. 4, fig. 21). Upper Devonian, Rhinestreet shale of Portage group, Shaleton, Erie County, N. Y.

Hindeodella subtilis Ulrich and Bassler, 1926 (p. 39, pl. 8, figs. 17–19). Mississippian, Hardin sandstone at base of Chattanooga shale, Mount Pleasant, Tenn.

Ligonodina Ulrich and Bassler, 1926 (p. 12), Genotype: *Ligonodina pectinata* Ulrich and Bassler, 1926.

Ligonodina deflecta Ulrich and Bassler, 1926 (13 pl. 2, figs. 3, 4). Upper Devonian, Rhinestreet shale of Portage group, Shaleton, Erie County, N. Y.

Ligonodina falciformis Ulrich and Bassler, 1926 (p. 14, pl. 2, figs. 11–13). Upper Devonian, Rhinestreet shale of the Portage group, Shaleton, Erie County, N. Y.

Ligonodina hibbardi Ulrich and Bassler, 1926 (p. 14, pl. 2, figs. 7, 8). Upper Devonian, Rhinestreet shale of the Portage group, Shaleton, Erie County, N. Y.

Ligonodina hindei Ulrich and Bassler, 1926 (p. 14, pl. 2, figs. 14–16). Upper Devonian, Rhinestreet shale of the Portage group, Shaleton, Erie County, N. Y.

Ligonodina magnidens Ulrich and Bassler, 1926 (p. 14, pl. 2, figs. 5, 6). Upper Devonian, Rhinestreet shale of the Portage group, Shaleton, Erie County, N. Y.

Ligonodina panderi Hinde, 1879, *Prionodus panderi* Hinde, 1879 (p. 361, pl. 16, fig. 4); Grabau, 1899 (p. 152, fig. 33H); Grabau and Shimer, 1910 (p. 244, fig. 1533*a*). Upper Devonian, Genesee or Portage, Eighteen Mile Creek, N. Y. *Ligonodina panderi* (Hinde) Ulrich and Bassler, 1926 (p. 13, pl. 2, figs. 1, 2). Upper Devonian, Rhinestreet shale of the Portage group, Shaleton, Erie County, N. Y.

Ligonodina pectinata Ulrich and Bassler, 1926 (p. 13, pl. 2, figs. 9, 10). Upper Devonian, Rhinestreet shale of the Portage group, Shaleton, Erie County, N. Y.

Ligonodina simplex Ulrich and Bassler, 1926 (p. 15, pl. 9, fig. 28). Mississippian, Hardin sandstone at base of Chattanooga shale, Mount Pleasant, Tenn.

Ligonodina tridentata Ulrich and Bassler, 1926 (p. 15, pl. 9, fig. 5). Mississippian, Hardin sandstone at base of Chattanooga shale, Mount Pleasant, Tenn.

Lonchodina Ulrich and Bassler, 1926 (p. 30). Genotype: *Lonchodina typicalis* Ulrich and Bassler, 1926.

Lonchodina abnormis ULRICH and BASSLER, 1926 (p. 34, pl. 6, figs. 8–10). Upper Devonian, Rhinestreet shale of the Portage group, Shaleton, Erie County, N. Y.

Lonchodina alternata ULRICH and BASSLER, 1926 (p. 35, pl. 6, fig. 4). Upper Devonian, Rhinestreet shale of the Portage group, Shaleton, Erie County, N. Y.

Lonchodina arcuata ULRICH and BASSLER, 1926 (p. 32, pl. 5, fig. 15). Upper Devonian, Rhinestreet shale of the Portage group, Shaleton, Erie County, N. Y.

Lonchodina bilateralis ULRICH and BASSLER, 1926 (p. 32, pl. 5, fig. 18.) Upper Devonian, Rhinestreet shale of the Portage group, Shaleton, Erie County, N. Y.

Lonchodina clavata HINDE, 1879, *Prioniodus clavatus* HINDE, 1879, (p. 360, pl. 15, fig. 16) ; GRABAU, 1899 (p. 151, fig. 33c) ; GRABAU and SHIMER, 1910 (p. 244, fig. 1537*b*) ; BRYANT, 1921 (p. 16, pl. 6, figs. 3, 6). Upper Devonian, Genundewa limestone at base of Genesee, North Evans, Eighteen Mile Creek, N. Y.

Lonchodina delicatula ULRICH and BASSLER, 1926 (p. 33, pl. 5, fig. 11). Upper Devonian, Rhinestreet shale of the Portage group, Shaleton, Erie County, N. Y.

Lonchodina discreta ULRICH and BASSLER, 1926 (p. 36, pl. 10, figs. 1, 2). Mississippian, Hardin sandstone at base of Chattanooga shale, Mount Pleasant, Tenn.

Lonchodina erratica HINDE, 1879, *Prioniodus erraticus* HINDE, 1879 (p. 359, pl. 15, fig. 14) ; GRABAU, 1899 (p. 150, fig. 33A) ; GRABAU and SHIMER, 1910, p. 244, fig. 1537*c*) ; BRYANT, 1921 (p. 17, pl. 2, fig. 10; pl. 7, fig. 1). Upper Devonian, Genundewa limestone at base of Genesee, North Evans, Eighteen Mile Creek, N. Y.

Lonchodina geniculata ULRICH and BASSLER, 1926 (p. 36, pl. 4, fig. 15). Upper Devonian, Rhinestreet shale of the Portage group, Shaleton, Erie County, N. Y.

Lonchodina ? increbescens ULRICH and BASSLER, 1926 (p. 35, pl. 5, fig. 20; pl. 3, figs. 15, 16). Upper Devonian, Rhinestreet shale of the Portage group, Shaleton, Erie County, N. Y.

Lonchodina paucidens ULRICH and BASSLER, 1926 (p. 34, pl. 6, fig. 1). Upper Devonian, Rhinestreet shale of the Portage group, Shaleton, Erie County, N. Y.

Lonchodina peracuta ULRICH and BASSLER, 1926 (p. 33, pl. 5, fig. 19). Upper Devonian, Rhinestreet shale of the Portage group, Shaleton, Erie County, N. Y.

Lonchodina perlonga ULRICH and BASSLER, 1926 (p. 32, pl. 5, figs. 6, 7). Upper Devonian, Rhinestreet shade of the Portage group, Shaleton, Erie County, N. Y.

Lonchodina ? projecta ULRICH and BASSLER, 1926 (p. 35, pl. 5, figs. 9, 10). Upper Devonian, Rhinestreet shale of the Portage group, Shaleton, Erie County, N. Y.

Lonchodina ? prona ULRICH and BASSLER, 1926 (p. 36, pl. 5, figs. 16, 17). Upper Devonian, Rhinestreet shale of the Portage group, Shaleton, Erie County, N. Y.

Lonchodina rectangulata ULRICH and BASSLER, 1926 (p. 37, pl. 10, fig. 4). Mississippian, Hardin sandstone at base of Chattanooga shale, Mount Pleasant, Tenn.

Lonchodina rectidens ULRICH and BASSLER, 1926 (p. 31, pl. 5, figs. 13, 14). Upper Devonian, Rhinestreet shale of the Portage group, Shaleton, Erie County, N. Y.

Lonchodina separata ULRICH and BASSLER, 1926 (p. 31, pl. 5, fig. 12). Upper Devonian, Rhinestreet shale of the Portage group, Shaleton, Erie County, N. Y.

Lonchodina ? spinata HADDING, 1913, *Polygnathus spinatus* HADDING, 1913, (p. 32, pl. 1, fig. 8). Ordovician, Dicellograptus zone, Southern Norway.

Lonchodina subangulata ULRICH and BASSLER, 1926 (p. 32, pl. 5, fig. 3). Upper Devonian, Rhinestreet shale of the Portage group, Shaleton, Erie County, N. Y.

Lonchodina subrecta ULRICH and BASSLER, 1926 (p. 33, pl. 5, figs. 4, 5). Upper Devonian, Rhinestreet shale of the Portage group, Shaleton, Erie County, N. Y.

Lonchodina subsymmetrica ULRICH and BASSLER, 1926 (p. 34, pl. 6, figs. 5–7; pl. 5, fig. 8; pl. 1, fig. 24). Upper Devonian, Rhinestreet shale of the Portage group, Shaleton, Erie County, N. Y.

Lonchodina transversa ULRICH and BASSLER, 1926 (p. 34, pl. 6, figs. 2, 3). Upper Devonian, Rhinestreet shale of the Portage group, Shaleton, Erie County, N. Y.

Lonchodina typicalis ULRICH and BASSLER, 1926 (p. 31, pl. 5, figs. 1, 2). Upper Devonian, Rhinestreet shale of the Portage group, Shaleton, Erie County, N. Y.

Lonchodus PANDER, 1856 (p. 80) (*Centrodus* PANDER, 1856, p. 31, preoccupied); ULRICH and BASSLER, 1926 (p. 42); ROUNDY, 1926 (p. 15) Genotype (first species): *Lonchodus* (*Centrodus*) *simplex* PANDER, 1856.

Lonchodus convexus PANDER, 1856. *Centrodus convexus* PANDER, 1856 (p. 31, pl. 2A, fig. 4). Carboniferous limestone, Tula, Russia. *Polygnathus* (*Centrodus*) *convexus* (Pander) HINDE, 1900 (p. 342, pl. 9, figs. 6–8). Carboniferous, Upper limestone, Monkcastle, Dalry, etc., west Scotland.

Lonchodus coronatus HINDE, 1879, *Polygnathus coronatus* HINDE, 1879 (p. 365, pl. 17. fig. 1). Devonian, Genesee, Kettle Point, Ontario; GRABAU and SHIMER, 1910 (p. 243, fig. 1535*a*); BRYANT, 1921 (p. 21). Bryant records this species from Portage shale at Sturgeon Point, N. Y. Possibly a species of *Lonchodina* but Hinde's restoration does not match any of the species so far noted.

Lonchodus curvatus SMITH, 1907. *Polygnathus curvatus* SMITH, 1907 (p. 245, pl. 5, fig. 11). Ordovician, Arenig-Llandeilo, southern uplands of Scotland.

Lonchodus distans SMITH, 1907. *Centrodus distans* SMITH, 1907 (p. 244, pl. 5, fig. 7). Ordovician, Arenig-Llandeilo, southern uplands of Scotland.

Lonchodus duplicatus PANDER, 1856. See *Hindeodella duplicata*.

Lonchodus erectus SMITH, 1907. *Centrodus erectus* SMITH, 1907 (p. 244, pl. 5, figs. 1, 2, 4, 5). Ordovician, Arenig-Llandeilo, southern uplands of Scotland.

Lonchodus lineatus PANDER, 1856. See *Hindeodella lineata*.

Lonchodus minus SMITH, 1907. *Polygnathus minus* SMITH, 1907 (p. 245, pl. 5, fig. 8). Ordovician, Arenig-Llandeilo, southern uplands of Scotland.

Lonchodus obliquus SMITH, 1907. *Centrodus obliquus* SMITH, 1907 (p. 244, pl. 5, fig. 3). Ordovician, Arenig-Llandeilo, southern uplands of Scotland.

Lonchodus parvus SMITH, 1907. *Polygnathus parvus* SMITH, 1907 (p. 245, pl. 5, fig. 6). Ordovician, Arenig-Llandeilo, southern uplands of Scotland.

Lonchodus princeps HINDE, 1870. *Polygnathus princeps* HINDE, 1879 (p. 365, pl. 16, fig. 23); GRABAU, 1899 (p. 155, fig. 36); *Centrodus princeps* (Hinde) BRYANT, 1921 (p. 22, text fig. 6). Upper Devonian, Genundewa limestone at base of Genesee, North Evans, Eighteen Mile Creek, New York. *Polygnathus princeps* (Hinde) SMITH, 1907 (p. 245, pl. 5, figs. 9, 10, 12, 13). Ordovician, Arenig-Llandeilo, southern uplands of Scotland.

Lonchodus simplex PANDER, 1856. *Centrodus simplex* PANDER, 1856 (p. 31, pl. 2A, figs. 2, 3, 5, 6). Carboniferous limestone, Tula, Russia; ROUNDY, 1926 (p. 15, pl. 3, figs. 1–5). Barnett shale of Mississippian, San Saba County, Texas.

Machairodia SMITH, 1907. See *Distacodus* HINDE, 1879.

Machairodus PANDER, 1856. See *Distacodus* HINDE, 1879.

Oistodus PANDER, 1856 (p. 27). Genotype (first species): *Oistodus lanceolatus* PANDER, 1856.

Oistodus acuminatus PANDER, 1856 (p. 27, pl. 2, fig. 20). Lower Ordovician, Baltic Provinces.

Oistodus inaequalis PANDER, 1856 (p. 27, pl. 2, fig. 37). Lower Ordovician, Baltic Provinces.

Oistodus lanceolatus PANDER, 1856 (p. 27, pl. 2, figs. 17–19). Lower Ordovician, Baltic Provinces.

Oistodus parallelus PANDER, 1856 (p. 27, pl. 2, fig. 40). Lower Ordovician, Baltic Provinces.

Pachysomia SMITH, 1907, (p. 246); ULRICH and BASSLER, 1926 (p. 43). Genotype: *Pachysomia wanlockensis* Smith, 1907.

Pachysomia wanlockensis SMITH, 1907 (p. 246, pl. 6, fig. 23). Ordovician, Arenig-Llandeilo, southern uplands of Scotland.

Palmatodella ULRICH and BASSLER, 1926 (p. 41). Genotype: *Palmatodella delicatula* ULRICH and BASSLER, 1926.

Palmatodella delicatula ULRICH and BASSLER, 1926 (p. 41, pl. 10, fig. 5; text fig. 20). Mississippian, Chattanooga shale, north of Huntsville, Alabama and Hardin sandstone at base of Chattanooga shale, Mount Pleasant, Tenn.

Palmatolepis ULRICH and BASSLER, 1926 (p. 49). Genotype: *Palmatolepis perlobata* ULRICH and BASSLER, 1926.

Palmatolepis asymmetrica ULRICH and BASSLER, 1926 (p. 50, pl. 7, fig. 18). Mississippian, Hardin sandstone at base of Chattanooga shale, Mount Pleasant, Tenn.

Palmatolepis bifurcata ULRICH and BASSLER, 1926 (p. 50, pl. 7, figs. 16, 17). Mississippian, Hardin sandstone at base of Chattanooga shale, Mount Pleasant, Tenn.

Palmatolepis extralobata ULRICH and BASSLER, 1926 (p. 50, pl. 8, fig. 3). Mississippian, Hardin sandstone at base of Chattanooga shale, Mount Pleasant, Tenn.

Palmatolepis glaber ULRICH and BASSLER, 1926 (p. 51, pl. 9, figs. 18–20). Mississippian, Hardin sandstone at base of Chattanooga shale, Mount Pleasant, Tenn.

Palmatolepis lobatula ULRICH and BASSLER, 1926 (p. 50, pl. 7, figs. 3, 4). Mississippian, Hardin sandstone at base of Chattanooga shale, Mount Pleasant, Tenn.

Palmatolepis peculiaris ULRICH and BASSLER, 1926 (p. 51, pl. 8, figs. 11, 12). Mississippian, Hardin sandstone at base of Chattanooga shale, Mount Pleasant, Tenn.

Palmatolepis perlobata ULRICH and BASSLER, 1926 (p. 49, pl. 7, figs. 19–23). Mississippian, Hardin sandstone at base of Chattanooga shale, Mount Pleasant, Tenn.

Palmatolepis punctata HINDE, 1879. *Polygnathus punctatus* HINDE, 1879 (p. 367, pl. 17, fig. 14); GRABAU, 1899 (p. 157, fig. 43); GRABAU and SHIMER, 1910 (p. 244, fig. 1536*d*); BRYANT, 1921 (p. 25). Devonian, Genundewa limestone, at base of Genesee, North Evans, Eighteen Mile Creek, New York; ULRICH and BASSLER, 1926 (p. 51, pl. 1, figs. 6, 7). Rhinestreet shale of Portage group, Shaleton, Erie County, New York.

Paltodus PANDER, 1856 (p. 24). Genotype (first species): *Paltodus subaequalis* PANDER, 1856.

Paltodus bicostatus PANDER, 1856 (p. 25, pl. 1, fig. 21). Lower Ordovician, Baltic Provinces.

Paltodus canaliculatus PANDER (p. 25, pl. 1, fig. 36). Lower Ordovician, Baltic Provinces.

Paltodus obtusus PANDER, 1856 (p. 24, pl. 1, figs. 13, 16, 29, 32). Lower Ordovician, Baltic Provinces.

Paltodus rotundatus PANDER, 1856 (p. 25, pl. 1, figs. 33, 34). Lower Ordovician, Baltic Provinces.

Paltodus subaequalis PANDER, 1856 (p. 24, pl. 1, fig. 24). Lower Ordovician, Baltic Provinces.

Paltodus truncatus PANDER, 1856 (p. 25, pl. 1, figs. 18–20). Lower Ordovician, Baltic Provinces.

Panderodella ULRICH and BASSLER, 1926 (p. 52). Genotype: *Panderodella truncata* ULRICH and BASSLER, 1926.

Panderodella maxillaris ULRICH and BASSLER, 1926 (p. 53, pl. 9, fig. 21). Mississippian, Hardin sandstone at base of Chattanooga shale, Mount Pleasant, Tenn.

Panderodella scitula HINDE, 1900, *Polygnathus scitulus* HINDE, 1900 (p. 343, pl. 9, figs. 9–11). Carboniferous, upper limestone, Dalry, etc., west Scotland.

Panderodella serrata HINDE, 1879, *Polygnathus serratus* HINDE, 1879 (p. 365, pl. 17, figs. 4, 5). Devonian, Genesee, Kettle Point, Ontario.

Panderodella solida HINDE, 1879, *Polygnathus solidus* HINDE, 1879 (p. 365, pl. 17, fig. 2); GRABAU, 1899 (p. 155, fig. 37); GRABAU and SHIMER, 1910 (p. 243, fig. 1535*b*); BRYANT, 1921 (p. 27, pl. 7, figs. 7–10, 12). Upper Devonian, Genundewa limestone at base of Genesee, North Evans, Eighteen Mile Creek, N. Y.

Panderodella subcrassa ULRICH and BASSLER, 1926 (p. 53, pl. 9, fig. 14). Mississippian, Hardin sandstone at base of Chattanooga shale, Mount Pleasant, Tenn.

Panderodella truncata ULRICH and BASSLER, 1926 (p. 52, pl. 9, figs. 15–17), Mississipian, Hardin sandstone at base of Chattanooga shale, Mount Pleasant, Tenn.

Polygnathellus ULRICH and BASSLER, 1926 (p. 53). Genotype: *Polygnathellus typicalis* Ulrich and Bassler, 1926.

Polygnathellus colligatus BRYANT, 1921, *Prioniodus colligatus* BRYANT, 1921, (p. 17, pl. 3, figs. 1, 2, 4; pl. 5, figs. 6, 10; pl. 6, fig. 8; pl. 7, figs. 2, 6). Upper Devonian, Genundewa limestone at base of Genesee, North Evans, Eighteen Mile Creek, N. Y.

Polygnathellus curvatus ULRICH and BASSLER, 1926 (p. 54, pl. 1, fig. 4). Upper Devonian, Rhinestreet shale of Portage group, Shaleton, Erie County, N. Y.

Polygnathellus typicalis ULRICH and BASSLER, 1926 (p. 53, pl. 1, figs. 1–3). Upper Devonian, Rhinestreet shale of Portage group, Shaleton, Erie County, N. Y.

Polygnathidae ULRICH and BASSLER, 1926 (p. 43).

Polygnathus HINDE, 1879 (p. 361); BRYANT, 1921 (p. 23); ULRICH and BASSLER, 1926 (p. 43); ROUNDY, 1926 (p. 13). Genotype: *Polygnathus pennatus* HINDE, 1879 (*Polygnathus dubius* HINDE, 1879, part).

Polygnathus ? acaulis ULRICH and BASSLER, 1926 (p. 47, pl. 8, figs. 4, 5). Mississippian, Hardin sandstone at base of Chattanooga shale, Mount Pleasant, Tenn.

Polygnathus alternans HADDING, 1913. See *Prioniodus ? alternans.*

Polygnathus argos T. H. CLARK, 1924 (p. 70, pl. 6, fig. 7). Not a conodont. probably fringe of appendage of merostome or trilobite. Canadian, Point Levis, Canada.

Polygnathus bilineatus ROUNDY, 1926 (p. 13, pl. 3, fig. 10). Barnett shale of Mississippian, San Saba County, Tex.

Polygnathus caelatus BRYANT, 1921 (p. 27, pl. 13, figs. 1–13). Upper Devonian, Genundewa limestone at base of Genesee, North Evans, Eighteen Mile Creek, N. Y.

Polygnathus ? claviger ROUNDY, 1926 (p. 14, pl. 4, figs. 1, 2). Barnett shale of Mississippian, San Saba County, Tex.

Polygnathus concentricus ULRICH and BASSLER, 1926 (p. 47, pl. 8, figs. 6, 7). Mississippian, Hardin sandstone at base of Chattanooga shale, Mount Pleasant, Tenn.

Polygnathus confluens ULRICH and BASSLER, 1926 (p. 46, pl. 7, figs. 14, 15). Mississippian, Hardin sandstone at base of Chattanooga shale, Mount Pleasant, Tenn.

Polygnathus convexus HINDE, 1900. See *Lonchodus convexus.*

Polygnathus crassulus ULRICH and BASSLER, 1926 (p. 48, pl. 8, figs. 8–10). Mississippian, Hardin sandstone at base of Chattanooga shale, Mount Pleasant, Tenn.

Polygnathus crassus HINDE, 1879. See *Gnathodus ? crassus.*

Polygnathus cristatus HINDE, 1879 (p. 366, pl. 17, fig. 11); J. M. CLARKE, 1886 (pl. A–1, fig. 20); BRYANT, 1921 (p. 24); *Polygnathus dubius* HINDE, 1879 (p. 363, pl. 16, figs. 16, 18); J. W. CLARKE, 1886 (pl. A–1, fig. 20). Described from Genundewa limestone at North Evans, but probably from Portage beds of same locality, according to Bryant.

Polygnathus ? curvatus HINDE, 1879. See *Gnathodus curvatus.*

Polygnathus curvatus SMITH, 1907. See *Lonchodus curvatus.*

Polygnathus delicatulus ULRICH and BASSLER, 1926 (p. 45, pl. 7, figs. 9, 10). Mississippian, Hardin sandstone at base of Chattanooga shale, Mount Pleasant, Tenn.

Polygnathus dubius HINDE, 1879 (p. 362, pl. 16, figs. 6–18); GRABAU, 1899 (p. 153, fig. 34); GRABAU and SHIMER, 1910 (p. 243, figs. 1533*c–i;* 1534*a–c*). Described from an assemblage of species of different genera on a slab probably of Portage age, western New York; J. M. CLARKE, 1886, pl. A–1. Naples shale, Naples, N. Y. *See Polygnathus pennatus.*

Polygnathus dubius SMITH, 1900. See *Bryantodus dubius.*

Polygnathus dubius SMITH, 1907. See *Hindeodella dubia.*

Polygnathus duplicatus HINDE, 1879. See *Bryantodus duplicatus.*

Polygnathus ? eriensis HINDE, 1879. See *Gnathodus eriensis.*

Polygnathus foliatus BRYANT, 1921 (p. 24, pl. 10, figs. 13–16). Upper Devonian, Genundewa limestone at base of Genesee, North Evans, Eighteen Mile Creek, N. Y.

Polygnathus folium ULRICH and BASSLER, 1926 (p. 46, pl. 7, fig. 5). Mississippian, Hardin sandstone at base of Chattanooga shale, Mount Pleasant, Tenn.

Polygnathus germanus ULRICH and BASSLER, 1926 (p. 46, pl. 7, figs. 11, 12). Mississippian, Hardin sandstone at base of Chattanooga shale, Mount Pleasant, Tenn.

Polygnathus glaber ULRICH and BASSLER, 1926 (p. 46, pl. 7, fig. 13). Mississippian, Hardin sandstone at base of Chattanooga shale, Mount Pleasant, Tenn.

Polygnathus immersus HINDE, 1879. See *Bryantodus immersus*.

Polygnathus lanceolatus SMITH, 1907. See *Euprioniodina ? lanceolata*.

Polygnathus linguiformis HINDE, 1879 (p. 367, pl. 17, fig. 15); GRABAU, 1899 (p. 157, pl. 44); BRYANT, 1921 (p. 25, pl. 11, figs. 1–9; pl. 14, fig. 2). *Polygnathus simplex* HINDE, 1879 (p. 367, pl. 17, fig. 18); GRABAU, 1899 (p. 157, fig. 46). Upper Devonian, Genundewa limestone at base of Genesee, North Evans, Eighteen Mile Creek, N. Y. North Shore of Lake Erie, Ontario.

Polygnathus minus SMITH, 1907. See *Lonchodus minus*.

Polygnathus mosquensis HINDE, 1879. See *Gnathodus mosquensis*.

Polygnathus nasutus HINDE, 1879. See *Synprioniodina nasuta*.

Polygnathus navicula HINDE, 1900 (p. 342, pl. 9, fig. 5). Carboniferous. Upper limestone near Douglass, West Scotland.

Polygnathus ordinatus BRYANT, 1921 (p. 24, pl. 10, figs. 10, 11). Upper Devonian, Genundewa limestone at base of Genesee, North Evans, Eighteen Mile Creek, N. Y.

Polygnathus palmatus HINDE, 1879 (p. 367, pl. 17, figs. 16, 17); GRABAU, 1899 (p. 157); GRABAU and SHIMER, 1910 (p. 244, fig. 1536*h*). Genesee (?Portage) Kettle Paint, Ontario.

Polygnathus parvus SMITH, 1907. See *Lonchodus parvus*.

Polygnathus pauperatus SMITH, 1907. See *Prioniodus pauperatus*.

Polygnathus pennatus HINDE, 1879 (p. 366, pl. 17, fig. 8); J. M. CLARKE, 1886 (pl. A–1, fig. 9); GRABAU, 1899 (p. 156, fig. 39); GRABAU and SHIMER, 1910 (p. 243, fig. 1536*a*); BRYANT, 1921 (p. 23, pl. 10, figs. 1–9). *Polygnathus dubius* HINDE, 1879 (part), (p. 363, pl. 16, fig. 17); J. M. CLARKE, 1886 (pl. A–1, figs. 2, 3, 13). Upper Devonian, Genundewa limestone at base of Genesee, North Evans, Eighteen Mile Creek, N. Y.

Polygnathus pennatulus ULRICH and BASSLER, 1926 (p. 45, pl. 7, fig 8, pl. 9, figs. 24, 25). Mississippian, Hardin sandstone at base of Chattanooga shale, Mount Pleasant, Tenn.

Polygnathus peracutus BRYANT, 1921 (p. 25, pl. 10, fig. 12). Upper Devonian. Genundewa limestone at base of Genesee, North Evans, Eighteen Mile Creek, N. Y.

Polygnathus princeps HINDE, 1879. See *Lonchodus princeps*.

Polygnathus punctatus HINDE, 1879. See *Palmatolepis punctata*.

Polygnathus radiatus HINDE, 1879. See *Bryantodus radiatus*.

Polygnathus rhomboideus ULRICH and BASSLER, 1926 (p. 46, pl. 7, fig. 6). Mississippian, Hardin sandstone at base of Chattanooga shale, Mount Pleasant, Tenn.

Polygnathus rimulatus ULRICH and BASSLER, 1926 (p. 45, pl. 1, figs. 8, 9). Devonian, Rhinestreet shale, Shaleton, N. Y.

Polygnathus rotundilobus BRYANT, 1921 (p. 26, pl. 12, figs. 1–6; text fig. 7). *Polygnathus tuberculatus* HINDE, 1879 (part) (p. 366, pl. 17, fig. 10). Upper Devonian, Genundewa limestone at base of Genesee, North Evans, Eighteen Mile Creek, N. Y.

Polygnathus scitulus HINDE, 1900. See *Panderodella scitula*.

Polygnathus serratus HINDE, 1879. See *Panderodella serrata*.

Polygnathus simplex HINDE, 1879. Synonym for *Polygnathus linguiformis* HINDE, 1879.

Polygnathus solidus HINDE, 1879. See *Panderodella solida.*

Polygnathus spinatus HADDING, 1913. See *Lonchodina ? spinata.*

Polygnathus sublatus ULRICH and BASSLER, 1926 (p. 47, pl. 8, fig. 2). Mississippian, Hardin sandstone at base of Chattanooga shale, Mount Pleasant, Tenn.

Polygnathus taffi ROUNDY, 1926 (p. 13, pl. 3, fig. 11). Barnett shale of Mississippian, San Saba County, Tex.

Polygnathus texanus ROUNDY, 1926 (p. 14, pl. 3, fig. 13). Barnett shale of Mississippian, San Saba County, Tex.

Polygnathus truncatus HINDE, 1879 (p. 366, pl. 17, figs. 12, 13) ; GRABAU, 1899 (p. 156, fig. 42) ; GRABAU and SHIMER, 1910 (p. 243, figs. 1536*b*, *c*). "Genesee, Bear Creek, Ontario."

Polygnathus tuberculatus HINDE, 1879 (p. 366, pl. 17, figs. 9, 10) ; GRABAU, 1899 (p. 156, fig. 40) ; GRABAU and SHIMER, 1910 (p. 244, figs. 1536*e*, *f*) ; BRYANT, 1921 (p. 25, pl. 12, figs. 7–9). Upper Devonian, Genundewa limestone at base of Genesee, North Evans, Eighteen Mile Creek, N. Y.

Polygnathus wilsoni U. P. JAMES, 1884 (p. 148, pl. 7, fig. C). Ordovician (Maysville) Warren County, Ohio. Fossil of uncertain affinities.

Prioniodella ULRICH and BASSLER, 1926 (p. 18). Genotype: *Prioniodella normalis* Ulrich and Bassler, 1926.

Prioniodella aequidens ULRICH and BASSLER, 1926 (p. 19, pl. 4, figs. 6, 7). Upper Devonian, Rhinestreet shale of Portage group, Shaleton, Erie County, N. Y.

Prioniodella brevispina ULRICH and BASSLER, 1926 (p. 20, pl. 10, fig. 21). Missippian, Hardin sandstone at base of Chattanooga shale, Mount Pleasant, Tenn.

Prioniodella conferta ULRICH and BASSLER, 1926 (p. 21, pl. 10, fig. 25.) Mississippian, Hardin sandstone at base of Chattanooga shale, Mount Pleasant, Tenn.

Prioniodella gracilis ULRICH and BASSLER, 1926 (p. 20, pl. 10, figs. 22, 23). Mississippian, Hardin sandstone at base of Chattanooga shale, Mount Pleasant, Tenn.

Prioniodella inaequalis ULRICH and BASSLER, 1926 (p. 19, pl. 4, figs. 2, 3). Upper Devonian, Rhinestreet shale of Portage group, Shaleton, Erie County, N. Y.

Prioniodella informata ULRICH and BASSLER, 1926 (p. 20, pl. 10, figs. 19, 20). Mississippian, Hardin sandstone at base of Chattanooga shale, Mount Pleasant, Tenn.

Prioniodella invalida BRYANT, 1921. *Centrodus invalidus* BRYANT, 1921 (p. 21, pl. 3, figs. 3, 5). Upper Devonian, Genundewa limestone at base of Genesee, North Evans, Eighteen Mile Creek, N. Y.

Prioniodella multidens ULRICH and BASSLER, 1926 (p. 19, pl. 4, figs. 4, 5). Upper Devonian, Rhinestreet shale of Portage group, Shaleton, Erie County, N. Y.

Prioniodella normalis ULRICH and BASSLER, 1926 (p. 19, pl. 4, figs. 1, 1′). Upper Devonian, Rhinestreet shale of Portage group, Shaleton, Erie County, N. Y.

Prioniodella robusta ULRICH and BASSLER, 1926 (p. 20, pl. 10, fig. 24). Mississippian, Hardin sandstone at base of Chattanooga shale, Mount Pleasant, Tenn.

Prioniodidae ULRICH and BASSLER, 1926 (p. 7).

Prioniodina ULRICH and BASSLER, 1926 (p. 18). Genotype: *Prioniodina subcurvata* Ulrich and Bassler, 1926.

Prioniodina? gemina HINDE, 1900. *Prioniodus geminus* HINDE, 1900 (p. 344, pl. 10, fig. 25). Carboniferous, Upper limestone, Glencart, etc., west Scotland.

Prioniodina recedens BRYANT, 1921, *Prioniodus recedens* Bryant, 1921 (p. 13, text fig. 3; pl. 1, figs. 1, 2, 6–14; pl. 2, figs. 1–4, 7, 9). Upper Devonian, Genundewa limestone at base of Genesee, North Evans, Eighteen Mile Creek, N. Y.

Prioniodina separata ULRICH and BASSLER, 1926 (p. 18, pl. 4, figs. 17, 18). Upper Devonian, Rhinestreet shale of Portage group, Shaleton, Erie County, N. Y.

Prioniodina subcurvata ULRICH and BASSLER, 1926 (p. 18, pl. 4, figs. 22–24). Upper Devonian, Rhinestreet shale of Portage group, Shaleton, Erie County, N. Y.

Prioniodina? volborthii PANDER, 1856. *Prioniodus volborthii* PANDER, 1856 (p. 30, fig. A on p. 20). Carboniferous? of Russia.

Prioniodinidae ULRICH and BASSLER, 1926 (p. 15).

Prioniodus PANDER, 1856 (p. 29); ROUNDY, 1926 (p. 10); ULRICH and BASSLER, 1926 (p. 8). Genotype (first species); *Prioniodus elegans* PANDER, 1856.

Prioniodus abbreviatus HINDE, 1879 (p. 359, pl. 15, fig. 15): GRABAU, 1899 (p. 150, fig. 33B); GRABAU and SHIMER, 1910 (p. 244, fig. 1537*a*); BRYANT, 1921 (p. 14, pl. 1, figs. 3–5; pl. 3, fig. 7). Upper Devonian, Genundewa limestone at base of Genesee, North Evans, Eighteen Mile Creek, N. Y.

Prioniodus acicularis HINDE, 1879. See *Euprioniodina acicularis.*

Prioniodus alatus HINDE, 1879 (p. 361, pl. 16, fig 5); GRABAU, 1899 (p. 153, fig. 331); GRABAU and SHIMER, 1910 (p. 244, fig. 1533*b*); BRYANT, 1921 (p. 15, pl. 3, fig. 10; pl. 4, figs. 1–7). Upper Devonian, Genundewa limestone at base of Genesee, North Evans, Eighteen Mile Creek, N. Y.; ULRICH and BASSLER, 1926 (p. 11, pl. 1, figs. 25, 26). Upper Devonian, Rhinestreet shale of Portage group, Shaleton, Erie County, N. Y.

Prioniodus alatus HADDING, 1913. See *Euprioniodina ? alata.*

Prioniodus ? alternans HADDING, 1913. *Polygnathus alternans* HADDING, 1913 (p. 32, pl. 1, fig. 7). Ordovician, Dicellograptus zone), southern Norway.

Prioniodus angulatus HINDE, 1879, 1900. See *Hibbardella angulata.*

Prioniodus armatus HINDE, 1879 (p. 360, pl. 15, figs. 20, 21); GRABAU, 1899 (p. 152, fig. 33F); GRABAU and SHIMER, 1910 (p. 244, figs. 1537 *f, g*); BRYANT, 1921 (p. 18); ULRICH and BASSLER, 1926 (p. 12). "Genesee, North Evans, N. Y." Apparently from Rhinestreet shale of Portage, western New York.

Prioniodus ? carinatus PANDER, 1856 (p. 30, pl. 2, fig. 25). Lower Ordovician, Baltic Provinces.

Prioniodus clavatus HINDE, 1879. See *Lonchodina clavata.*

Prioniodus colligatus BRYANT, 1921. See *Polygnathellus colligatus.*

Prioniodus complex HINDE, 1900 (p. 344, pl. 10, fig. 24). Carboniferous, Upper limestone, Glencart, etc., west Scotland.

Prioniodus concavus ULRICH and BASSLER, 1926 (p. 10, pl. 9, fig. 11). Mississippian, Hardin sandstone at base of Chattanooga shale, Mount Pleasant, Tenn.

Prioniodus cristatus BRYANT, 1921. See *Bryantodus cristatus.*

Prioniodus cultratus ULRICH and BASSLER, 1926 (p. 9, pl. 9, fig. 7). Mississippian Hardin sandstone at base of Chattanooga shale, Mount Pleasant, Tenn.

Prioniodus curvatus SMITH, 1907. See *Euprioniodina curvata.*

Prioniodus curvidens ULRICH and BASSLER, 1926 (p. 11, pl. 1, figs. 16, 17). Upper Devonian, Rhinestreet shale of Portage group, Shaleton, Erie, County, N. Y.

Prioniodus dilata BRYANT, 1921, *Prioniodus dilatus* BRYANT, 1921 (p. 20, pl. 7, figs. 3, 4, 11). Upper Devonian, Genundewa limestone at base of Genesee, North Evans, Eighteen Mile Creek, N. Y.

Prioniodus discedens HADDING, 1913. See *Euprioniodina ? discedens.*

Prioniodus disparilis ULRICH and BASSLER, 1926 (p. 10, pl. 9, fig. 12). Mississippian, Hardin sandstone at base of Chattanooga shale, Mount Pleasant, Tenn.

Prioniodus dorcens T. H. CLARK, 1924 (p. 68, pl. 6, fig. 3). Not a conodont, but a spiny terminal fragment of trilobite. Canadian, Point Levis, Canada.

Prioniodus dychei U. P. JAMES, 1884 (p. 148, pl. 7, figs. A, C.). Ordovician (Maysville), Warren County, Ohio. Probably an annelid jaw.

Prioniodus elegans PANDER, 1856 (p. 29, pl. 2, figs. 22, 23). Lower Ordovician, Baltic Provinces. HINDE, 1879 (p. 358, pl. 15, fig. 10); GRABAU and SHIMER, 1910 (p. 244, fig. 1538*d*); PARKS, 1922 (p. 36, pl. 6, fig. 24). Upper Ordovician, Lorraine-Dundas, Toronto, Ontario.

Prioniodus equalis SMITH, 1907 (p. 249, pl. 8, figs. 38, 39). Ordovician, Arenig-Llandeilo, southern uplands of Scotland.

Prioniodus erraticus HINDE, 1879. See *Lonchodina erratica.*

Prioniodus furcatus HINDE, 1879. See *Euprioniodina ? furcata.*

Prioniodus geminus HINDE. See *Prioniodina? gemina.*

Prioniodus hamatus BRYANT, 1921 (p. 15, text fig. 5; pl. 2, figs. 5, 6, 8, 11). Upper Devonian, Genundewa limestone at base of Genesee, North Evans, Eighteen Mile Creek, N. Y.

Prioniodus healdi ROUNDY, 1926 (p. 10, pl. 4, fig. 5). Barnett shale of Mississippian, San Saba County, Tex.

Prioniodus immersus BRYANT, 1921. See *Bryantodus immersus.*

Prioniodus inequalis ULRICH and BASSLER, 1926 (p. 10, pl. 9, fig. 6). Mississippian, Hardin sandstone at base of Chattanooga shale, Mount Pleasant, Tenn.

Prioniodus inflatus SMITH, 1907 (p. 249, pl. 8, fig. 36). Ordovician, Arenig Llandeilo, southern uplands of Scotland.

Prioniodus inutilis ULRICH and BASSLER, 1926 (p. 11, pl. 1, fig. 23). Upper Devonion, Rhinestreet shale of Portage group, Shaleton, Erie County, N. Y.

Prioniodus lelaps T. H. CLARK, 1924 (p. 69, pl. 6, fig. 4). Not a conodont, but an annelid jaw, Canadian, Point Levis, Canada.

Prioniodus macconochii SMITH, 1907 (p. 249, pl. 8, figs. 41, 42). Ordovician, Arenig-Llandeilo, southern uplands of Scotland.

Prioniodus macrodentatus BRYANT, 1921. See *Bryantodus macrodentatus.*

Prioniodus melampus T. H. CLARKE, 1924 (p. 68, pl. 6, fig. 2). Not a conodont. but the spiny terminal fragment of a trilobite, Canadian, Point Levis, Canada.

Prioniodus muricatus BRYANT, 1921. See *Bryantodus muricatus.*

Prioniodus nasutus BRYANT, 1921. See *Synprioniodina nasuta.*

Prioniodus obtusus BRYANT, 1921. See *Bryantodus obtusus.*

Prioniodus pamphagus T. H. CLARK, 1924 (p. 70, pl. 6, fig. 6). Not a conodont, but an annelid jaw and the same as *Prioniodus lelaps* T. H. Clark, 1924 Canadian, Point Levis, Canada.

Prioniodus panderi HINDE, 1879. See *Ligonodina panderi.*

Prioniodus parvidentatus ULRICH and BASSLER, 1926 (p. 9, pl. 9, fig. 1). Mississippian, Hardin sandstone at base of Chattanooga shale, Mount Pleasant Tenn.

Prioniodus parvulus BRYANT, 1921. See *Bryantodus parvulus.*

Prioniodus pauperatus SMITH, 1907. *Polygnathus pauperatus* SMITH, 1907, (p. 245, pl. 5, fig. 14). Ordovician, Arenig-Llandeilo, southern uplands of Scotland.

Prioniodus peracutus HINDE, 1900 (p. 343, pl. 10, figs. 21–23). Carboniferous, lower and upper limestone, Monkcastle, Dalry, etc., west Scotland; ROUNDY, 1926 (p. 10, pl. 4, figs. 6–8) Barnett shale of Mississippian, San Saba County, Tex.

Prioniodus politus Hinde, 1879. See *Bryantodus politus*.

Prioniodus porcatus Hinde, 1900 (p. 344, pl. 10, fig. 26). Carboniferous, upper limestone, Monkcastle, etc., west Scotland.

Prioniodus pravus Bryant, 1921. See *Bryantodus pravus*.

Prioniodus proclinatus Ulrich and Bassler, 1926 (p. 10, pl. 1, fig. 22). Upper Devonian, Rhinestreet shale of Portage group, Shaleton, Erie County, N. Y.

Prioniodus proclinis Ulrich and Bassler, 1926 (p. 9, pl. 9, figs. 8–10). Mississippian, Hardin sandstone at base of Chattanooga shale, Mount Pleasant, Tenn.

Prioniodus radiatus Bryant, 1921. See *Bryantodus radiatus*.

Prioniodus radicans Hinde, 1879. See *Euprioniodina radicans*.

Prioniodus recedens Bryant, 1921. See *Prioniodina recedens*.

Prioniodus retusus Bryant, 1921. See *Bryantodus retusus*.

Prioniodus reversus Ulrich and Bassler, 1926 (p. 10, pl. 9, fig. 4). Mississippian, Hardin sandstone at base of Chattanooga shale, Mount Pleasant, Tenn.

Prioniodus spatulatus Bryant, 1921. See *Bryantodus spatulatus*.

Prioniodus spicatulus Ulrich and Bassler, 1926 (p. 9, pl. 9, figs. 2, 3). Mississippian, Hardin sandstone at base of Chattanooga shale, Mount Pleasant, Tenn.

Prioniodus spicatus Hinde, 1879 (p. 361, pl. 16, figs. 1–3); Clarke, 1886, (pl. A–1, fig. 22); Grabau, 1899 (p. 152, fig. 33G); Bryant, 1921 (p. 19). Upper Devonian, Portage-Naples and Rhinestreet shales, western New York; Hinde, 1900 (p. 343, pl. 10, fig. 20). Carboniferous, lower limestone, Birkhead, Dalry, etc., west Scotland.

Prioniodus subcompactus Smith, 1907 (p. 249, pl. 8, fig. 37). Ordovician, Arenig-Llandeilo, southern uplands of Scotland.

Prioniodus sulcatus Pander, 1856 (p. 29, pl. 2, fig. 24). Lower Ordovician, Baltic Provinces.

Prioniodus tigris T. H. Clark, 1924 (p. 69, pl. 6, fig. 5). Not a conodont, but probably fringe appendage of merostome or trilobite. Canadian, Point Levis, Canada.

Prioniodus theron T. H. Clark, 1924 (p. 67, pl. 6, fig. 1). Not a conodont; probably fringe appendage of merostome or trilobite. Canadian, Point Levis, Canada.

Prioniodus tulensis Pander, 1856 (p. 30, pl. 2A, figs. 1, 18–20). Carboniferous limestone. Tula, Russia; Hinde, 1900 (p. 343, pl. 9, figs. 15–20). Carboniferous, upper and lower limestone, Glencart, Dalry, etc., west Scotland.

Prioniodus undosus Ulrich and Bassler, 1926 (p. 12, pl. 1, figs. 18–20). Upper Devonian, Rhinestreet shale of Portage group, Shaleton, Erie County, N. Y.

Prioniodus volborthii Pander, 1856. See *Prioniodina volborthii*.

Prionognathus Pander, 1856 (p. 34); Ulrich and Bassler, 1926 (p. 43). Genotype (only species): *Prionognathus brandtii*, Pander, 1856.

Prionognathus brandtii Pander, 1856 (p. 34, pl. 4, fig. 19). Silurian, Rootsikülle, Island of Oesel. Probably not a conodont.

Scolopodus Pander, 1856 (p. 25). Genotype (first species): *Scolopodus sublaevis* Pander, 1856.

Scolopodus aequilateralis Pander, 1856 (p. 26, pl. 2, fig. 5). Lower Ordovician, Baltic Provinces.

Scolopodus costatus Pander, 1856 (p. 26, pl. 2, fig. 7). Lower Ordovician, Baltic Provinces.

Scolopodus quadratus Pander, 1856 (p. 26, pl. 2, fig. 6). Lower Ordovician, Baltic Provinces.

Scolopodus semicostatus Pander, 1856 (p. 26, pl. 2, fig. 4). Lower Ordovician, Baltic Provinces.

Scolopodus striatus PANDER, 1856 (p. 26, pl. 2, fig. 8). Lower Ordovician, Baltic Provinces.

Scolopodus sublaevis PANDER, 1856 (p. 25, pl. 2, fig. 3). Lower Ordovician, Baltic Province.

Subprioniodus SMITH, 1907 (p. 247). Genotype: *Subprioniodus paucidentatus* Smith, 1907. Genus retained provisionally for Ordovician species of *Prioniodus* referred here by Smith.

Subprioniodus acutus SMITH, 1907 (p. 250, pl. 9, fig. 45; pl. 7, fig. 33). Ordovician, Arenig-Llandeilo, southern uplands of Scotland.

Subprioniodus calcarus SMITH, 1907 (p. 250, pl. 9, fig. 46). Ordovician, Arenig-Llandeilo, southern uplands of Scotland.

Subprioniodus crassus SMITH, 1907 (p. 250, pl. 9, fig. 48). Ordovician, Arenig-Llandeilo, southern uplands of Scotland.

Subprioniodus cringcrampensis SMITH, 1907 (p. 248, pl. 7, fig. 35). Ordovician, Arenig-Llandeilo, southern uplands of Scotland.

Subprioniodus distans SMITH, 1907 (p. 250, pl. 9, fig. 44). Ordovician, Arenig-Llandeilo, southern uplands of Scotland.

Subprioniodus equalis SMITH, 1907 (p. 248, pl. 7, fig. 31). Ordovician, Arenig-Llandeilo, southern uplands of Scotland.

Subprioniodus falcatus SMITH, 1907 (p. 250, pl. 9, fig. 51). Ordovician, Arenig-Llandeilo, southern uplands of Scotland.

Subprioniodus fardingensis SMITH, 1907 (p. 250, pl. 9, fig. 47). Ordovician, Arenig-Llandeilo, southern uplands of Scotland.

Subprioniodus furcatus SMITH, 1907 (p. 247, pl. 6, fig. 22). Ordovician, Arenig-Llandeilo, southern uplands of Scotland.

Subprioniodus gibbosus SMITH, 1907 (p. 247, pl. 7, fig. 27). Ordovician, Arenig-Llandeilo, southern uplands of Scotland.

Subprionidus huntlawensis SMITH, 1907 (p. 248, pl. 7, fig. 34 a, b). Ordovician, Arenig-Llandeilo, southern uplands of Scotland.

Subprioniodus lanceolatus SMITH, 1907 (p. 247, pl. 7, fig. 29). Ordovician, Arenig-Llandeilo, southern uplands of Scotland.

Subprioniodus obliquo-lanceolatus SMITH, 1907 (p. 248, pl. 7, fig. 30). Ordovician, Arenig-Llandeilo, southern uplands of Scotland.

Subprioniodus parvus SMITH, 1907 (p. 247, pl. 7, figs. 26, 28). Ordovician, Arenig-Llandeilo, southern uplands, of Scotland.

Subprioniodus paucidentatus SMITH, 1907 (p. 247, pl. 6, fig. 21). Ordovician, Arenig-Llandeilo, southern uplands, of Scotland.

Subprioniodus peracutus SMITH, 1907 (p. 248, pl. 7, fig. 32). Ordovician, Arenig-Llandeilo, southern uplands of Scotland.

Subprioniodus subserratus SMITH, 1907 (p. 250, pl. 9, fig. 43). Ordovician, Arenig-Llandeilo, southern uplands, of Scotland.

Synprioniodina ULRICH and BASSLER, 1926 (p. 42). Genotype: *Synprioniodina alternata* Ulrich and Bassler, 1926.

Synprioniodina alternata ULRICH and BASSLER, 1926 (p. 42, text fig. 22). Mississippian, Chattanooga shale, 13 miles east of north of Huntsville, Ala.

Synprioniodina nasuta HINDE, 1879. *Polygnathus nasutus* HINDE, 1879 (p. 364, pl. 16, fig. 22); GRABAU, 1899 (p. 155, fig. 35). *Prioniodus nasutus* (Hinde) BRYANT, 1921 (p. 19). Devonian, Genesee shales, North Evans, Eighteen Mile Creek, N. Y.

Valentia SMITH, 1907 (p. 251); ULRICH and BASSLER, 1926 (p. 43). Genotype (only species): *Valentia morrochensis* SMITH, 1907.

Valentia morrochensis SMITH, 1907 (p. 257, pl. 9, fig. 50). Ordovician, Arenig-Llandeilo, southern uplands of Scotland.

DESCRIPTION OF EARLY MISSISSIPPIAN SPECIES

All of the species herein described were obtained in the Chattanooga black shale of Early Mississippian age at a locality 13 miles east of north of Huntsville, Ala.

Family PRIONIODIDAE Ulrich and Bassler, 1926

Genus PRIONIODUS (Hinde) Bryant, 1921

PRIONIODUS ALABAMENSIS, new species

Plate 9, figs. 1, 2

Tooth consisting of a long, thin, tapering, recurved cusp rising from a flat, thick bar. This central cusp is not produced below the base. A series of short, sharp pointed denticles which are well separated, rises at an acute angle from the bar.

Cotypes.—Cat. No. 11431, U.S.N.M.

PRIONIODUS ALATOIDES, new species

Plate 9, fig. 3

This is a more delicate species than Hinde's *Prioniodus alatus*. The bar is straight, flat, and thin. The cusp is very wide at the base but tapers to a sharp point, extends below and forms an obtuse angle with the bar. The denticles and the cusp rise from the bar at obtuse angles.

Holotype.—Cat. No. 11432, U.S.N.M.

PRIONIODUS CULTRATUS Ulrich and Bassler, 1926

Plate 9, fig. 4

1926. *Prioniodus cultratus* Ulrich and Bassler, Proc. U. S. Nat. Mus., vol. 68, art. 12, p. 9, pl. 9, fig. 7.

Tooth composed of a broad, flat, tapering cusp rising from the slightly deflected end of a moderately flat bar at a right angle. Four long, sharp pointed, slightly recurved denticles are placed on the bar at obtuse angles with the base of the cusp. These are succeeded by several short, smaller denticles.

Plesiotype.—Cat. No. 11433, U.S.N.M.

Genus LIGONODINA Ulrich and Bassler, 1926

LIGONODINA PARVULA, new species

Plate 9, fig. 5

The pointed, recurved cusp extends below a slightly curved bar on which are several denticles, well rounded and set at obtuse angles to the bar. A wide space separates the cusp and the denticles, which in turn are removed from one another by means of a space about equal to the width of a denticle. The characteristic suckerlike markings are present on the downward extension of the main cusp.

Holotype.—Cat. No. 11434, U.S.N.M.

Family PRIONIODINIDAE Ulrich and Bassler, 1926

Genus HINDEODELLA Ulrich and Bassler, 1926

HINDEODELLA TENERRIMA, new species

Plate 9, figs. 6, 7

A long, thin, sharp pointed cusp rises from a very slender bar. Two broken denticles are on one side of the cusp and nine or ten are on the other side, all widely spaced. Due to the concavity of the bar immediately below the cusp, it may be inferred that this is the inner side of the jaw.

Cotypes.—Cat. No. 11435, U.S.N.M.

HINDEODELLA MINUTIDENS, new species

Plate 9, fig. 8

The upright denticles in this specimen are so minute and regularly, though closely, spaced and the bar is so long and flat that this conodont resembles a fine-toothed saw.

Holotype.—Cat. No. 11436, U.S.N.M.

HINDEODELLA GERMANA, new species

Plate 9, fig. 9

The anterior side of the bar is very thick and bears several needlelike, irregular denticles. On the posterior side the denticles, which slant backward, are alternately long and short. In one or two places two small denticles are found between the longer ones. The posterior end of the bar terminates in a spinelike point.

Holotype.—Cat. No. 11437, U.S.N.M.

HINDEODELLA SUBTILIS Ulrich and Bassler

Plate 9, figs. 10, 11

1926. *Hindeodella subtilis* ULRICH and BASSLER, Proc. U. S. Nat. Mus., vol. 68, art, 12, p. 39, pl. 8, figs. 17–19.

This species, described from the Hardin sandstone, is well represented in the succeeding Chattanooga black shale, where entire specimens, such as those in Figure 10, are not uncommon. The characteristic basketlike expansion at the anterior end and the minuteness and decided alternation of the denticles along the bar are features easily recognized. Figure 11 represents a variety in which the alternation of the denticles is not so evident and the denticles are shorter.

Plesiotypes.—Cat. No. 11438, U.S.N.M.

Genus LONCHODINA Ulrich and Bassler, 1926

LONCHODINA IRREGULARIS, new species

Plate 9, fig. 12

Bar slightly outwardly bowed, irregularly curved, with the anterior end shorter and bent abruptly downward. Main cusp located at the point of downward bending, followed posteriorly by two equally large denticles separated by a minute one. Rest of bar occupied by narrow, more delicate denticles decreasing in size to the extremities. The irregularity of curvature and the three larger central denticles characterize this species.

Holotype.—Cat. No. 11439, U.S.N.M.

LONCHODINA DISCRETA Ulrich and Bassler

Plate 9, fig. 13

1926. *Lonchodina discreta* Ulrich and Bassler, Proc. U. S. Nat. Mus., vol. 18, p. 36, pl. 10, figs. 1, 2.

A pointed, short, robust cusp rises from an irregularly curved, narrow bar. The cusp is separated from the denticles on each side by spaces several times its diameter. The two denticles on one side of the bar are short and robust; on the other side there are three which are thin.

Plesiotype.—Cat. No. 11440, U.S.N.M.

Genus PRIONIODELLA Ulrich and Bassler, 1926

PRIONIODELLA ARCUATA, new species

Plate 9, fig. 14

Tooth minute, broadly arched, the bar of which is very narrow, but well rounded. Denticles all similar, being delicate and needle-like, but the long ones are grouped on the anterior part of the bar and the short ones on the posterior. The decided curvature of the bar, the absence of a main cusp, and the two sets of delicate denticles characterize this species.

Holotype.—Cat. No. 11441, U.S.N.M.

PRIONIODELLA INUTILIS, new species

Plate 9, fig. 15

Bar broad, very slightly curved, bearing closely arranged, but distinctly separated denticles rather equal in size.

Holotype.—Cat. No. 11442, U.S.N.M.

Genus PRIONIODINA Ulrich and Bassler, 1926

PRIONIODINA SEPARANS, new species

Plate 9, figs. 16, 17

Tooth consisting of a slender curved bar bearing fourteen or more rather short, flattened denticles, separated from each other by more than their own diameter and with a main cusp about twice the size of a denticle, developed at the angle of curvature. The cusp is slightly extended below the bar into a protuberance. The denticles are very similar to each other and to the cusp in shape.

Cotypes.—Cat. No. 11443, U.S.N.M.

PRIONIODINA UNDULATA, new species

Plate 9, fig. 18

This bar is slightly arched along the posterior extension, but is sharply deflected at the cusp, forming a right angle. The main cusp is very long, stout, well rounded, and bluntly pointed. The denticles on both sides are similar to the cusp but they are about one-third the size and they vary somewhat as to length. The denticles farthest from the cusp are upright but the nearer they approach the cusp, the more they bend toward this great central tooth. A space a little less than the width of the denticles separates them.

Holotype.—Cat. No. 11444, U.S.N.M.

Genus BRYANTODUS Ulrich and Bassler, 1926

BRYANTODUS INEQUALIS, new species

Plate 10, figs. 1, 2

The bar is traversed for half its length by a median ridge. The other half is very flat, curling slightly at the end. A broad, short, sharply pointed, and slightly recurved cusp rises at an obtuse angle from the center of the bar. The cusp is about four times as broad as the denticles at its base. Posterior to the main cusp the denticles are short and slightly separated. On the anterior side the denticles are about twice this length, although they gradually become shorter as they approach the end of the bar. As the denticles become shorter they are at right angles with the bar, whereas the long ones near the cusp are noticeably curved toward that tooth.

The unequal size of the two sets of denticles marks this species.

Cotypes.—Cat. No. 11445, U.S.N.M.

BRYANTODUS INCLINATUS, new species

Plate 10, fig. 3

Tooth triangular in outline, consisting of a broad flat sharp pointed main cusp, inclined to the bar, followed posteriorly by at least 10 slender denticles diminishing in size toward the extremity and anteriorly by three or four similar denticles. All of the denticles are also blunt and are very much alike except in length. All are inclined with the main cusp.

The strong inclination of both main cusp and denticles characterize this species.

Holotype.—Cat. No. 11446, U.S.N.M.

BRYANTODUS GERMANUS, new species

Plate 10, fig. 5

The wide, almost flat bar is traversed for its entire length by a median line The upper and lower portions of the bar thus lie in two different planes. From the center of the upper half a broad angled and strongly recurved tooth rises. On the concave side of this cusp there is a broad, blunt denticle about as long as the cusp. The other denticles vary in length but are of the same general shape. On the other side of the cusp the denticles are longer, flatter, and very sharp pointed. Narrow but equal spaces separate all of the denticles.

Holotype.—Cat. No. 11447, U.S.N.M.

BRYANTODUS SUBANGULATUS, new species

Plate 10, fig. 6

This narrow bar is very strongly arched or angulated. On one side of the cusp the denticles are much shorter than those on the other side. All of the denticles become gradually shorter toward the ends of the bar.

Holotype.—Cat. No. 11448, U.S.N.M.

Genus EUPRIONIODINA Ulrich and Bassler, 1926

EUPRIONIODINA GERMANA, new species

Plate 10, fig. 7

The moderately arched bar is broad and angulated on one side of the cusp. On the other side it is stout but somewhat flat. Broad, heavy denticles rise from the long side of the bar. The terminal denticle is about as broad as any two of the others. All of the denticles are separated by very narrow spaces. There is a wide space on each side of the cusp which is round, very thick, and slightly extended below the bar. On the short side of the bar the denticles are thinner than the others but they are quite substantial looking. They are short and widely spaced.

Holotype.—Cat. No. 11449, U.S.N.M.

Genus DIPLODODELLA Ulrich and Bassler, 1926

DIPLODODELLA BILATERALIS Ulrich and Bassler, 1926

Plate 10, fig. 8

1926. *Diplododella bilateralis* Ulrich and Bassler, Proc. U. S. Nat. Mus., vol. 68, p. 41, text, fig. 21.

The short, narrow, blunt cusp rises from the center of a strongly arched bar, both sides of which are about equal in length. The median ridge, extending the whole length of the bar, divides the bar into two parts which lie in different planes. Beneath the cusp there is a small concave depression. The denticles, which are alike on both sides of the cusp, seem to rise from the median ridge rather than from the edge of the bar. Spaces wider than the denticles separate them. The denticles themselves vary in size; the nearer the ends of the bar, the smaller and thinner they become.

Holotype.—Cat. No. 11306, U.S.N.M.

Genus HIBBARDELLA Ulrich and Bassler, 1926

HIBBARDELLA CURVATA, new species

Plate 10, fig. 9

This is a tiaralike tooth. There are five short, thick denticles with blunt points on each side of a narrow but very robust bar. Very wide spaces separate the denticles. The crownlike appearance is helped by the curved contour of the strongly arched bar. The blunt-pointed cusp is very wide, thick, and long.

Holotype.—Cat. No. 11450, U.S.N.M.

Genus PALMATODELLA Ulrich and Bassler, 1926

PALMATODELLA DELICATULA Ulrich and Bassler, 1926

Plate 10, fig. 10

1926. *Palmatodella delicatula* Ulrich and Bassler, Proc. U. S. Nat. Mus., vol. 68, p. 4, pl. 10, fig. 5, text fig. 20.

This sharply arched bar is distinctly divided into two parts. On one side of the long, angular cusp which has its origin in the peak of the bar, the round, thick bar bears a number of short, sharp-pointed and well-separated denticles. The other side has the appearance of a flat, finely serrated palm leaf. Here the denticles gradually diminish in length from the very long one next to the cusp to the one at the end of the bar which is so minute as to be hardly distinguished from the bar itself. Spaces about the width of very fine hairs separate these denticles.

Holotype.—Cat. No. 11307, U.S.N.M.

Genus SYNPRIONIODINA Ulrich and Bassler, 1926

SYNPRIONIODINA ALTERNATA Ulrich and Bassler, 1926

Plate 10, figs. 11, 12

1926. *Synprioniodina alternata* Ulrich and Bassler, Proc. U. S. Nat. Mus., vol. 68, p. 42, text, fig. 22.

Both of these specimens exhibit the interior sides of two opposite plates. The long, stout cusp, tapering to a very blunt point, divides the bar into two unequal parts. The denticles are merely indicated on the short side of the sharply arched bar. The long side bears a number of long, needlelike denticles. In some places the relatively wide spaces between the denticles are filled with very fine denticles. In Figure 11 the denticles are much longer than those in Figure 12.

Holotype and plesiotype.—Cat. No. 11308, U.S.N.M.

SYNPRIONIODINA PLANA, new species

Plate 10, fig. 13

The bar is very broad, flat, and strongly arched. A median ridge divides the bar into two parts. The cusp is flat, very wide, and tapers a little toward a rather wide, blunt point. It is about twice the length of the other denticles, which are similar in shape. The spaces become wider as both ends of the bar are approached. All of the denticles are set at right angles to the bar, which is very long on the steeper side of the arch. This specimen, as well as several others the bars of which are divided by the median ridge, gives one the impression of being one of a series, set in a jaw, as the shark's teeth are.

Holotype.—Cat. No. 11451, U.S.N.M.

Family POLYGNATHIDAE Ulrich and Bassler, 1926

Genus PANDERODELLA Ulrich and Bassler, 1926

PANDERODELLA RECTA, new species

Plate 10, fig. 14

Our figure shows the convex side of the plate or tooth, the bar of which is very flat and broad. The cusp, which is scarcely different from the other short, blunt pointed denticles, is moderately produced as a flange below the bar. These denticles are all widely separated. The terminal tooth of the long side helps to form a convex end to the bar.

Holotype.—Cat. No. 11452, U.S.N.M.

PANDERODELLA SUBRECTA, new species

Plate 10, fig. 15

This specimen is a modification of *Panderodella recta.* The deflection of the bar is more noticeable. The denticles on the long side of the bar are short, spear-shaped, and evenly spaced. Those on the deflected side are needlelike.

Holotype.—Cat. No. 11453, U.S.N.M.

Genus POLYGNATHUS (Hinde) Bryant, 1921

POLYGNATHUS GYRATILINEATUS, new species

Plate 11, figs. 1, 2

Plate an irregular polygon with the tubercules united so as to form parallel ridges extending in concentric lines from one side of the median ridge to a place on the other side directly opposite the point of origin. The median ridge, which is slightly flexed to the right and to the left, is produced beyond the plate into a carina bearing denticles.

Cotypes.—Cat. No. 11454, U.S.N.M.

POLYGNATHUS PERGYRATUS, new species

Plate 11, fig. 3

This species is very similar to *Polygnathus gyratilineatus* but the lines are much closer together. The posterior end of the plate is produced into a carina as usual in this type of species.

Holotype.—Cat. No. 11455, U.S.N.M.

POLYGNATHUS TRILOBATUS, new species

Plate 11, fig. 4

As its name indicates this is a distinctly three-lobed plate. The anterior lobe is long and narrow, while the lateral lobes sweep in broad lines from the anterior lobe to the carina. A low median ridge rises in the middle of the anterior lobe becoming flattened towards the top but gradually narrowing posteriorly until it is produced beyond the plate into a broad carina, bearing denticles. The tubercules of the basal portion are stronger and more concentrically arranged than in *Polygnathus concentricus.* The tubercules of the anterior lobe extend from side to side across the top of the median ridge.

Holotype.—Cat. No. 11456, U.S.N.M.

POLYGNATHUS CONCENTRICUS Ulrich and Bassler, 1926

Plate 11, figs. 5–7

1926. *Polygnathus concentricus* Ulrich and Bassler, Proc. U. S. Nat. Mus., vol 68, p. 47, pl. 8, figs. 6, 7.

The plate is roughly triangular, having three well-defined lobes. The rounded lateral lobes gradually disappear into the sides of the sharp-pointed anterior lobe by means of a shallow, curving indentation. The plate is slightly depressed toward the posterior end but elevated in the anterior lobe. The median ridge, which is low but sharp in the posterior end, extends the entire length of the plate and in the anterior lobe becomes broad, being produced beyond the plate by a carina bearing several round, compressed denticles. Both the median ridge and the carina are somewhat sinuous in their courses. Short tubercules are concentrically arranged in the lobes. In the anterior lobe, where they cross the median ridge, they are so closely spaced as to appear as continuous lines. Compared with *Polygnathus trilobatus*, this species differs in its more finely marked basal portion and in the extension of the median ridge to the anterior extremity.

Plesiotypes.—Cat. No. 11457, U.S.N.M.

POLYGNATHUS RHOMBOIDEUS Ulrich and Bassler

Plate 11, figs. 11, 12

1926. *Polygnathus rhomboideus* Ulrich and Bassler, Proc. U. S. Nat. Mus., vol. 68, p. 46, pl. 7, fig. 6.

Plate rhomboidal in shape. Posterior lobe long and narrow. Lateral lobes slightly broader and somewhat rounded. The median ridge which extends the length of the plate is extended beyond the plate by a short, narrow carina, bearing several denticles, varying in shape and size. These denticles are extensions of those borne on the median ridge. In the anterior end of the plate the ridge is traversed by tubercules concentrically arranged but terminating abruptly at the ill-defined base of the ridge. Parallel rows of denticles extend from the anterior lobe to the origin of the carina, where they turn at a sharp angle and terminate in the margin of the lateral lobes.

The rhomboidal shape, less conspicuous transverse ribs, fewer rows of tubercules, and their more longitudinal arrangement, distinguish this species from its allies such as *Polygnathus concentricus*.

Plesiotypes.—Cat. No. 11456, U.S.N.M.

POLYGNATHUS PENNATULOIDEA, new species

Plate 11, fig. 14

This species is somewhat similar to *Polygnathus pennatulus* Ulrich and Bassler. The high median ridge is surmounted by numerous tubercules. It extends the whole length of the plate, beyond which it is produced by means of a long, robust carina, bearing several large denticles. The tubercules on the plate are arranged in less definite order than in *P. pennatulus*.

Holotype.—Cat. No. 11, 461, U.S.N.M.

POLYGNATHUS PENNATULUS Ulrich and Bassler

Plate 11, fig. 15

1926. *Polygnathus pennatulus* ULRICH and BASSLER, Proc. U. S. Nat. Mus., vol. 68, p. 45, pl. 7, fig. 8; pl. 9, figs. 24, 25.

The narrow median ridge which bears denticles throughout its length extends from the anterior end of the plate to the carina, which is slightly deflected. Several stout denticles are borne on the carina. The tubercules on both sides of the plate occur in short parallel lines extending from the margin to a depression at the base of the ridge.

Plesiotype.—No. 11, 462, U.S.N.M.

Genus PALMATOLEPIS Ulrich and Bassler, 1926

PALMATOLEPIS INEQUALIS, new species

Plate 11, figs. 8–10

This plate is divided into three parts by the unequal bifurcations of the median ridge. The main part of the ridge which is produced beyond the plate by a short, blunt carina, is broad and stout. The branches which are thin and high bear six or seven denticles. The short, blunt tubercules on each section of the plate are generally arranged at right angles to the main ridge or its branches. Figure 10 is the under surface of plate with the same bifurcated ridges but without ornament.

Cotypes.—Cat. No. 11, 458, U.S.N.M.

PALMATOLEPIS ELONGATA, new species

Plate 11, fig. 13

This is a long, narrow, minute plate with the finely denticulated median ridge extending its whole length. The ridge is very low at the anterior end but rises toward the posterior end where it becomes high and broad. On one side of the plate there is a short, pointed lobe. The relative smoothness of the surface serves to distinguish this species from *Palmatolepis perlobata* Ulrich and Bassler to which it is related.

Holotype.—Cat. No. 11, 460, U.S.N.M.

PALMATOLEPIS PERLOBATUS Ulrich and Bassler

Plate 11, figs. 16–19

1926. *Palmatolepis perlobatus* Ulrich and Bassler, Proc. U. S. Nat. Mus., vol. 68, p. 49, pl. 7, figs. 19–23.

Plate irregularly diamond shaped, flexed either to the right or to the left in the posterior portion. The ridge extends the whole length of the plate and is slightly produced beyond by a short, thick carina. The anterior portion of the ridge is indicated by a low, narrow line. From a central prominence the ridge thickens toward the carina. One side, which is rounded, extends slightly beyond the center. The other side which is produced in the central region by an angular lobe extends almost the entire length of the median ridge but becomes gradually narrower as it approaches the carina. In the anterior lobe the short, blunt tubercules converge toward the central prominence. This in the posterior half of the plate are at right angles to the central ridge.

Plesiotype.—Cat. No. 11, 463, U.S.N.M.

EXPLANATION OF PLATES

Plate 1

All of the figures on this and the following seven plates are copied from the authors cited. The magnification was often not stated but it lies usually between 10 and 20 diameters.

Fig. 1. *Distacodus (Machairodus) angustus* Pander, 1856.
2. *Distacodus (Machairodus) canaliculatus* Pander, 1856.
3, 4. *Distacodus (Machairodus) dilatatus* Pander, 1856.
5–9. *Distacodus (Machairodus) ensiformis* Pander, 1856.
10. *Distacodus (Machairodus) inaequalis* Pander, 1856.
11. *Distacodus (Machairodus) incurvus* Pander, 1856.
12. *Distacodus incurvus* (Pander) Hinde, 1879.
13. *Distacodus (Machairodus) planus* Pander, 1856.
14. *Distacodus (Machairodia) rhombeus* (Pander) Smith, 1907.
15. *Distacodus (Machairodia) sulcata* Smith, 1907.
16. *Belodus gracilis* Pander, 1856.
17. *Distacodus (Machairodus) rhomboideus* Pander, 1856.
18. *Distacodus (Machairodus) rhomboideus* Pander, 1856, var.
19. *Distacodus (Machairodus) solidus* Pander, 1856.
20. *Acodus acutus* Pander, 1856.
21, 22. *Acodus crassus* Pander, 1856.
23. *Acodus erectus* Pander, 1856.
24. *Acodus planus* Pander, 1856.
25. *Acodus sigmoideus* Pander, 1856.
26. *Acontiodus gracilis* Pander, 1856.
27. *Acontiodus latus* Pander, 1956.
28. *Acontiodus triangularis* Pander, 1856.
29. *Drepanodus acutus* Pander, 1856.
30–35. *Drepanodus arcuatus* Pander, 1856.
36, 37. *Drepanodus arcuatus* (Pander) Hinde, 1879.
38. *Drepanodus falcatus* Hadding, 1913.
39–41. *Drepanodus flexuosus* Pander, 1856.
42. *Drepanodus inflexus* Pander, 1856.

PLATE 2

FIG. 1. *Drepanodus flexuosus* (Pander) Smith, 1907.
2. *Drepanodus inflexus* Pander, 1856.
3. *Drepanodus obtusus* Pander, 1856.
4. *Drepanodus robustus* Hadding, 1913.
5. *Drepanodus verutus* Hadding, 1913.
6. *Scolopodus aequilateralis* Pander, 1856.
7. *Scolopodus costatus* Pander, 1856.
8. *Scolopodus quadratus* Pander, 1856.
9. *Scolopodus semicostatus* Pander, 1856.
10. *Scolopodus striatus* Pander, 1856.
11. *Scolopodus sublaevis* Pander, 1856.
12. *Oistodus parallelus* Pander, 1856.
13. *Oistodus inaequalis* Pander, 1856.
14. *Oistodus acuminatus* Pander, 1856.
15–17. *Oistodus lanceolatus* Pander, 1856.
18. *Paltodus bicostatus* Pander, 1856.
19. *Paltodus canaliculatus* Pander, 1856.
20, 21. *Paltodus rotundatus* Pander, 1856.
22–25. *Paltodus obtusus* Pander, 1856.
26. *Paltodus subaequalis* Pander, 1856.
27–29. *Paltodus truncatus* Pander, 1856.

PLATE 3

FIG. 1. *Prioniodus sulcatus* Pander, 1856.
2. *Prioniodus carinatus* Pander, 1856.
3. *Prioniodus alternans* Hadding, 1913.
4–6. *Prioniodus elegans* Pander, 1856.
7. *Prioniodus elegans* (Pander) Hinde, 1879.
8. *Prioniodus abbreviatus* Hinde, 1879.
9, 10. *Prioniodus armatus* Hinde, 1879.
11–13. *Prioniodus spicatus* Hinde, 1879.
14. *Prioniodus spicatus* Hinde, 1900.
15. *Prioniodus spicatus* (Hinde) Clarke, 1886.
16–19. *Prioniodus tulensis* Pander, 1856.
20–22. *Prioniodus tulensis* (Pander) Hinde, 1900.
23, 24. *Prioniodus equalis* Smith, 1907.
25. *Prioniodus inflatus* Smith, 1907.
26. *Prioniodus porcatus* Hinde, 1900.
27. *Prioniodus lelaps* T. H. Clark, 1924.
28, 29. *Prioniodus macconochii* Smith, 1907.
30. *Prioniodus tigris* T. H. Clark, 1924.
31. *Prioniodus pamphagus* T. H. Clark, 1924.
32. *Prioniodus complex* Hinde, 1900.
33. *Prioniodus dorcens* T. H. Clark, 1924.
34. *Prioniodus (Polygnathus) pauperatus* Smith, 1907.
35. *Prioniodus subcompactus* Smith, 1907.
36. *Prioniodus melampus* T. H. Clark, 1924.
37–39. *Prioniodus peracutus* Hinde, 1900.
40. *Prioniodus alatus* Hinde, 1879.

PLATE 4

FIG. 1. *Subprioniodus subserratus* Smith, 1907.
2. *Subprioniodus calcarus* Smith, 1907.
3–5. *Subprioniodus acutus* Smith, 1907.
6. *Subprioniodus crassus* Smith, 1907.
7. *Subprioniodus distans* Smith, 1907.
8. *Subprioniodus cringcampensis* Smith, 1907.
9. *Subprioniodus equalis* Smith, 1907.
10. *Subprioniodus falcatus* Smith, 1907.
11. *Subprioniodus furcatus* Smith, 1907.
12. *Subprioniodus fardingensis* Smith, 1907.
13. *Subprioniodus gibbosus* Smith, 1907.
14, 15. *Subprioniodus huntlawensis* Smith, 1907.
16. *Subprioniodus lanceolatus* Smith, 1907.
17. *Subprioniodus obliquo-lanceolatus* Smith, 1907.
18, 19. *Subprioniodus parvus* Smith, 1907.
20, 21. *Subprioniodus paucidentatus* Smith, 1907.
22. *Subprioniodus peracutus* Smith, 1907.
23–29. *Cordylodus angulatus* Pander, 1856.
30. *Cordylodus ramosus* Hadding, 1913.
31, 32. *Cordylodus rotundatus* Pander, 1856.
33. *Cornuramia bicornua* Smith, 1907.
34. *Cornuramia diplodonta* Smith, 1907.
35. *Cornuramia monodonta* Smith, 1907.
36. *Hindeodella* (*Polygnathus*) *dubius* (Hinde) Smith, 1907.
37, 38. *Hindeodella* (*Centrodus*) *duplicatus* Pander, 1856.
39. *Hindeodella* (*Centrodus*) *duplicatus* (Pander) Hinde, 1879.
40, 41. *Hindeodella* (*Centrodus*) *lineatus* (Pander) Hinde, 1879.
42. *Hindeodella* (*Centrodus*) *lineatus* Pander, 1856.
43. *Ligonodina* (*Prioniodus*) *panderi* Hinde, 1879.
44. *Prioniodus theron* T. H. Clark, 1924.

PLATE 5

FIGS. 1, 2. *Hindeodella* (*Ctenognathus*) *obliquus* Pander, 1856.
3–5. *Hindeodella* (*Ctenognathus*) *obliquus* (Pander) Hinde, 1879.
6. *Pachysomia wanlockensis* Smith, 1907.
7. *Lonchodina* (*Polygnathus*) *spinata* Hadding, 1913.
8. *Lonchodina* (*Prioniodus*) *erraticus* Hinde, 1879.
9. *Lonchodina* (*Prioniodus*) *clavatus* Hinde, 1879.
10. *Prioniodina* (*Prioniodus*) *geminus* Hinde, 1879.
11. *Prioniodina* (*Prioniodus*) *volborthii* Pander, 1856.
12. *Bryantodus* (*Polygnathus*) *radiatus* Hinde, 1879.
13. *Bryantodus* (*Polygnathus*) *duplicatus* Hinde, 1879.
14. *Bryantodus* (*Polygnathus*) *immersus* Hinde, 1879.
15, 16. *Bryantodus* (*Prioniodus*) *politus* Hinde, 1879.
17, 18. *Euprioniodina* (*Prioniodus*) *alata* Hadding, 1913.
19. *Euprioniodina* (*Prioniodus*) *discedens* Hadding, 1913.
20, 21. *Euprioniodina* (*Prioniodus*) *acicularis* Hinde, 1879.
22. *Euprioniodina* (*Polygnathus*) *lanceolata* Smith, 1907.
23. *Euprioniodina* (*Prioniodus*) *furcata* Hinde, 1879.
24–29. *Euprioniodina* (*Prioniodus*) *radicans* Hinde, 1879.
30. *Euprioniodina* (*Prioniodus*) *curvata* Smith, 1907.
31. *Hibbardella* (*Prioniodus*) *angulatus* Hinde, 1879.
32, 33. *Hibbardella* (*Prioniodus*) *angulatus* Hinde, 1900.

PLATE 6

FIG. 1. *Lonchodus* (*Polygnathus*) *parvus* Smith, 1907.
2–5. *Lonchodus* (*Centrodus*) *simplex* Pander, 1856.
6. *Lonchodus* (*Centrodus*) *obliquus* Smith, 1907.
7–10. *Lonchodus* (*Centrodus*) *erectus* Smith, 1907.
11. *Lonchodus* (*Centrodus*) *convexus* Pander, 1856.
12–14. *Lonchodus* (*Polygnathus*) *convexus* (Pander) Hinde, 1900.
15. *Lonchodus* (*Centrodus*) *distans* Smith, 1907.
16. *Lonchodus* (*Polygnathus*) *princeps* Hinde, 1879.
17–20. *Lonchodus* (*Polygnathus*) *princeps* (Hinde) Smith, 1907.
21. *Lonchodus* (*Polygnathus*) *curvatus* Smith, 1907.
22. *Lonchodus* (*Polygnathus*) *coronatus* Hinde, 1879.
23. *Lonchodus* (*Polygnathus*) *minus* Smith, 1907.
24. *Valentia morrochensis* Smith, 1907.
25. *Panderodella* (*Polygnathus*) *solidus* Hinde, 1879.
26–28. *Panderodella* (*Polygnathus*) *scitulus* Hinde, 1900.
29, 30. *Panderodella* (*Polygnathus*) *serratus* Hinde, 1879.
31. *Gnathodus mosquensis* Pander, 1856.
32. *Gnathodus* (*Polygnathus*) *crassus* Hinde, 1879.
33. *Gnathodus* (*Polygnathus*) *curvatus* Hinde, 1879.
34, 35. *Prionognathus brandtii*, Pander, 1856.

PLATE 7

FIG. 1. *Gnathodus* (*Polygnathus*) *eriensis* Hinde, 1879. (Side view.)
2–4. *Polygnathus* (*Gnathodus*) *mosquensis* (Pander) Hinde, 1900.
5. *Polygnathus* ? *simplex* Hinde, 1879.
6. *Polygnathus cristatus* (Hinde) Clarke, 1885.
7. *Polygnathus cristatus* Hinde, 1879.
8, 9. *Polygnathus cristatus* Hinde (*Polygnathus dubius*, part), 1879.
10, 11. *Polygnathus pennatus* Hinde, 1879.
12. *Polygnathus pennatus* (Hinde) Clarke, 1885.
13. *Polygnathus argos* T. H. Clark, 1924.
14. *Polygnathus navicula* Hinde, 1900.
15, 16. *Polygnathus palmatus* Hinde, 1879.
17. *Palmatalepis* (*Polygnathus*) *punctatus* Hinde, 1879.
18, 19. *Polygnathus tuberculatus* Hinde, 1879.
20, 21. *Polygnathus truncatus* Hinde, 1879.
22. *Polygnathus linguiformis* Hinde, 1879.
23. *Ctenognathus murchisoni* Pander, 1856.
24. *Ctenognathus keyserlingii* Pander, 1856.
25–29. *Ctenognathus verneuilli* Pander, 1956.
30. *Synprioniodina* (*Polygnathus*) *nasutus* Hinde, 1879.

PLATE 8

FIG. 1. *Prioniodina* (*Polygnathus*) *dubius* (Hinde) Smith, 1900. A species of *Bryantodus*.
2–13. *Polygnathus dubius* Hinde, 1879. Devonian (probably Portage) western New York. Specimens of different genera as follows, referred to this species: 2, 4, *Bryantodus;* 3, *Prioniodina;* 5, 8, *Hindeodella;* 7, *Gnathodus* or *Polygnathus;* 6, 9, 11, 12, *Lonchodus* or undetermined; 13, *Lonchodina;*
14–32. *Polygnathus dubius* (Hinde) Clarke, 1885. Specimens from the Naples shale at Naples, Ontario County, N. Y., referred by Clark in 1885 to this species. Genera represented as follows: 14–16, 19, 21, 22, side views of *Polygnathus;* 17, 25, *Bryantodus;* 18, *Prionidodus;* 20, 23, 24, *Lonchodus;* 26–28, 31, *Hindeodella;* 30, *Polygnathellus;* 29, 32, *Euprioniodina.*

Plate 9

All the specimens illustrated here and on plates 9 and 10 are from the Chattanooga black shale of Lower Mississippian age at a locality 13 miles east of north of Huntsville, Ala. All are magnified 12 diameters.

Figs. 1, 2. *Prioniodus alabamensis*, new species.
3. *Prioniodus alatoides*, new species.
4. *Prioniodus cultratus* Ulrich and Bassler.
5. *Ligonodina parvula*, new species.
6, 7. *Hindeodella tenerrima*, new species.
8. *Hindeodella minutidens*, new species.
9. *Hindeodella germana*, new species.
10, 11. *Hindeodella subtilis* Ulrich and Bassler.
12. *Lonchodina irregularis*, new species.
13. *Lonchodina discreta* Ulrich and Bassler.
14. *Prioniodella arcuata*, new species.
15. *Prioniodella inutilis*, new species.
16, 17. *Prioniodina separans*, new species.
18. *Prioniodina undulata*, new species.

Plate 10

Chattanooga black shale 13 miles east of north of Huntsville, Ala. Magnified 12 diameters.

Figs. 1, 2. *Bryantodus inequalis*, new species.
3. *Bryantodus inclinatus*, new species.
4. *Bryantodus*, species.
5. *Bryantodus germanus*, new species.
6. *Bryantodus subangulatus*, new species.
7. *Euprioniodina germana*, new species.
8. *Diplododella bilateralis* Ulrich and Bassler.
9. *Hibbardella curvata*, new species.
10. *Palmatodella delicatula* Ulrich and Bassler.
11, 12. *Synprioniodina alternata* Ulrich and Bassler.
13. *Synprioniodina plana*, new species.
14. *Panderodella recta*, new species.
15. *Panderodella subrecta*, new species.

Plate 11

Chattanooga black shale, 13 miles east of north of Huntsville, Ala. Magnified 12 diameters.

Figs. 1, 2. *Polygnathus gyratilineatus*, new species.
3. *Polygnathus pergyratus*, new species.
4. *Polygnathus trilobatus*, new species.
5–7. *Polygnathus concentricus* Ulrich and Bassler.
8–10. *Palmatolepis inequalis*, new species.
11, 12. *Polygnathus rhomboideus* Ulrich and Bassler.
13. *Palmatolepis elongatus*, new species.
14. *Polygnathus pennatuloideus*, new species.
15. *Polygnathus pennatulus* Ulrich and Bassler.
16–19. *Palmatolepis perlobatus* Ulrich and Bassler.

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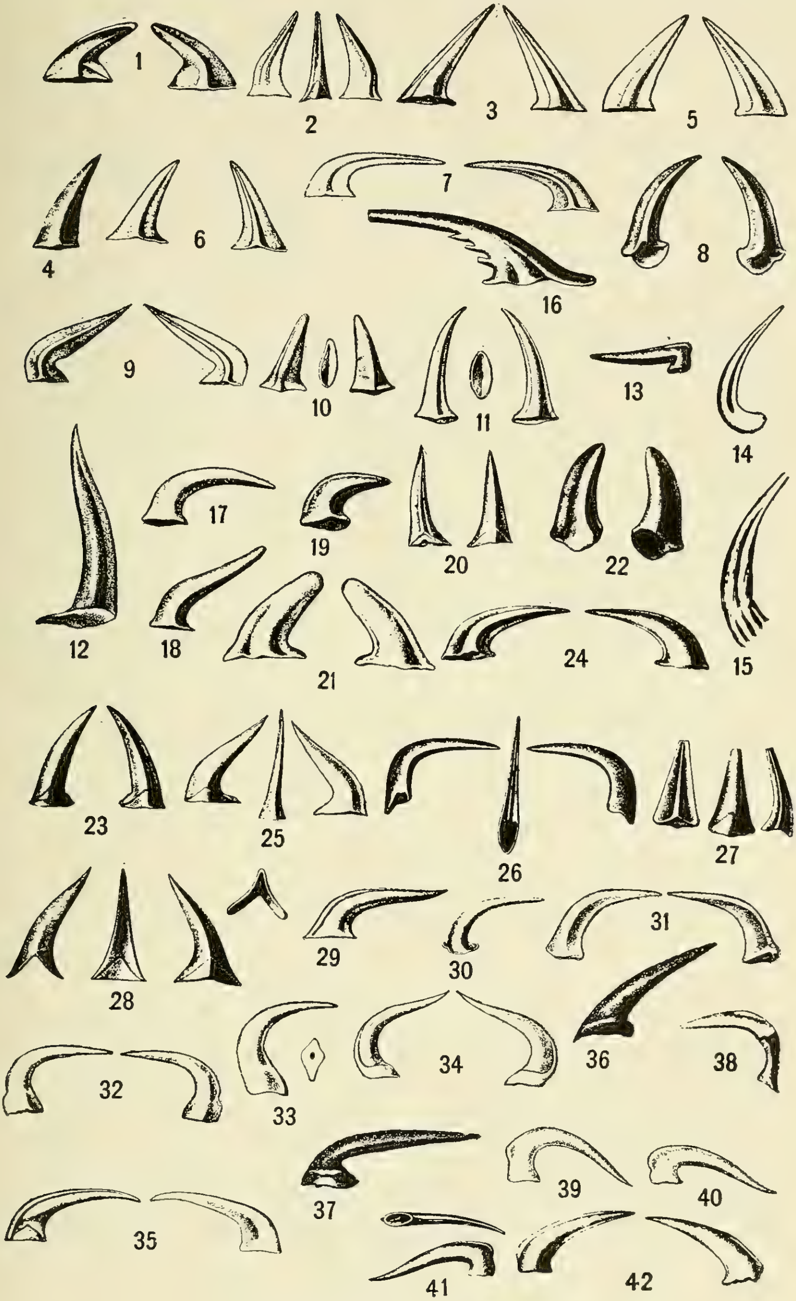
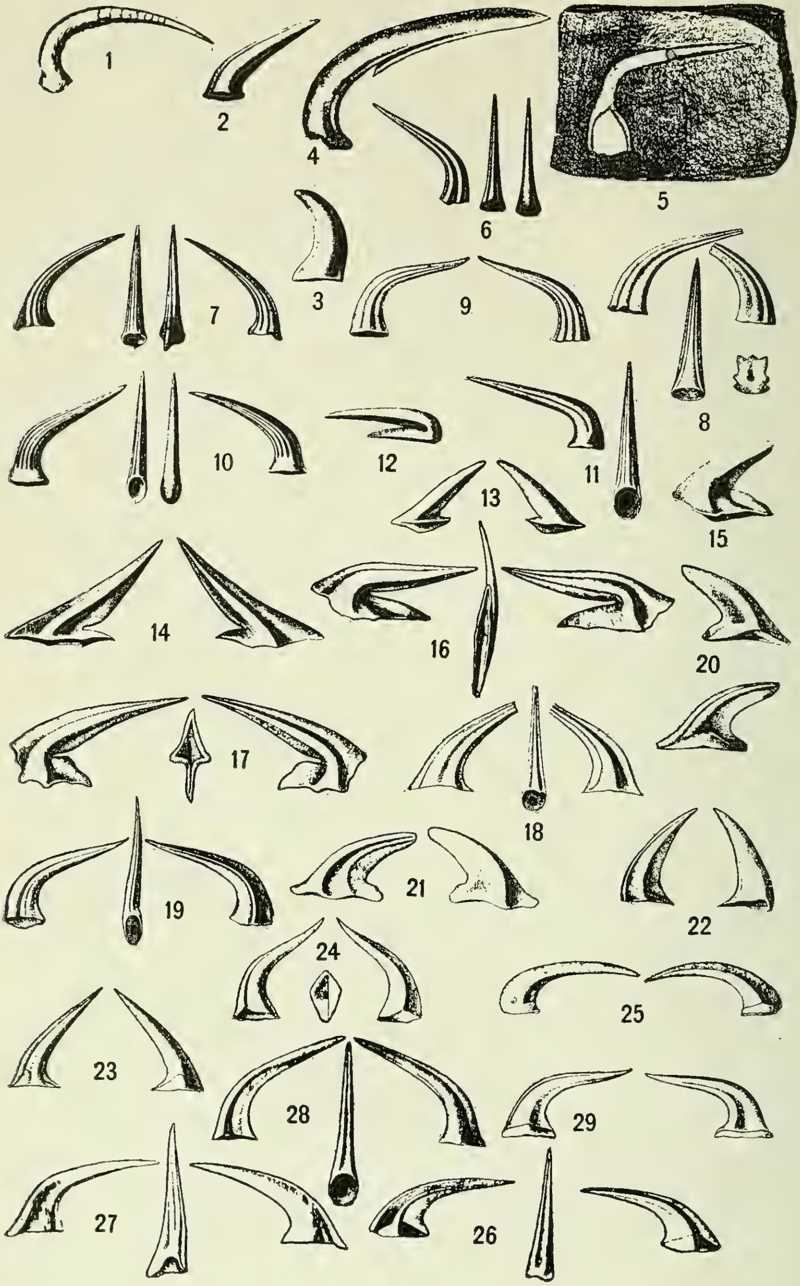


ILLUSTRATIONS OF CONODONTS

FOR EXPLANATION OF PLATE SEE PAGE 34



ILLUSTRATIONS OF CONODONTS

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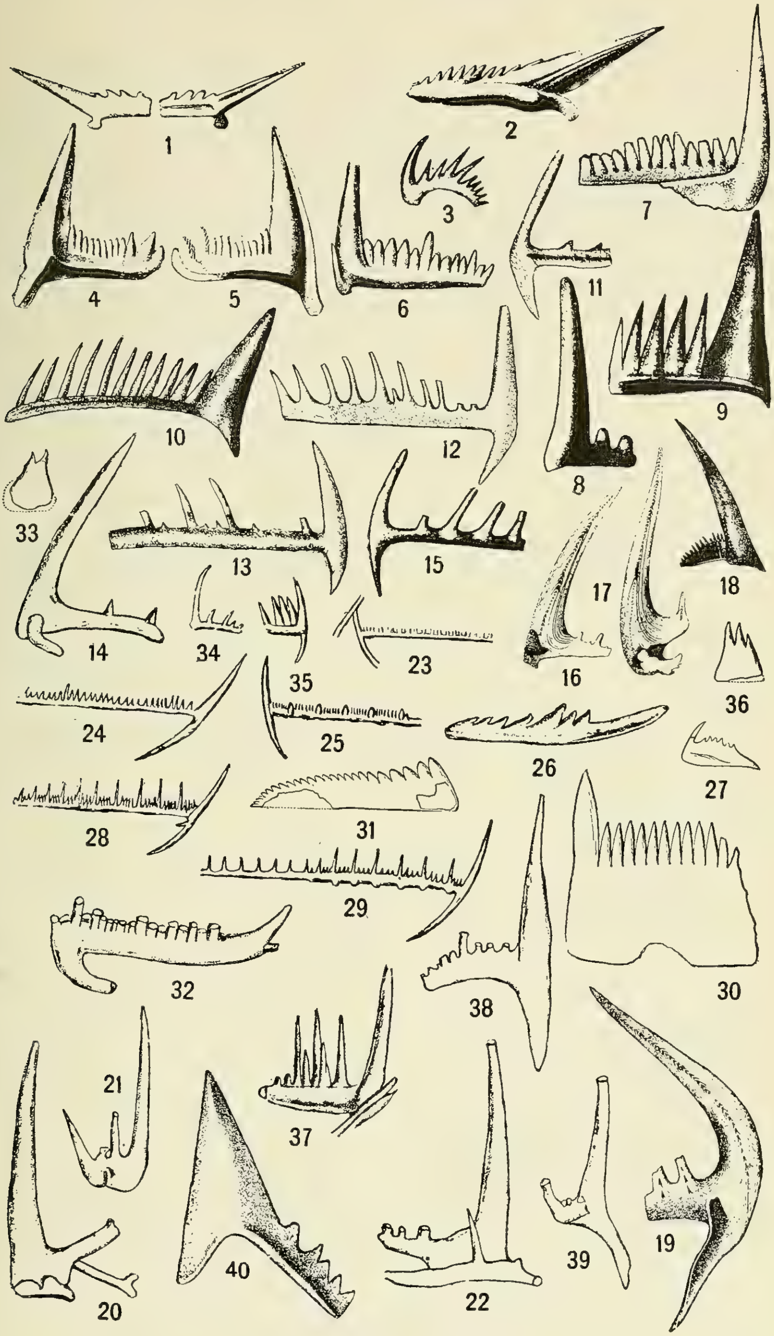

ILLUSTRATIONS OF CONODONTS

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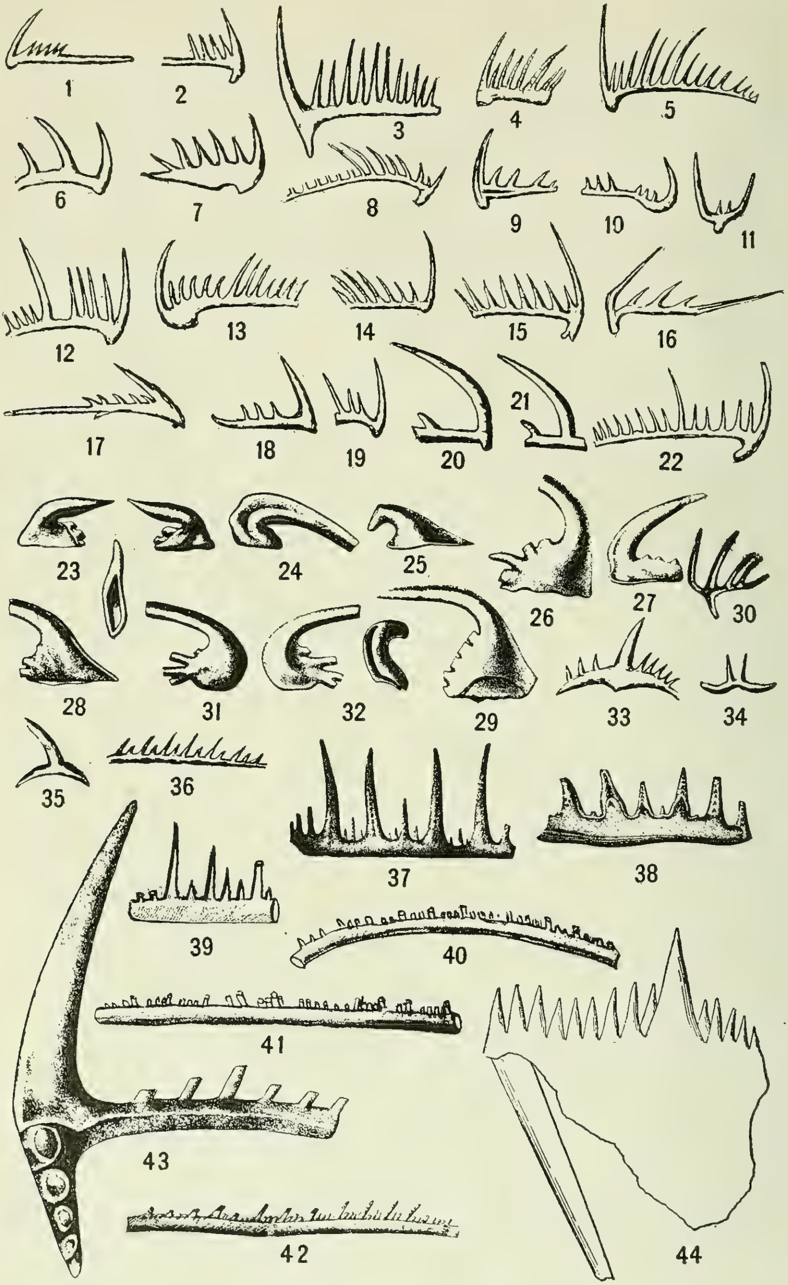
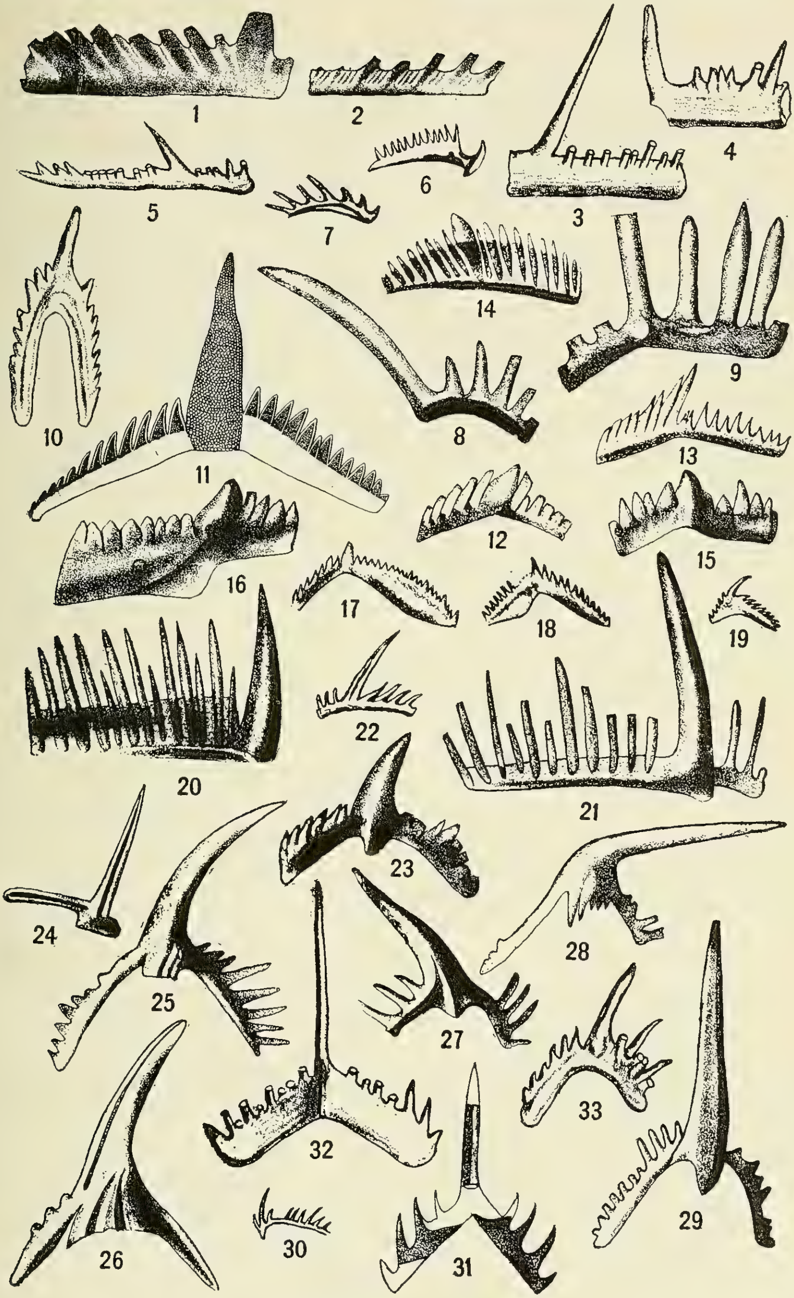


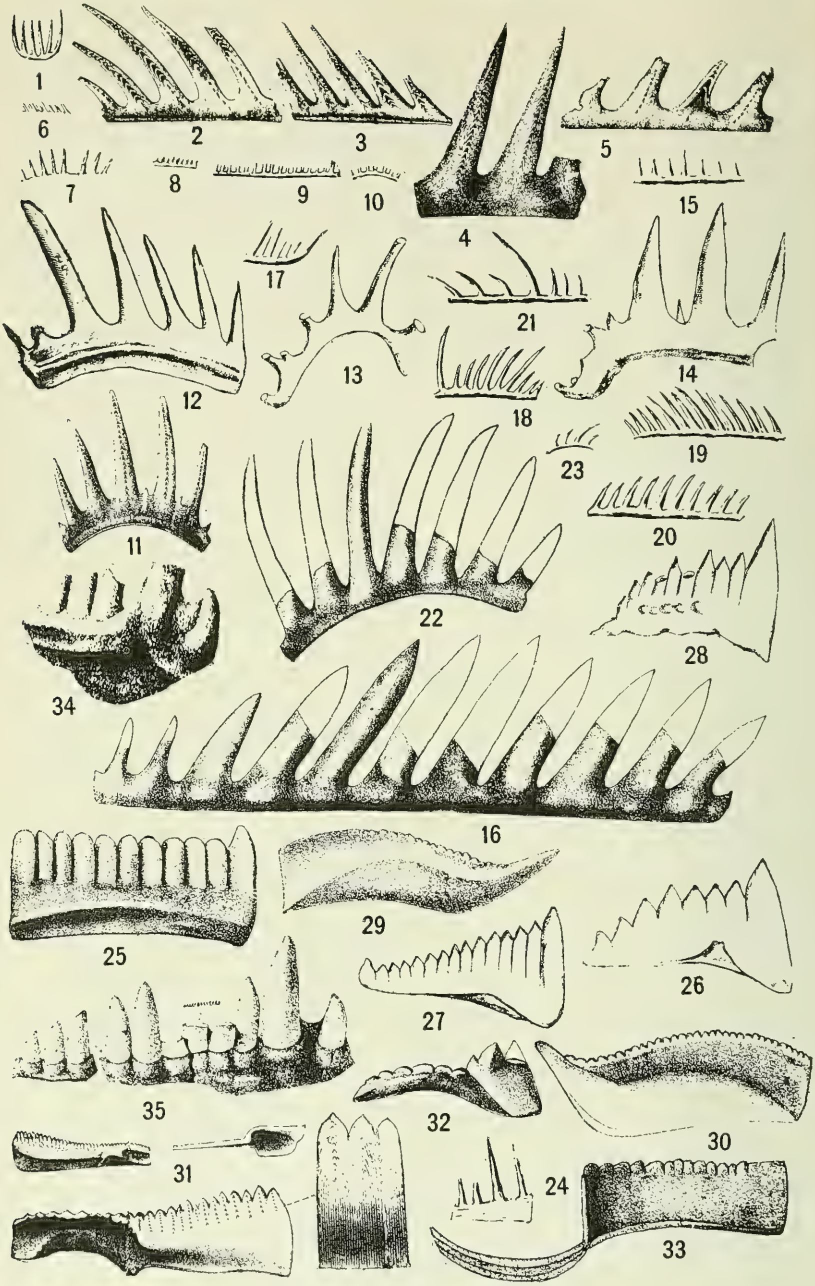
ILLUSTRATIONS OF CONODONTS

FOR EXPLANATION OF PLATE SEE PAGE 36



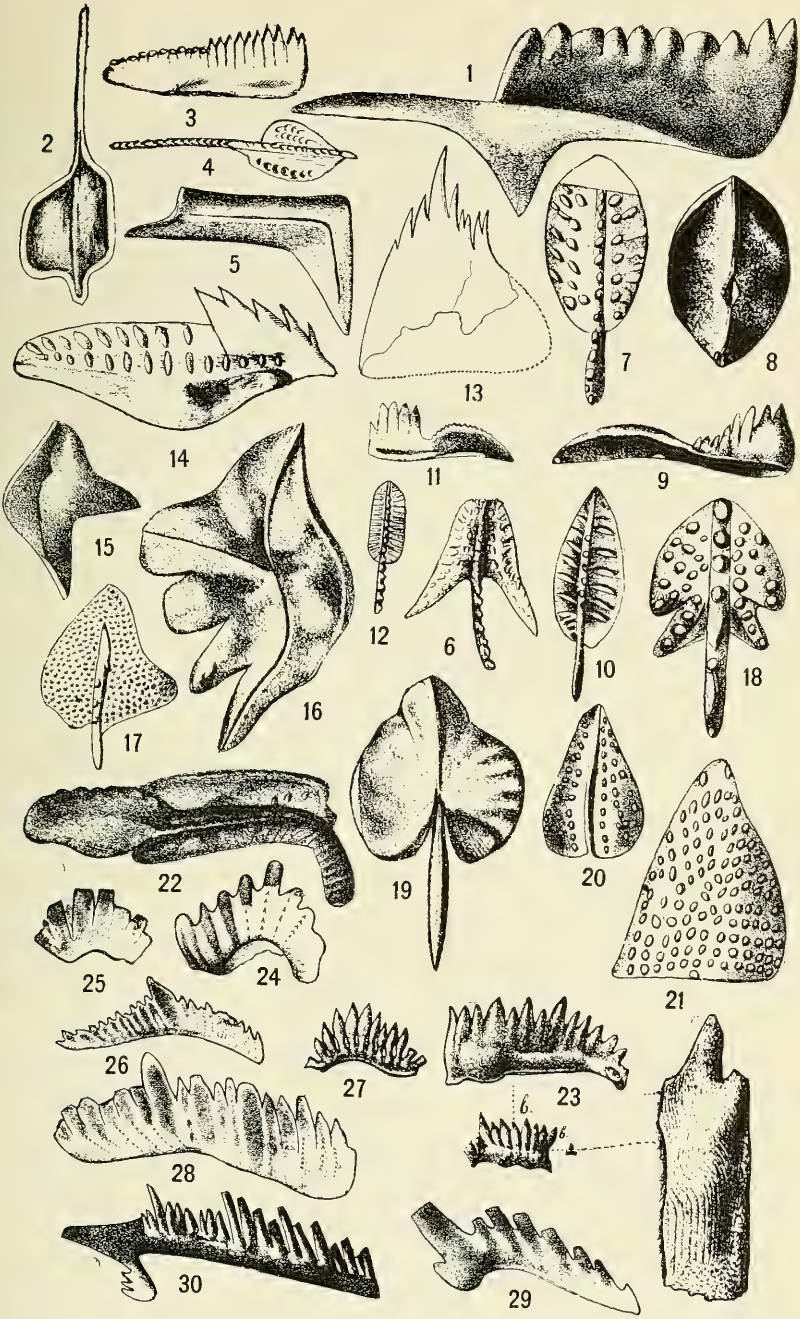
ILLUSTRATIONS OF CONODONTS

For explanation of plate see page 36



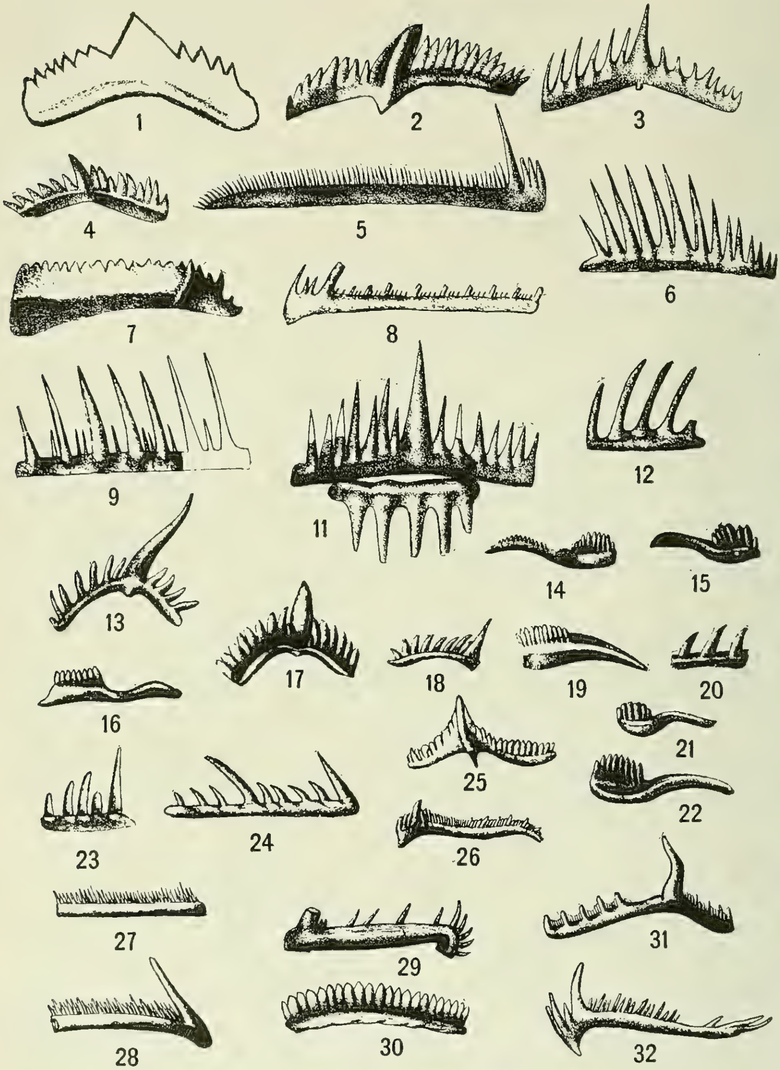
ILLUSTRATIONS OF CONODONTS

FOR EXPLANATION OF PLATE SEE PAGE 37



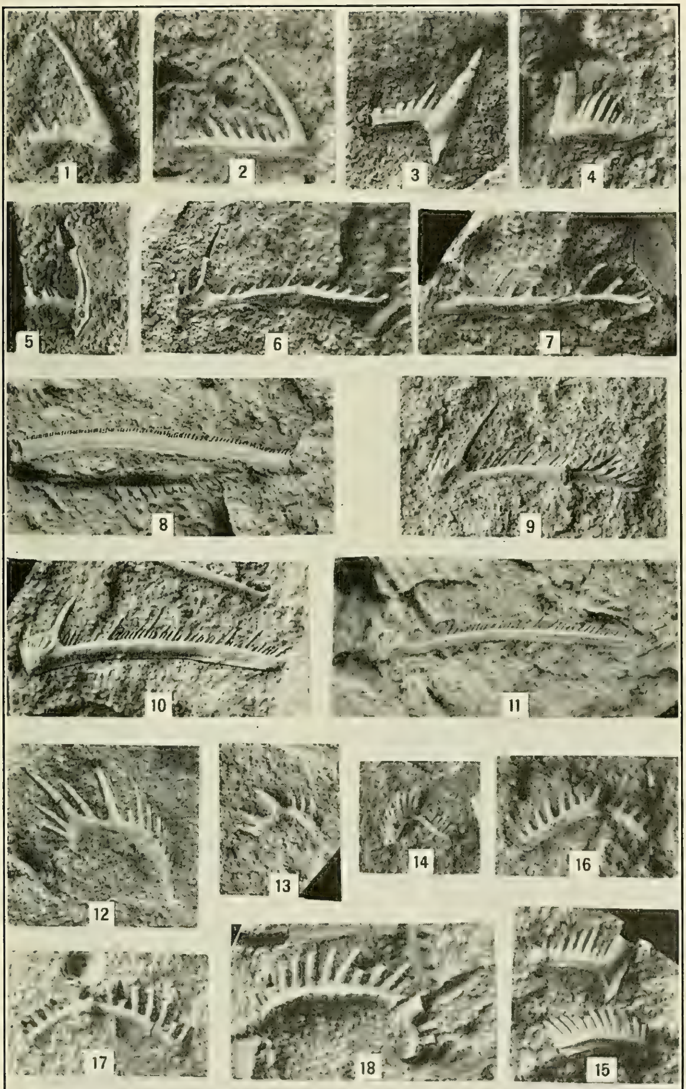
ILLUSTRATIONS OF CONODONTS

For explanation of plate see page 37



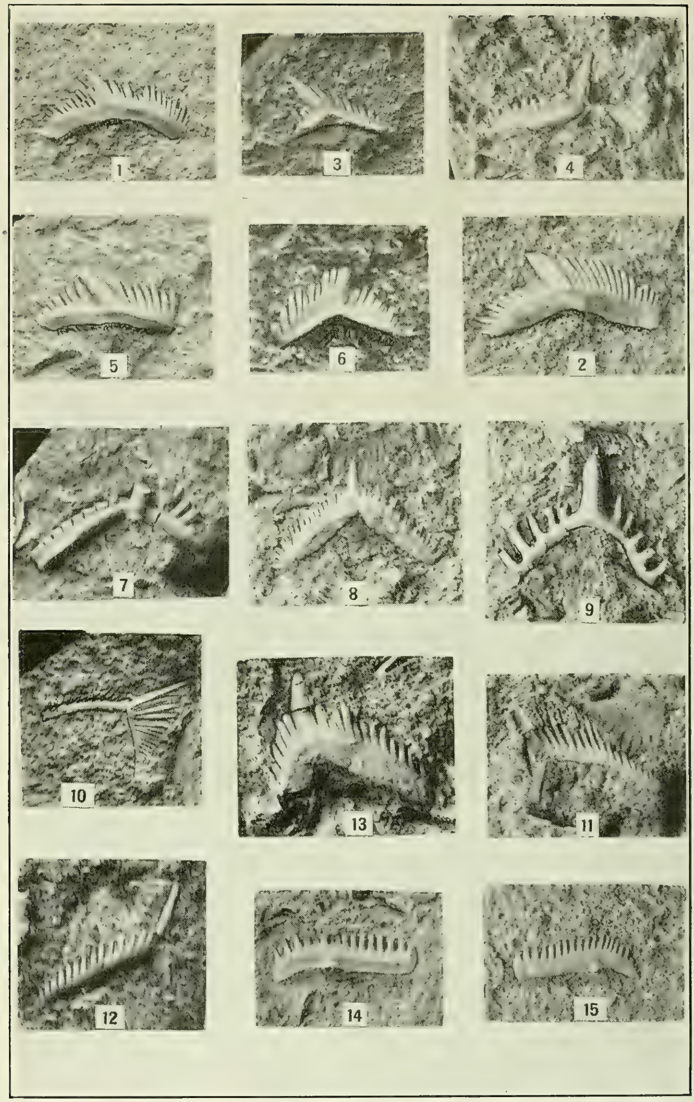
ILLUSTRATIONS OF CONODONTS

FOR EXPLANATION OF PLATE SEE PAGE 37



EARLY MISSISSIPPIAN CONODONTS

FOR EXPLANATION OF PLATE SEE PAGE 38



EARLY MISSISSIPPIAN CONODONTS

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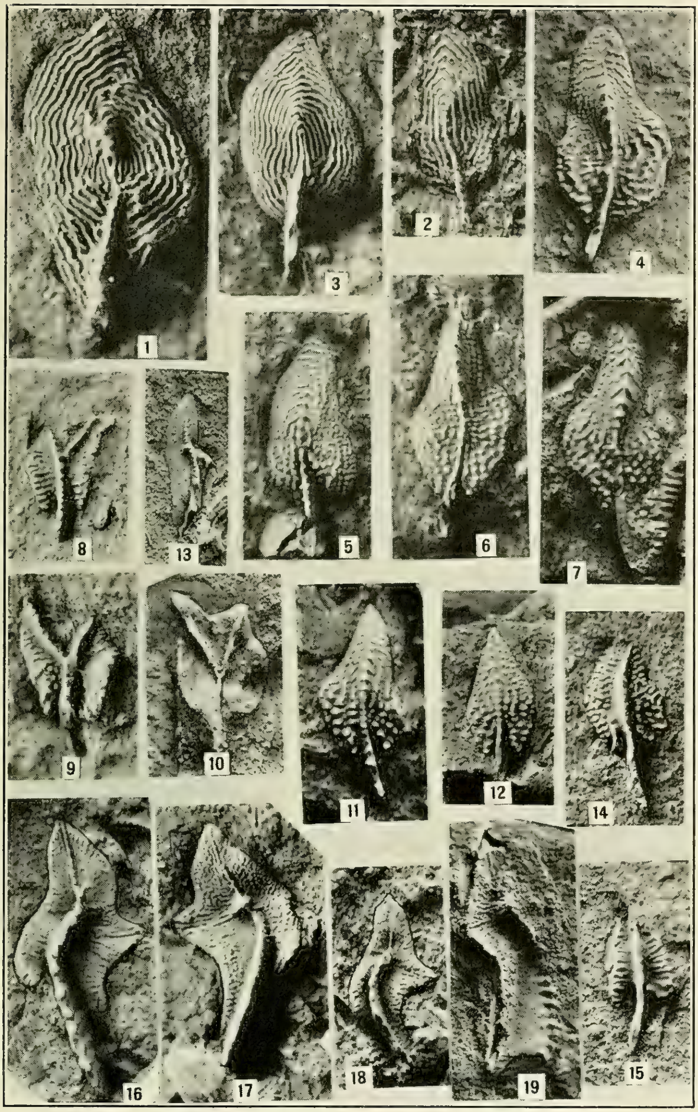

EARLY MISSISSIPPIAN CONODONTS

FOR EXPLANATION OF PLATE SEE PAGE 38

INSECTS OF THE SUBCLASS APTERYGOTA FROM CENTRAL AMERICA AND THE WEST INDIES

By J. W. Folsom

Of the United States Bureau of Entomology

This paper deals with the following forms:

Thysanura.

Lepidocampa zeteki, new species.
Gastrotheus lepismoideus Folsom.

Collembola.

Achorutes caecus, new species.
Pseudachorutes albipes, new species.
Folsomia fimetaria (Linnaeus) Tullberg.
Folsomia fimetaria (Linnaeus) Tullberg var. *dentata*, new variety.
Entomobrya cubensis, new species.
Lepidocyrtus usitatus, new species.
Lepidocyrtus nigrosetosus, new species.
Lepidocyrtus summersi MacGillivray.
Salina wolcotti, new species.
Cyphoderus inaequalis, new species.
Cyphoderus similis, new species.
Cyphoderus pinnatus Folsom.

Though all these forms are of interest because almost nothing has been published on the apterygotan fauna of Central America and the West Indies, some of them are of special interest for other reasons. Thus, *Lepidocampa* is a little known genus of generalized structure, being essentially a *Campodea* with scales. Four species of this paper are termitophilous. Three are cavernicolous. Two of the new species, occurring on sugar cane, may be of economic importance.

Eight species were collected by J. Zetek and I. Molino, of the Bureau of Entomology. Three forms were received from the Federal Horticultural Board, by whose inspectors they had been intercepted. Two species were collected in Porto Rico by G. N. Wolcott, entomologist. The termitophilous species were transmitted to the writer by Dr. T. E. Snyder, of the Bureau of Entomology.

Syntypes have been deposited in the United States National Museum, Washington, D. C.

THYSANURA

Genus LEPIDOCAMPA Oudemans

The rare genus *Lepidocampa* is of special interest on account of its resemblance to *Campodea.* It differs from *Campodea* chiefly in having scales; also in the imperfect segmentation of the cerci, and the presence of peculiar fringed pulvilli. In most respects, however, the two genera agree anatomically, except as regards minute details of structure.

The genus was founded by Oudemans ('90) for *L. weberi*, a species from the East Indies. The diagnosis of this species is, by the way, inadequate, being almost entirely generic rather than specific. The same species has been reported by Silvestri ('98, '99) from Argentina, Paraguay, Brazil, and Ecuador; but he finds that to decide whether the species from South America is actually the same as that from the East Indies will require a minute examination of material from both regions.

Silvestri ('16, '18) afterward recorded *L. weberi* from Ceylon, Sumatra, British East Africa, and German East Africa.

Carpenter ('16) described *L. fimbriatipes* from the Seychelles Islands, properly preferring to hold the species as distinct, for the present. His paper has been very useful in the writer's study of the morphology of *Lepidocampa.*

LEPIDOCAMPA ZETEKI, new species

Plates 1–3, figs. 1–30

White. Campodeiform (fig. 1). Body clothed with scales.

Head.—The Y-shaped epicranial suture is conspicuous. Eyes absent. Antennae a little more than half as long as the head and body, moniliform. The number of antennal segments found was as follows: One male, 27; four females, 22, 25, 27, 27, respectively; sex unknown, 27, 30, 26. Segments mostly cup-shaped; first two segments short and broad (fig. 2); terminal segment (fig. 3) only one-fifth or one-fourth longer than the penultimate segment, ovate or oval. Segments 4–7, inclusive, each bear a dorsal pair of bothriotricha (fig. 2), which are extremely long, delicate, fringed threads. Segments 5 and 6 each bear, in addition, a ventral or ventro-lateral bothriotrix.

Mouth-parts.—The *labrum* (fig. 4) bears antero-entally a pair of chitinous subtriangular toothed appendages ("unciform processes" of Silvestri).

The head of the mandible (figs. 5, 6) does not have the series of parallel ridges forming a molar area as described by Carpenter, but bears instead three teeth on one mandible and two on the opposite mandible.

The *lacinia* of the mandible also differs from that of Carpenter's species, being palmately cleft (figs. 5, 6), some of the slender tapering primary lobes bearing secondary teeth.

The *galea* of the maxilla (fig. 7) bears an anterior subclavate sensilla, mentioned by Carpenter. The *lacinia* is as in Figure 8. The lingua (fig. 9) is rounded anteriorly, with serrate antero-lateral margins. The *superlinguae* (*maxillulae*) are not subtriangular as in *fimbriatipes*, but are (fig. 9) rounded with the mesal margin anteriorly serrate, the teeth becoming successively smaller posteriorly. Each superlingua bears meso-basally a fingerlike lacinial lobe (fig. 9). The *palpus* of the *labium* bears an anterior sensory papilla, as in Figure 10.

Legs.—The *tibia* has an apical pair of stout, fringed, articulated spurs (fig. 11). The fringed *pulvilli* (fig. 12) are essentially like those described by Oudemans and by Carpenter, and quite unlike those figured by Silvestri.

Styli.—Styli are present on the first seven abdominal segments. Those of the first urosternum differ in form from the others, being (figs. 13, 14) stout, scarcely tapering, blunt, clothed throughout with setae, and ending in several spiniferous papillae. In the female (fig. 13) there are two simple setae on the mesal side of the base of the stylus. In the male (fig. 14) the stylus is relatively shorter than in the female, and the posterior region of the sternum is thickly clothed with setae; while the posterior border bears two rows of spiniferous papillae. The styli of the remaining segments (fig. 15) are elongate and tapering, each with 5 or 6 setae on the distal half, and a pair of strong spines, apical and subapical, respectively. *Exsertile vesicles* (fig. 15) are present on the second to the seventh abdominal segment, inclusive. The base of the vesicle is not, however, stiff and cylindrical like that of *fimbriatipes*.

Genitalia.—The external organs of reproduction pertain to the eighth abdominal segment. In the male (fig. 16) the eighth urosternum is prolonged posteriorly as a broad subtriangular lobe ending in a median rounded setigerous lobe; under the apical portion is the penis, composed of a pair of genital plates, described by Carpenter. In the female (fig. 17) the large sternal lobe terminates in a pair of blunt triangular lobes, each of which bears 4 or 5 setae; under these lobes is a pair of valves (fig. 18), each with 4 or 5 large setae.

Telson, cerci.—The telson (fig. 19) is subtriangular. The tenth sternum is divided posteriorly along the median line (figs. 20, 21). The anal valves are apparently not strongly developed in this species.

Only one intact cercus was present; this being one-third as long as the head and body. The segmentation of the cerci is not definite, but the transverse sutures shown in Figure 22 could be seen rather clearly.

Clothing.—Chaetotaxy is doubtless as important for the separation of species in this genus as it is in *Campodea.*

The macrochaetae are unilaterally fringed or feathered. The head bears numerous short simple setae. The lateral setae of the thoracic terga (fig. 23) are constant in form, size, and position. On most of the abdominal segments there are postero-dorsal setae, as in Figure 24; a little in advance of each postero-lateral angle are two macrochaetae.

Beside the base of each stylus is a lateral series of 5 setae (figs. 13, 15); on the mesal side, except on the first abdominal segment, are 6 setae in both sexes (fig. 15).

Near the posterior border of each of the first seven urosterna are two fringed setae, one on each side of the median line, in both sexes.

A comparison of the setal characters shows many differences between this species and *fimbriatipes.*

The thorax and abdomen are clothed densely with scales, dorsally and ventrally, but scales are almost absent on head, antennae, legs, and cerci. The scales (figs. 25–30) are variable in form and size, but are relatively large and mostly broad, with a comparatively few strong striae.

Maximum length of specimens: Male, 2.5 mm.; female, 2.8 mm.

Margarita Swamp, Canal Zone, June 28, 1923, with *Anoplotermes* species in termitarium in tree stump, J. Zetek and I. Molino (Z. 2154*b*).

Syntypes.—Cat. No. 40381, U.S.N.M.

Genus GASTROTHEUS Casey

GASTROTHEUS LEPISMOIDEUS (Folsom) [New combination]

Atelura lepismoidea FOLSOM, 1923.

Professor Silvestri has kindly informed me that this termitophilous species, which I described from British Guiana, belongs in the genus *Gastrotheus*, which he redescribed from one of the types.

Nine males and ten females, Rio Chinilla, Canal Zone, August 19, 1923, with *Nasutitermes ephratae* Holmgren, J. Zetek, collector (Z. 2214).

COLLEMBOLA

Genus ACHORUTES Templeton

ACHORUTES (SCHÖTTELLA) CAECUS, new species

Plate 4, figs. 31–38

White. Eyes absent. Postantennal organ (fig. 31) with commonly 6 (often 5, and rarely 4 or 7) peripheral tubercles in a rosette.

Accessory body ("Nebenkorper") absent. Antennae three-fourths as long as the head; segments as 10 : 10 : 13 : 13; third and fourth segments demarcated by a suture ventrally but not dorsally. Sense organ of third antennal segment (fig. 32) consisting of a single peg, resembling a short stout seta, with four accompanying setae. Fourth segment with a terminal sense organ (fig. 33) composed of three eversible vesicles; also with several distal curving slender olfactory setae, but little different from ordinary setae. Unguis (fig. 34) stout, curving; inner margin with a minute tooth one-third from the base on fore and mid claws, the tooth obscure or absent on hind claws; a pair of minute slender lateral teeth, one-third from the base, occurs on the first and second pairs of ungues, but is often obscure or absent on the third pair. Unguiculus absent. Tenent hairs absent. Anal spines absent; anal lobes rounded. Furcula extending as far as the ventral tube. Dentes (fig. 35) stout, with a few dorsal tubercles somewhat larger than those of the cuticula in general, and with 5 dorsal setae. Mucrones (figs. 35–37) two-fifths as long as dentes, bilamellate; outer lamella wider and more rounded than the inner lamella, with margin either entire or roughened; both lamellae ending before the apex of the mucro, which is rounded and not upturned. Rami of tenaculum tridentate; corpus without setae. Body setae (fig. 38) stout, slightly curving, of two sizes—large and small—both kinds distally, and mostly unilaterally, serrate. Length, 0.8 mm., occasionally 1 mm.

The number of tubercles in the postantennal organ was as follows, in eighteen specimens:

Right	Left	Right	Left
6	6	5	6
5	6	6	8
?	4	5	6
6	5	0	6
6	5	6	6
6	7	6	5
6	7	7	6
7	6	6	7
7	7	7	3

The types were selected from a large number of specimens, taken in limestone caves in bat dung, in company with two other species described in this paper.

Headwaters of Chilibrillo River, Canal Zone, September 29, 1923, J. Zetek and I. Molino, collectors.

Syntypes.—Cat. No. 40382, U.S.N.M.

Genus PSEUDACHORUTES Tullberg

PSEUDACHORUTES ALBIPES, new species

Plate 5, figs. 39–43

Dark blue dorsally and laterally (fig. 39); white mottled with pale blue ventrally. Dorsum with small spots and narrow lines of pale orange; integument marked off by pale orange lines into minute polygonal areas, indicating the hypodermis cells. Head blue, with white buccal cone. First two antennal segments blue; third white, mottled with blue basally and with narrow apical band; fourth white. Legs white, faintly pigmented on coxa, trochanter and femur. Manubrium mottled with blue and white; dentes white with a little pigment; mucrones white. Total length to width as 5:3. Eyes (fig. 40) 5+5. Antennae one-half longer than the head; segments as 3:4:3:8; fourth segment elongate-conical; suture between third and fourth segments absent dorsally, as usual. Unguis (fig. 41) with an inner tooth one-fourth from the base. Unguiculus absent. Tenent hairs absent. Dentes longer than manubrium (as 8:7), slightly narrowing, rounded apically, naked ventrally, with six dorsal setae. Mucrones (figs. 42, 43) three-eighths as long as dentes; outer and inner lamellae equal, terminating before the apex; apical lobe short, rounded. Cuticula tuberculate, almost naked. Length, 1.5 mm.

Margarita Swamp, Canal Zone, June 28, 1923, with *Eutermes exiguus* Hagen in termitarium near base of tree stump, J. Zetek and I. Molino, collectors (Z. 2151*a*).

Monotype.—Cat. No. 40383, U.S.N.M.

Genus FOLSOMIA Willem

FOLSOMIA FIMETARIA (Linnaeus) Tullberg

This well-known species of the soil fauna is already known to be cosmopolitan in distribution.

Specimens intercepted by the Federal Horticultural Board on shipments from Guatemala agree with typical *fimetaria* from Europe except in one particular. The femur and tibiotarsus have each an incomplete distal subsegment, the suture of which occurs only on the lower side of the leg; that is, the side which bears the unguiculus.

Collected on *Chamaedorea* species (pacaya or salad palm) from Coban, Guatemala, at Inspection House, Washington, D. C., by W. B. Wood and H. L. Sanford on January 29, 1920 (F. H. B. No. 29456).

Taken on roots of *Chamaedorea* species from Coban, Guatemala, at Inspection House, Washington, D. C., by H. L. Sanford, February 18, 1920 (F. H. B. No. 29598).

FOLSOMIA FIMETARIA (Linnaeus) Tullberg var. DENTATA, new variety

Plate 5, figs. 44, 45

This new variety agrees with typical *fimetaria* except as follows: Postantennal organ (fig. 44) subelliptical with a notch at the middle of the anterior margin (present occasionally in the typical form also); in length one-third of the basal width of the first antennal segment. Antennae subequal to head in length, with segments in relative lengths about as 3:5:4:7 or 2:4:3:5. Unguis (fig. 45) strongly unidentate at the middle of the inner margin. Furcula short, extending not beyond the middle of the second abdominal segment. Dentes longer than manubrium (as 4.5:4 or 5:4). Erect sensory setae of abdomen relatively short (two-fifths as long as the segment, on abdominal segment 1 and abdominal segment 2, respectively), and simple—not distally serrate. Length, 2 mm.

This variety *dentata* is close to var. *caldaria* Axelson, of Finland and Poland (Axelson, '05, p. 790; Linnaniemi, '12, p. 116; Stach, '21, p. 160), which also has an inner tooth on the unguis.

Taken in Irish potatoes from Vera Cruz, Mexico, intercepted at New Orleans, La., by W. T. Dillard, March 30, 1923 (Fed. Hort. Board, N. O. No. 281).

Syntypes.—Cat. No. 40384, U.S.N.M.

Genus ENTOMOBRYA Rondani

ENTOMOBRYA CUBENSIS, new species

Plate 6, figs. 46–50

White, rather scantily marked with blue (figs. 46, 47). Large specimens have often a yellowish tinge. The pigment is in the form of loose flecks, forming spots or clouds of indefinite form. Head with a little lateral pigment and a pair of spots or a transverse mark in front of the eyes. Prothorax feebly pigmented laterally; mesonotum and metanotum bordered laterally with pigment. First three abdominal segments each clouded with pigment laterally. Dorsum of fourth abdominal segment with an antero-lateral patch and an irregular posterior band; abd. 5 and 6 each with dorsal and lateral spots. Antennal segments white basally, blue apically. Legs white, excepting a distal spot or band on the femur and a spot or band before the middle of the tibia. In large yellowish specimens the femora are orange distally, and the tibiotarsi proximally. Furcula white. Eyes (fig. 48) 8+8, unequal, the two inner proximal being the smallest. Antennae twice as long as the head; second segment almost twice as long as the first, and a little longer than the third; fourth one and one-half to two times as long as the third. Unguis (fig. 49) almost straight, slender, with a pair of long sharp lateral teeth one-fourth from the base; a pair of strong inner teeth two-fifths from the base, and a pair of smaller teeth halfway between the first pair and the apex. Unguiculus lanceolate, extending three-fifths as far as the unguis. Tenent hair long and strong. Fourth abdominal segment from two and one-half to three and one-third times as long as the third. Furcula not attaining the ventral tube, extending a little beyond abd. 3. Dorsal crenulations of dens absent on the basal third, and ending at a distance from the apex equal to one and two-thirds the length of the mucro (fig. 50). Mucro short and stout, strongly rounded ventrally, falcate, with a single stout apical hook. Rami of tenaculum quadridentate; corpus with one long anterior seta. Feebly clavate fringed setae are numerous on the anterodorsal region of the head and on abd. 5 and 6. Short clavate fringed setae are present dorsally on the manubrium and the base of each dens. Length, 1.4 mm.

Taken on pineapple from Cuba, intercepted at New York City, April 22, May 6, May 14, 1924, by Inspectors I. Shiller, R. L. Trigg, A. C. Hill (Fed. Hort. Board, N. Y., Nos. 5034, 4227, 4232, 4278).

Taken in sugar cane from Tanamo, Cuba, intercepted at Philadelphia, Pa., June 15, 1924, by Mr. C. G. Albrecht (F. H. B., Phila. No. 2045).

Syntypes.—Cat. No. 40385, U.S.N.M.

Genus LEPIDOCYRTUS Bourlet

LEPIDOCYRTUS USITATUS, new species

Plate 6, figs. 51–54

White. In large specimens the head and body are minutely speckled with blue. Antennal segments with scattered blue pigment. Legs, excepting coxae, unpigmented. Furcula white. Mesonotum (fig. 51) not strongly projecting. Eyes (fig. 52) 8+8, unequal; the four proximal eyes smaller than the others, on each side. Antennae one-third longer than the head; second and third segments subequal and subclavate; fourth segment two and one-fourth to two and one-half times as long as the third. Unguis (fig. 53) slender, slightly curving, with a pair of lateral teeth one-fourth from the base; inner margin with a pair of teeth near the middle; other teeth absent. Unguiculus extending two-thirds as far as the unguis, on all the feet. Hind claws larger than the others. Tenent hair minutely knobbed, as long as unguiculus. Fourth abdominal segment four and one-half times as long as the third. Furcula attaining the ventral tube in large specimens, but not in small ones. Manubrium slightly shorter than dentes (as 10:11). Dorsal crenulations of dens ending at a distance from the apex equal to two and one-half times the length of the mucro. Mucro (fig. 54) comparatively elongate, with apical and anteapical teeth and long proximal spine. Length, 1 mm.

Headwaters of Chilibrillo River, Canal Zone, September 29, 1923, in limestone caves in bat dung, J. Zetek and I. Molino, collectors.

Dakota, Tela division, Honduras, May 20, 1923, T. H. Hubbell.

Syntypes.—Cat. No. 40386, U.S.N.M.

LEPIDOCYRTUS NIGROSETOSUS, new species

Plate 7, figs. 55–57

Body color, cream yellow. The scales, where present, form brown patches. Pigment purple, scanty. Mesonotum clouded with purple along the lateral border; metanotum feebly pigmented laterally; fourth urotergite with a little pigment at the postero-lateral angle and along the lateral border. The head bears dorsally a spot between the bases of the antennae, and a narrow curving line along each antennal base. First three antennal segments each yellow with purplish distal ring or cloud; fourth segment purplish. Legs yellow; precoxal segments weakly pigmented. Furcula yellow. Eyes (fig. 55) 8+8, the two inner proximal eyes of each side somewhat smaller. Antennae one-half longer than the head; segments as 4:7:8:13; first segment subcylindrical, second and third clavate-cylindrical, fourth elliptical. Mesonotum not strongly projecting over the head. Unguis (fig. 56) with a pair of lateral teeth; inner margin with a proximal pair of teeth two-fifths from the base, and a smaller distal tooth midway between the proximal pair and the apex. Unguiculus extending three-fifths as far as the unguis, lanceolate-oblong, acuminate, untoothed. Tenent hair a little shorter than the unguis. Fourth abdominal segment four to six times as long as the third. Furcula not attaining the ventral tube; extending a little beyond abd. 3. Dorsal surface of dens denticulate in profile, the teeth continuing along the mucro as far as the proximal spine. Mucro (fig. 57) comparatively elongate; apical and anteapical teeth subequal; proximal spine present, long, acicular. Most of the setae are dark colored; these blackish fringed setae are particularly conspicuous on the antennae, oral region, lateral borders of mesonotum and metanotum, and on abd. 5 and 6. Length, 1.6 mm.

Manati, P. R., April 30, 1924, on wet dead leaves of "jaguey" (*Ficus laevigata*) on the ground, G. N. Wolcott, collector.

Syntypes.—Cat. No. 40387, U.S.N.M.

LEPIDOCYRTUS SUMMERSI (MacGillivray) [New combination]

Strongylonotus summersii MacGillivray, 1894

Plate 7, figs. 58–60.

White, marked with purplish (fig. 58). Second and third abdominal segments each bordered posteriorly with purplish; abd. 4 with a broad irregular posterior band, in width about one-third of the length of the segment; or with large spots in place of a band. Ant. 3 with a basal and an apical spot; ant. 4 dull purplish except basally. Fore tibiotarsi with a little pigment proximally and considerable pigment distally; mid legs unpigmented; hind trochanters slightly pigmented; hind femora purplish except apically. Ventral tube unpigmented. Manubrium with a dorso-lateral stripe on each side. Eyes 8+8. Antennae two and one-half times as long as the head, or seven-tenths as long as head and body; segments as 25:33:33:55; last segment elliptico-cylindrical, obscurely and irregularly annulate distally. Mesonotum projecting over the head to an unusual degree. Fourth abdominal segment about eleven times as long as the third. Tibiotarsi each with two subsegments, the distal subsegment two-fifths as long as the entire segment. Unguis (fig. 59) slender, almost straight, with a pair of conspicuous lateral teeth two-thirds from the base and two pairs of inner teeth; the proximal pair two-fifths from the base; the distal pair midway between the proximal and the apex. Unguiculus narrowly lanceolate, extending four-fifths as far as unguis. Tenent hair strong, as long as the inner margin of the unguis. Manubrium five-sevenths as long as dentes. Dentes crenulate dorsally, the crenulations ending at a distance from the apex equal to twice the length of the mucro. Mucro (fig. 60) relatively long, strongly rounded ventrally; apical tooth large; anteapical small, inclined anteriorly; proximal spine short, acicular. Comparatively few setae are present on head and body, which are densely scaly; the scales being mostly elliptical. The posterior border of the fourth urotergite bears a fringe of straight, closely set setae, directed backward. Scales occur on the antennae and ventrally on the dentes except distally, where there are many long fringed setae. Length, 2 mm. and 2.4 mm.

This description was made from two types given to me by Doctor MacGillivray. The original description of the antennae was evidently based upon one of these types in which the antennae are deformed.

El Pilar, Venezuela, H. E. Summers, collector.

Syntypes.—Cat. No. 40388, U.S.N.M.

Genus SALINA MacGillivray

Salina MacGillivray, 1894
Cremastocephalus Schött, 1896

A study of my three types of *Salina banksii* MacGillivray shows that *Cremastocephalus* Schött is a synonym of *Salina* MacGillivray, a genus which had not been recognized since its description. I regret that it is necessary to drop such a well known name as *Cremastocephalus.*

The species described here is quite different from either the Floridan species *banksii* MacGillivray or the Californian *trilobatus* Schött.

SALINA WOLCOTTI, new species

Plate 7, figs. 61–64; Plate 8, figs. 65–67

Yellow, marked with black (fig. 61). Mesonotum bordered with black laterally and anteriorly. Body with black spots, mostly amoebiform with a clear central spot. Small individuals, and an occasional large one, have few if any black markings on the body, or have at most the marginal pigment of the mesonotum. Antennal segments apically black. Legs yellow; femur with a distal black spot; tibiotarsus with a small proximal and a large distal spot. Furcula yellow. Eyes (fig. 62) 8+8, the two inner proximal smaller than the others. Antennae a little longer than the head and body; second and third segments subequal; fourth one-half longer than the third. Ratio of body segments, excepting prothorax, as 31:17:18:25:9:81:17:11 or 35:22:19:32:10:108:27:17. Abd. 4 nine to twelve times as long as abd. 3. Tibiotarsus divided into two subsegments by a suture two-fifths from the apex. Unguis (fig. 63) with two pairs of inner teeth, the proximal teeth larger than the distal. Unguiculus with an inner angle-tooth. Tenent hair strong, broadly expanded apically, as is usual in the genus. Furcula about two-thirds as long as the body, but variable in length, extending only to the ventral tube, or to the middle of the mesothorax. Dens varying from slightly longer to one-fourth longer than the manubrium. Mucro suboblong (figs. 64–66) except in young individuals (fig. 67), commonly bilobed apically (fig. 64), occasionally with a small or obscure third tooth (figs. 65, 66). Apical scale of dens (fig. 64) as long as mucro, subelliptical, ovate or obovate. Corpus of tenaculum with a strong anterior seta, and sometimes a small second seta below the first. Maximum length, 1.7 mm.

The third tooth of the mucro was distinguishable in 8 mucrones out of 28. In one individual the left mucro was bilobed and the right trilobed (fig. 65). The dorsal tooth of the mucro is usually larger than the ventral.

Numerous specimens collected on cotton leaves were almost entirely yellow.

The type material consists of an abundance of specimens collected in Porto Rico by G. N. Wolcott, after whom the species is named. He says that these springtails on corn are moderately abundant on the north side of the island, and on the south (dry) side of the island occur in enormous numbers.

Porto Rico—Point Cangrejos, February 6, on the ground; Rio Piedras, February 9, 11, 23, on Yautia; Bayamon, February 19, on canna and water hyacinth; Guinica, March 18, on cane; Bayamon, May 5; Isabella, August 1, on cotton leaves; Peñuelas, August 16, on corn.

Syntypes.—Cat. No. 40389, U.S.N.M.

Genus CYPHODERUS Nicolet

CYPHODERUS INAEQUALIS, new species

Plate 8, figs. 68, 69

White. Eyes absent. Antennae two-fifths longer than the head; segments variable in relative lengths, but about as 10:26:17:41 or 4:8:5:12. Hind claws slightly larger than the others. Unguis (fig. 68) stout, curving, with a pair of lateral teeth near the base. Antero-proximal lobe oblong-lanceolate, acute. Postero-proximal lobe much larger, extending one-half as far as the unguis, lanceolate, acuminate. A small but evident third tooth on the inner margin occurs opposite the antero-proximal tooth. Unguiculus long and broad, extending as far as the unguis, with a large acute inferior wing with rounded margin. Tenent hair small, as long as the wing of the unguiculus. Fourth abdominal segment slightly more than four times as long as the third. Manubrium: dentes: mucrones as 3:2:1. Outer dorsal setae of dens 7, the last 6 pinnate. Inner dorsal setae 7, the last 4 or 5 pinnate. Inner distal pinna (fig. 69) long, extending almost as far as the anteapical tooth of the mucro. Outer distal pinna three-fifths as long as the inner. Mucro subequally bidentate, the two teeth somewhat distant from each other. A narrow lamella extends forward from the anteapical tooth. Length, 1 mm.

Headwaters of Chilibrillo River, Canal Zone, September 29, 1923, in limestone caves in bat dung, J. Zetek and I. Molino, collectors.

Syntypes.—Cat. No. 40390, U.S.N.M.

CYPHODERUS SIMILIS, new species

Plate 8, figs. 70, 71

White. Eyes absent. Antennae one-fifth to two-fifths longer than head; segments as 2:5:3:6. Abd. 1 and 2 subequal; abd. 3 one-half longer than abd. 2; abd. 4 two and one-half to three and one-half times as long as abd 3. Unguis (fig. 70) stout, with a pair of lateral teeth one-fourth from the base; antero-proximal lobe linear, ending in a tooth; postero-proximal lobe large, lanceolate to ovate, extending two-thirds as far as the unguis; beyond the proximal lobes are two distal teeth, the more distal of the two being sometimes absent. Unguiculus extending two-thirds as far as unguis, with large acute outer lobe. Tenent hair three-fourths as long as unguis. Dens (fig. 71) three-fourths as long as manubrium, and more than twice as long as mucro. Outer dorsal pinnae of dens 7 (occasionally 6). Inner dorsal pinnae 5. Inner distal pinna extending almost as far as the anteapical tooth of the mucro. Outer distal pinna a little more than half as long as the inner. Mucro (fig. 71) bidentate, with lamella extending to the anteapical tooth. Ventro-apical scale of dens extending as far as the anteapical tooth. Length, 1 mm.

Panama, April, 1917, J. Zetek, collector.

Syntypes.—Cat. No. 40391, U.S.N.M.

CYPHODERUS PINNATUS (Folsom) [New combination]

Plate 8, figs. 72–77

Borecus pinnatus Folsom, 1923

This variable species was described from British Guiana. My specimens from the Canal Zone agree with the types except in minor details, as follows:

The antero-proximal lobe of the unguis is usually smaller than the postero-proximal (fig. 72), though occasionally subequal to the latter, as in the types. At the middle of the inner margin of the unguis is a strong tooth, which is obscure in the types. The outer dorsal pinnae of the dens are 5; the inner usually 4 (sometimes 5 or 6). The inner distal pinna (fig. 73) extends to the second anteapical tooth of the mucro; the adjacent outer pinna (fig. 74) extending not quite so far. The teeth of the mucro (fig. 73) vary from 3 to 9 in the specimens at hand (figs. 75–77); an apical and two anteapical teeth being constant. Apical tooth relatively small, usually more or less hooked, sometimes almost straight. Anteapical teeth large, subequal, each giving rise anteriorly to a lamella. In addition to the three primary teeth there may be from one to six small secondary teeth; these occur between the two anteapical teeth, in front of the second anteapical tooth, or in both places. To express the number, size, and position of the mucronal teeth, the following formula may be used, in which the primary teeth are indicated by large numerals and the secondary teeth by small ones, beginning with the apical tooth. Thus the formula for Figure 75 would be 111; that for Figure 73, $11{\scriptstyle 1}1$.

In the specimens studied these formulae occurred:

Mucronal formula	Length of specimens (milimeters)
111 (fig. 75)	0.8, 1.2
$11{\scriptstyle 1}1$ (fig. 73)	0.5, 1
$11{\scriptstyle 1}1{\scriptstyle 1}$ (fig. 76)	0.5, 1
$11{\scriptstyle 1}1{\scriptstyle 11}$	1
$11{\scriptstyle 11}1$	1
$11{\scriptstyle 11}1{\scriptstyle 11}$ (fig. 77)	1
$11{\scriptstyle 11}1{\scriptstyle 1111}$	1.1

This table shows no close correlation between the number of secondary teeth and the size of the specimen as indicated by its length.

A pair of bothriotricha occurred on abd. 2, 3 and 4, respectively.

Maximum length, 1.2 mm.

Fort San Lorenzo, Canal Zone, June 14, 1923, with *Coptotermes niger* Snyder in termitarium on tree stump, J. Zetek, collector (Z. No. 2111*a*).

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EXPLANATION OF PLATES

PLATE 1

Lepidocampa zeteki

FIG. 1. Dorsal aspect of female, × 25.
2. Dorsal aspect of base of right antenna of male, × 175.
3. Last two segments of left antenna of female, dorsal aspect, × 320.
4. Dorsal aspect of labrum, × 320.
5. Dorsal aspect of head of right mandible, × 505.
6. Dorsal aspect of head of left mandible, × 505.
7. Galea (*g*) and palpus (*p*) of right maxilla, dorsal aspect, × 505.
8. Lacinia of right maxilla, dorsal aspect, × 505.
9. Dorsal aspect of lingua and superlinguae, × 370.

PLATE 2

Lepidocampa zeteki

FIG. 10. Left half of labium. *g*, galea; *l*, lacinia; *p*, palpus, × 320.
11. Apical spurs of right fore tibia, × 505.
12. Claws and pulvilli of left hind foot, × 635.
13. Left stylus of first abdominal segment of female, × 290.
14. Left stylus of first abdominal segment of male, × 290.
15. Left stylus and exsertile vesicle of third abdominal segment of male, × 290.
16. Posterior region of eighth urosternum of male, × 298.
17. Posterior region of eighth urosternum of female, × 298.
18. Genital valves of female, × 505.

PLATE 3

Lepidocampa zeteki

FIG. 19. Telson of female, dorsal aspect, × 225.
20. Tenth sternum of male, × 262.
21. Right half of tenth sternum of female, × 262.
22. Dorsal aspect of right cercus of female, × 80.
23. Left side of thoracic terga of female, × 110.
24. Postero-lateral angle of fifth urotergite, × 175.
25–30. Dorsal scales, × 505.

PLATE 4

Achorutes (*Schöttella*) *caecus*

FIG. 31. Left postantennal organ, × 1264.
32. Sense organ of third segment of left antenna, × 1264.
33. Terminal sense organ of right antenna, × 1264.
34. Unguis of left mid foot, × 1016.
35. Left dens and mucro, × 808.
36. Left mucro, × 1264.
37. Left mucro, × 1264.
38. Dorsal setae of second abdominal segment, × 1016.

PLATE 5

Pseudachorutes albipes

FIG. 39. Dorsal aspect, × 45.
40. Eyes of right side, × 262.
41. Unguis of left hind foot, × 394.
42. Dorsal aspect of left mucro, × 757.
43. Dorsal aspect of right mucro, × 757.

Folsomia fimetaria dentata

FIG. 44. Left postantennal organ, × 757.
45. Unguis of left hind foot, × 757.

PLATE 6

Entomobrya cubensis

FIG. 46. Dorsal aspect, × 55.
47. Left aspect, × 55.
48. Eyes of right side, × 320.
49. Left hind foot, × 790.
50. Left mucro and end of dens, × 790.

Lepidocyrtus usitatus

FIG. 51. Head and mesonotum, × 110.
52. Eyes of left side, × 505.
53. Left hind foot, × 790.
54. Left mucro, × 790.

PLATE 7

Lepidocyrtus nigrosetosus

FIG. 55. Eyes of right side, × 320.
56. Right hind foot, × 505.
57. Left mucro and end of dens, × 505.

Lepidocyrtus summersi

FIG. 58. Left aspect, × 29.
59. Left mid foot, × 505.
60. Left mucro and end of dens, × 505.

Salina wolcotti

FIG. 61. Left aspect, × 37.
62. Eyes of right side, × 262.
63. Right mid foot, × 635.
64. Left mucro and end of dens, × 790.

PLATE 8

Salina wolcotti

FIG. 65. Mucro, × 635.
66. Mucro, × 790.
67. Mucro of small specimen, × 869.

Cyphoderus inaequalis

FIG. 68. Left fore foot, × 790.
69. Left mucro and end of dens, × 370.

Cyphoderus similis

FIG. 70. Left hind foot, × 790.
71. Left dens and mucro, × 320.

Cyphoderus pinnatus

FIG. 72. Left hind foot, × 790.
73. Left mucro and end of dens, × 635.
74. Outer distal pinna of dens, × 635.
75–77. Left mucrones, × 635.

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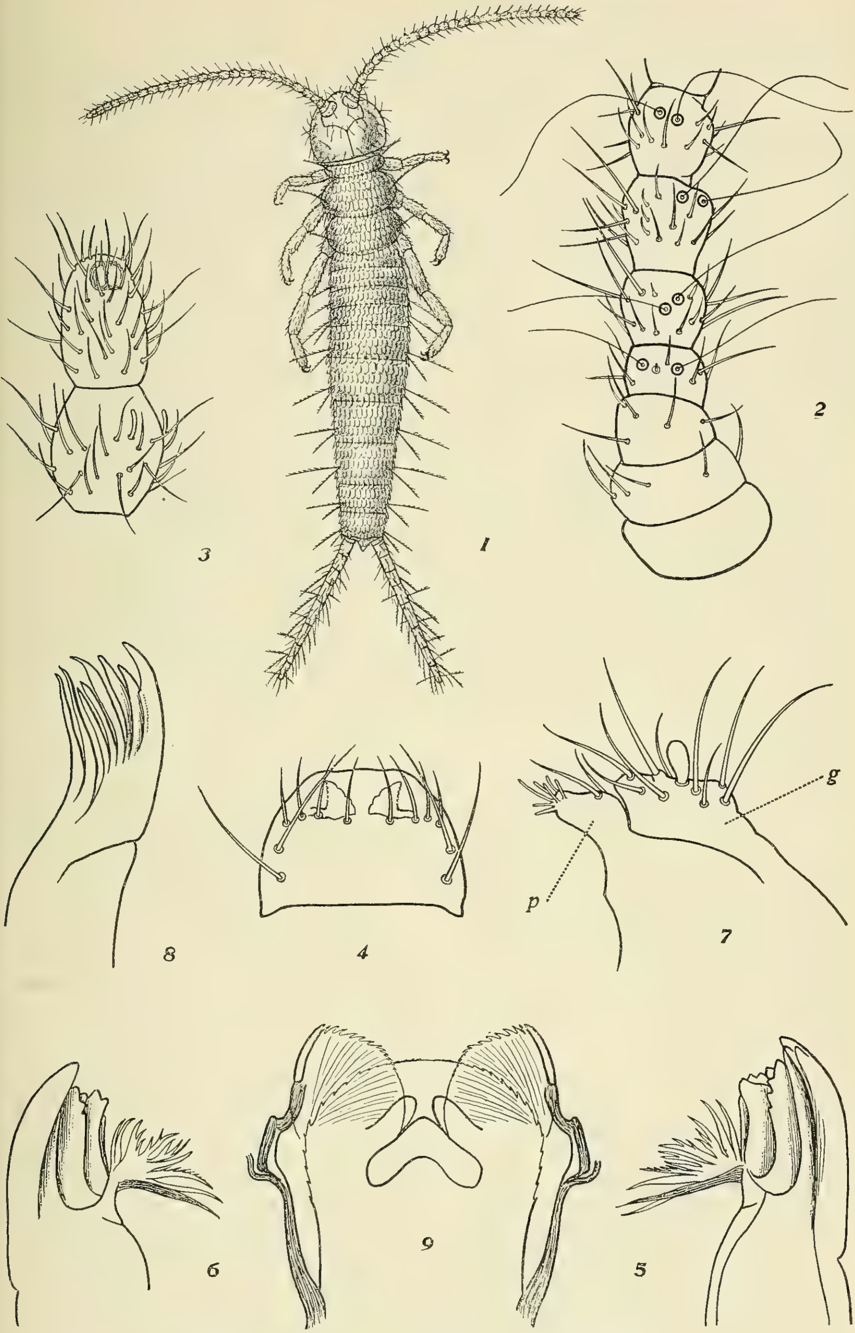
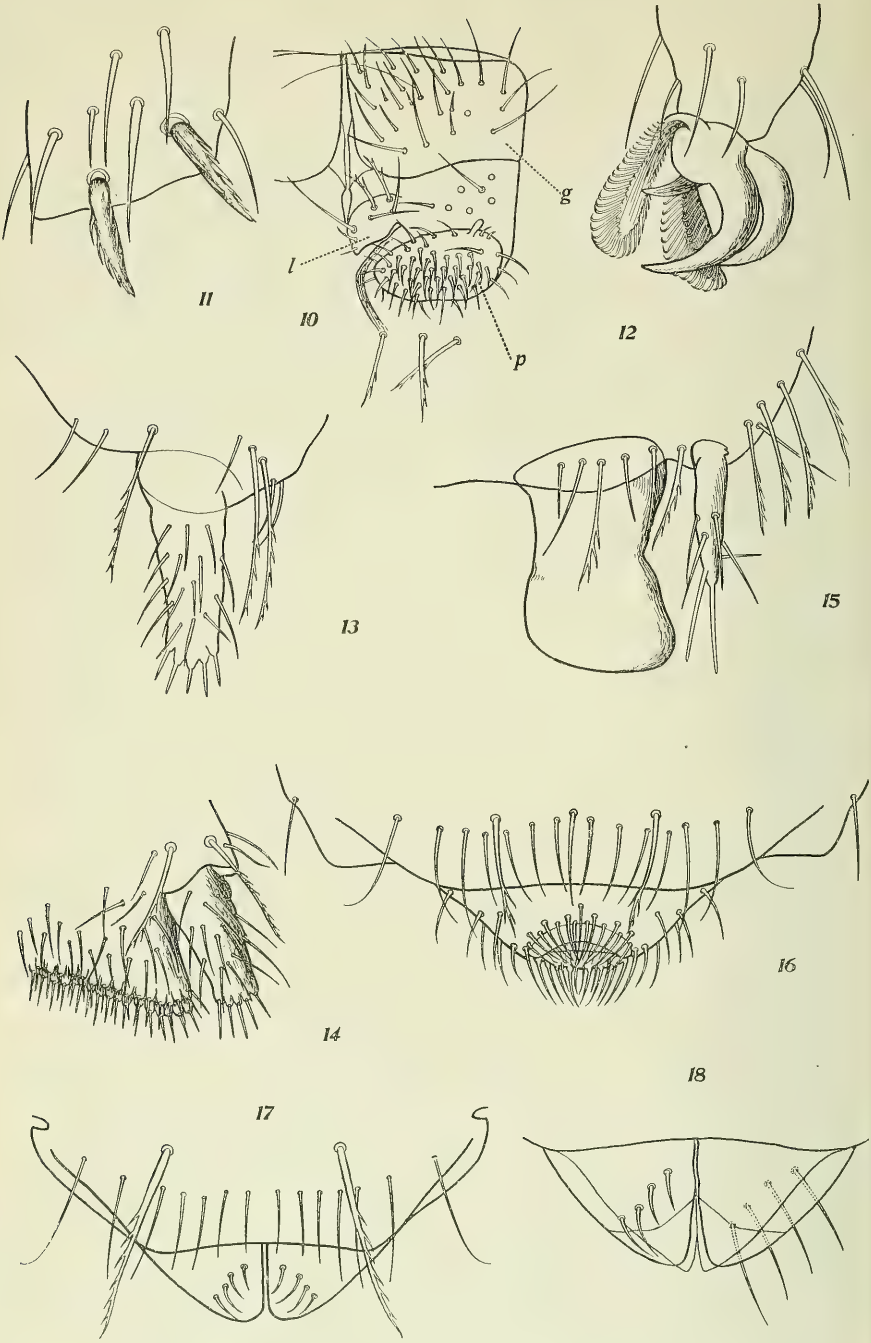


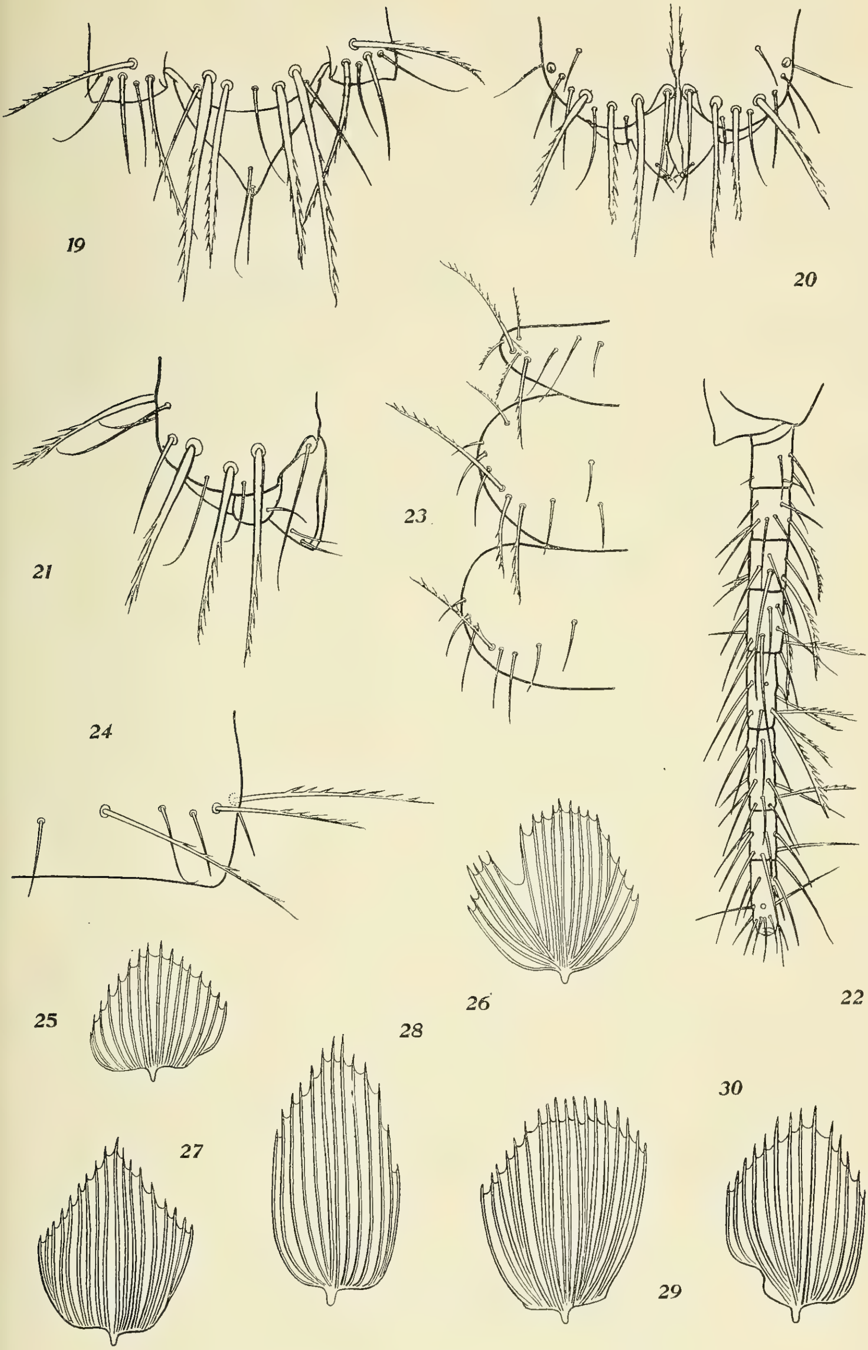
CENTRAL AMERICAN AND WEST INDIAN APTERYGOTA

FOR EXPLANATION OF PLATE SEE PAGE 14



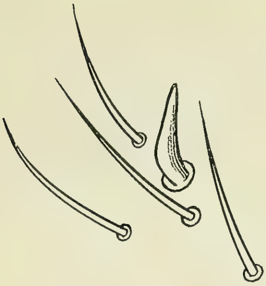
CENTRAL AMERICAN AND WEST INDIAN APTERYGOTA

FOR EXPLANATION OF PLATE SEE PAGE 16



CENTRAL AMERICAN AND WEST INDIAN APTERYGOTA

FOR EXPLANATION OF PLATE SEE PAGE 15



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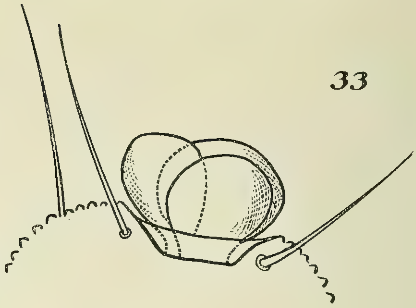

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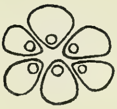

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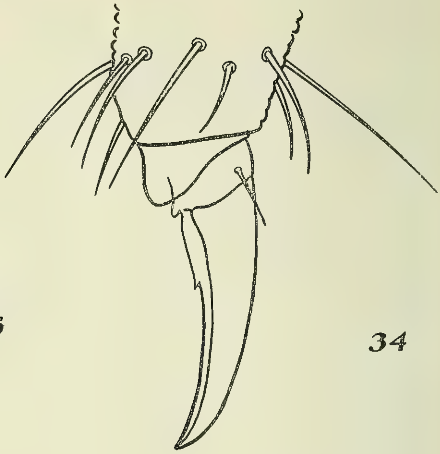

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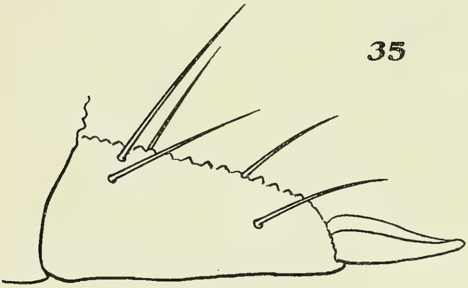

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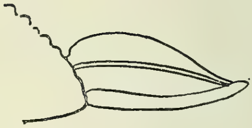

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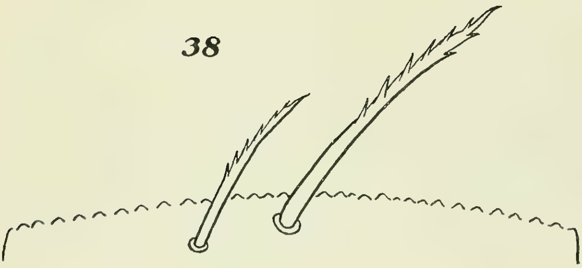

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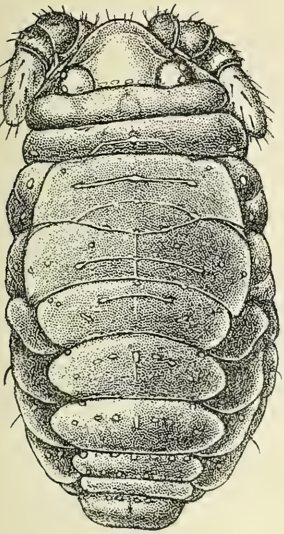
CENTRAL AMERICAN AND WEST INDIAN APTERYGOTA

FOR EXPLANATION OF PLATE SEE PAGE 15



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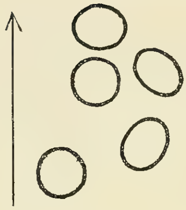

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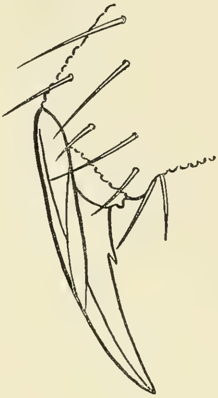

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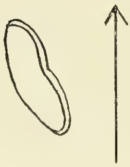

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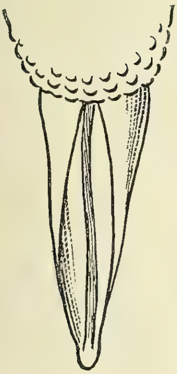

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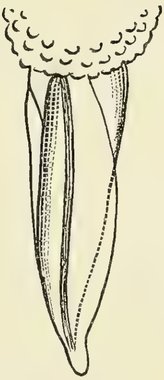

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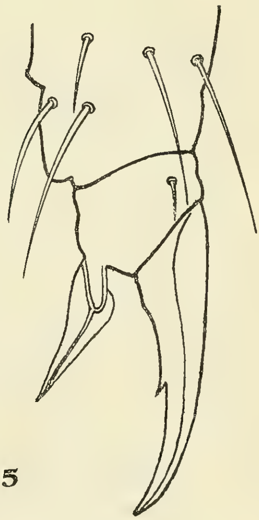
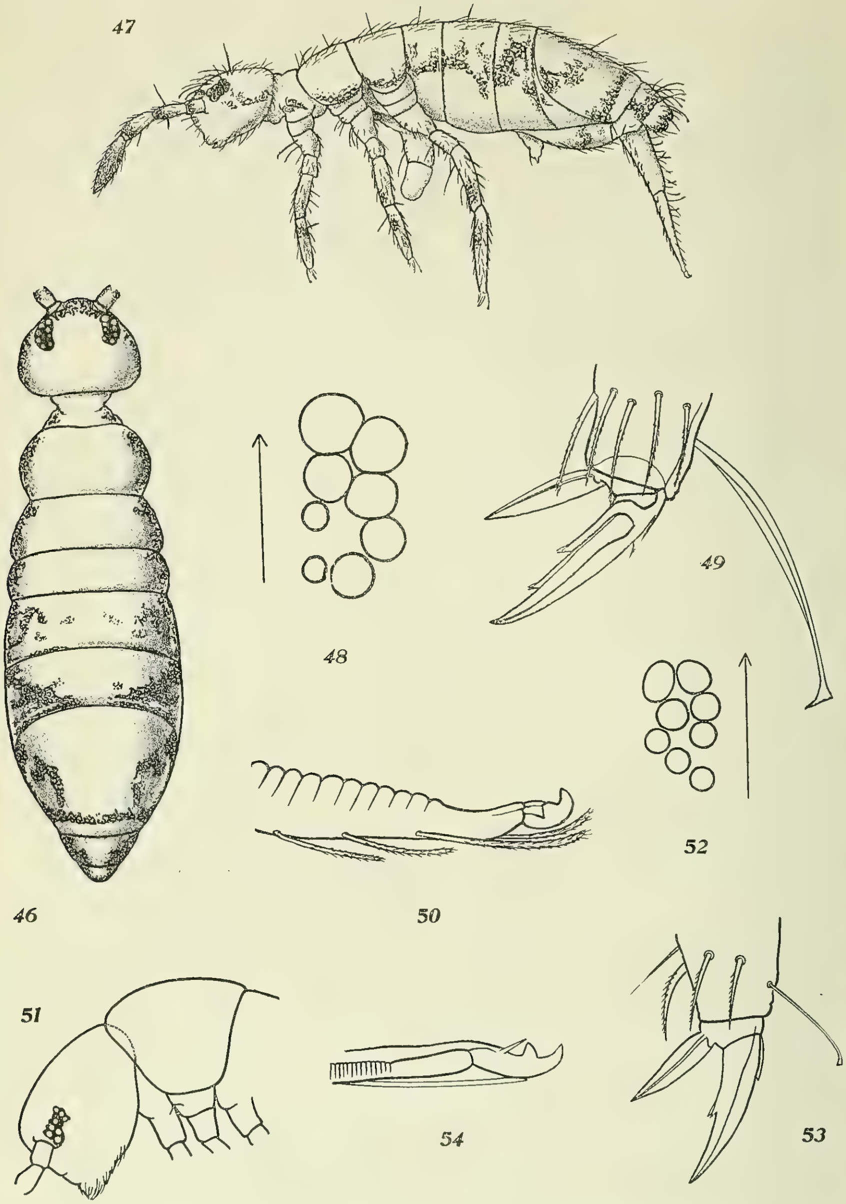


45

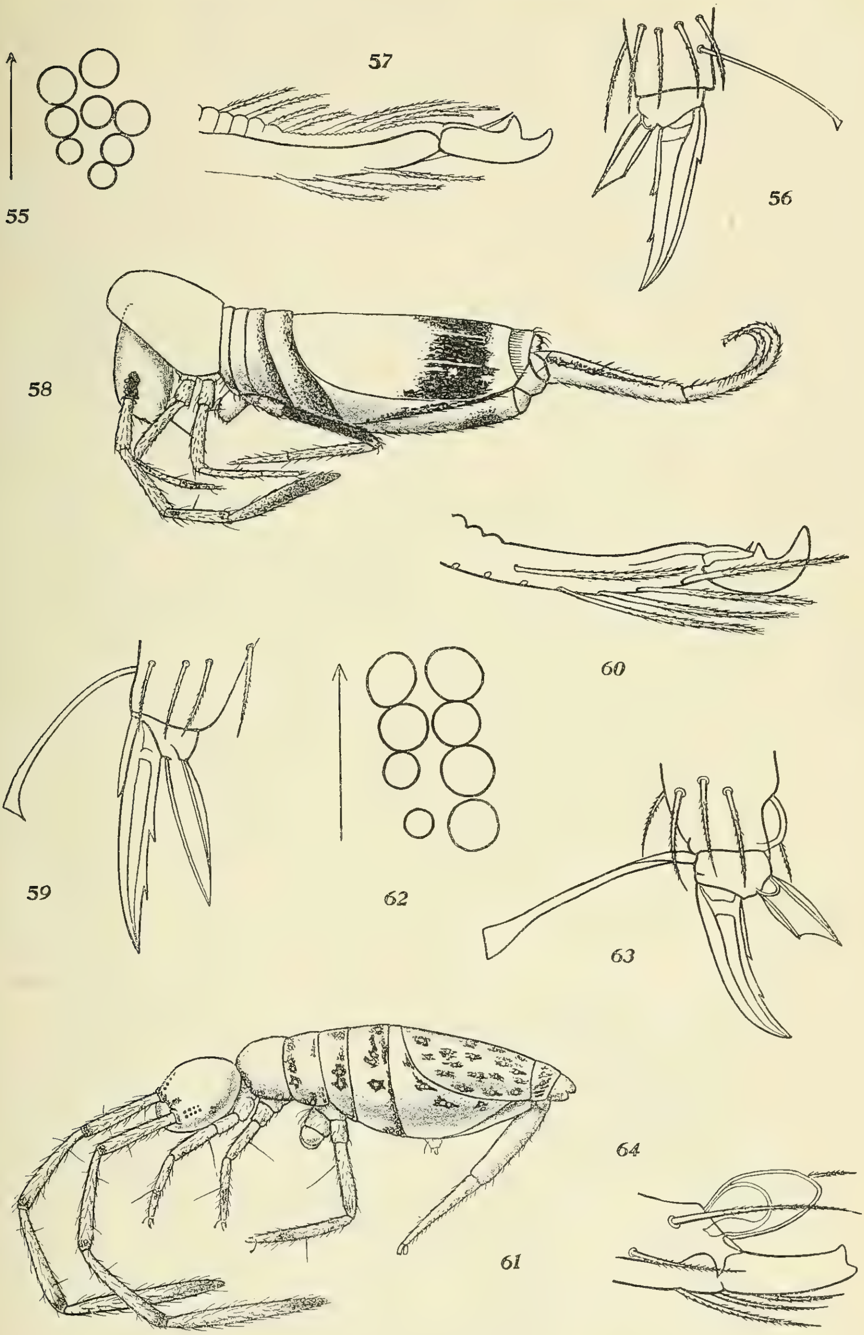
Central American and West Indian Apterygota

For explanation of plate see page 15



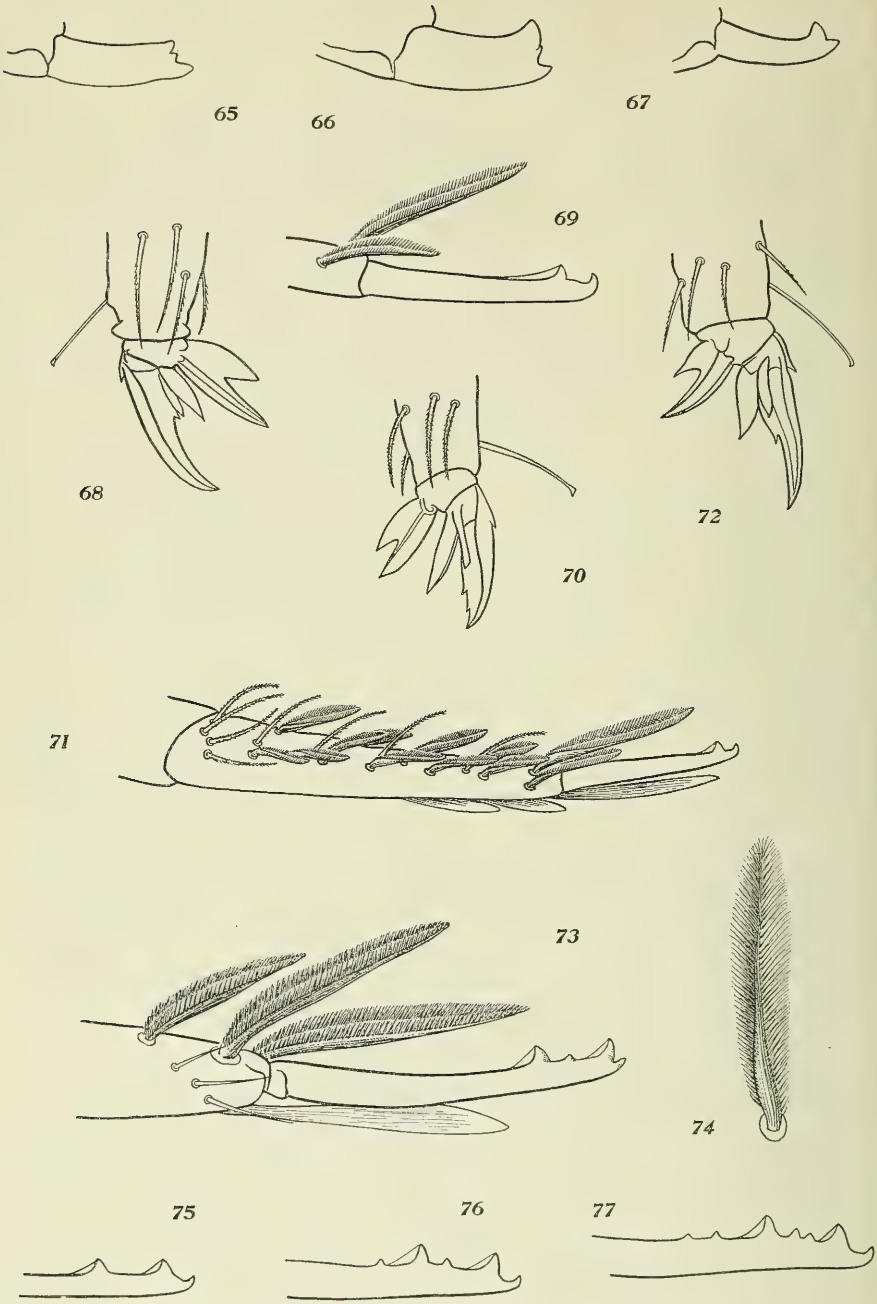
CENTRAL AMERICAN AND WEST INDIAN APTERYGOTA

FOR EXPLANATION OF PLATE SEE PAGE 16



CENTRAL AMERICAN AND WEST INDIAN APTERYGOTA

FOR EXPLANATION OF PLATE SEE PAGE 16



CENTRAL AMERICAN AND WEST INDIAN APTERYGOTA

FOR EXPLANATION OF PLATE SEE PAGE 16

REDESCRIPTION OF TYPES OF AMERICAN MUSCOID FLIES IN THE COLLECTION OF THE VIENNA NATURAL HISTORY MUSEUM, WITH INCIDENTAL NOTES

By J. M. Aldrich

Associate Curator, Division of Insects, United States National Museum

The Vienna Natural History Museum contains a large amount of type material in the American muscoid flies. This is principally in the species described by Wiedemann[1] in 1830, by Schiner[2] in 1868, and by Brauer and Bergenstamm[3] in parts 4, 5, and 6 of their series called "Zweiflügler des Kaiserlichen Museums zu Wien." The last-named series contains many new genera based on new species and those of Wiedemann and Schiner.

The authorities of the Vienna Museum a few years ago indicated a willingness to lend the American types to this museum for study, and I have availed myself of their liberality so far as to borrow six lots, numbering in all 110 species. I have reported on 79 of these in three articles published in the Annals of the Entomological Society of America.[4] On account of the magnitude of the project it is thought best to continue it in the Proceedings of the Museum, and the remainder thus far studied are included in the present paper.

The study of these types has verified many identifications in the United States National Museum, demonstrated the synonomy of many genera and species, and furnished more complete data than formerly existed for the future identification of a considerable number of species not as yet represented in this museum.

[1] Aussereuropäische Zweiflügelige Insekten, 2 volumes.

[2] Diptera der Novara Reise, 1 volume.

[3] Denkschriften der Kaiserlichen Akademie der Wissenschaften; part 4 is in vol. 56, 1889, pp. 1–180, with 11 plates; part 5 in vol. 58, 1891, pp. 305–446; and part 6 in vol. 60, 1893, pp. 89–240.

[4] Vol. 17, 1924, pp. 209–218; vol. 18, 1925, pp. 107–130, and 456–469.

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The species reported upon in the three articles just mentioned are as follows:

FIRST PAPER

1. *Morellia bipuncta* Wiedemann.
2. *Sarcophaga plinthopyga* Wiedemann.
3. *Sarcophaga georgina* Wiedemann.
4. *Sarcophaga chrysostoma* Wiedemann.
5. *Sarcophaga rufiventris* Wiedemann.
6. *Erythrandra picipes* Brauer and Bergenstamm.
7. *Arrenopus americanus* Brauer and Bergenstamm.
8. *Megaprosopus rufiventris* Macquart.
9. *Macrometopa mexicana* Brauer and Bergenstamm.
10. *Prorhynchops bilimeki* Brauer and Bergenstamm.
11. *Eudexia goliath* Brauer and Bergenstamm.
12. *Echinodexia pseudohystricia* Brauer and Bergenstamm.
13. *Myiophasia aenea* Wiedemann.
14. *Angiorhina crudelis* Wiedemann.
15. *Oestrophasia clausa* Brauer and Bergenstamm.
16. *Phasiopteryx bilimeki* Brauer and Bergenstamm.
17. *Tetragrapha tessellata* Brauer and Bergenstamm.
18. *Podotachina vibrissata* Brauer and Bergenstamm.
19. *Podotachina americana* Brauer and Bergenstamm.
20. *Parahypochaeta heteroneura* Brauer and Bergenstamm.
21. *Plagiomima disparata* Brauer and Bergenstamm.
22. *Myiopharus metopia* Brauer and Bergenstamm.
23. *Hesperomyia erythrocera* Brauer and Bergenstamm.
24. *Hemithrixion oestriforme* Brauer and Bergenstamm
25. *Pseudogermaria georgiae* Brauer and Bergenstamm.
26. *Eliozeta americana* Brauer and Bergenstamm.

SECOND PAPER

27. *Viviania georgiae* Brauer and Bergenstamm.
28. *Masiphya brasiliana* Brauer and Bergenstamm.
29. *Alsopsyche nemoralis* Brauer and Bergenstamm.
30. *Chrysotachina rheinwardtii* Wiedemann.
31. *Nemorilla trivittata* Wiedemann.
32. *Prospalaea insularis* Brauer and Bergenstamm.
33. *Gaediopsis mexicana* Brauer and Bergenstamm.
34. *Paralispe brasiliana* Brauer and Bergenstamm.
35. *Sardiocera valida* Brauer and Bergenstamm.
36. *Gonia rubens* Wiedemann.
37. *Ptilodexia carolinensis* Brauer and Bergenstamm.
38. *Trichodura anceps* Fabricius.
39. *Chaetogyne vexans* Wiedemann.
40. *Mochlosoma validum* Brauer and Bergenstamm.
41. *Lasiopalpus flavitarsis* Macquart.
42. *Myiomitho elata* Brauer and Bergenstamm.
43. *Pseudoredtenbacheria brasiliensis* Schiner.
44. *Beskia cornuta* Brauer and Bergenstamm.
45. *Peteina stylata* Brauer and Bergenstamm
46. *Wulpia aperta* Brauer and Bergenstamm.

47. *Leskiomima tenera* Wiedemann.
48. *Microchira mexicana* Brauer and Bergenstamm.
49. *Argyromima mirabilis* Brauer and Bergenstamm.
50. *Leptoda gracilis* Wiedemann.
51. *Myiomima sarcophagina* Brauer and Bergenstamm.
52. *Tropiopsis pyrrhaspis* Wiedemann.
53. *Leptoda thomae* Wiedemann.
54. *Bibiomima handlirschi* Brauer and Bergenstamm.
55. *Reinwardtia tachinina* Brauer and Bergenstamm.
56. *Masipoda geminata* Brauer and Bergenstamm.
57. *Sturmia cubaecola* Jaennicke.
58. *Argyrophylax albincisa* Wiedemann.
59. *Trichophora analis* Schiner.
60. *Arthrochaeta demoticoides* Brauer and Bergenstamm.

THIRD PAPER

61. *Paralucilia fulvipes* Blanchard.
62. *Paradoria nigra* Brauer and Bergenstamm.
63. *Paragymnomma hystrix* Brauer and Bergenstamm.
64. *Bombyliomyia flavipalpis* Macquart.
65. *Phasiophana obsoleta* Brauer and Bergenstamm.
66. *Cryptomeigenia setifacies* Brauer and Bergenstamm.
67. *Pseudoviviania platypoda* Brauer and Bergenstamm.
68. *Selenomyia brevicornis* Brauer and Bergenstamm.
69. *Sisyropa vorax* Wiedemann.
70. *Chaetoprocta tarsalis* Schiner.
71. *Thysanomyia fimbriata* Van der Wulp.
72. *Macromeigenia chrysoprocta* Wiedemann.
73. *Gaediophana atra* Brauer and Bergenstamm.
74. *Paragaedia hedemanni* Brauer and Bergenstamm.
75. *Hypotachina disparata* Brauer and Bergenstamm.
76. *Exorista optica* Schiner.
77. *Mallonotum brevicornis* Wiedemann.
78. *Parexorista inculta* Wiedemann.
79. *Tricholyga vivida* Wiedemann.

The species in the present paper are numbered consecutively with the preceding.

80. ACTINOCHAETA COLUMBIAE Brauer and Bergenstamm

Actinochaeta columbiae Brauer and Bergenstamm, Denk. Wien. Akad. Wiss., vol. 56, 1899, p. 137; vol. 58, 1893, p. 128.

Two females, both "Lindig 1864 Venezuela" and both with label in purple ink, large hand, "columbiae BB type."

These agree with the description and may be the types although originally the species was said to be from Colombia. An easily recognizable species with outstanding characters, among them the front tarsi greatly enlarged and lengthened; the scutellum with only two pairs of bristles, apical strongly decussate; abdomen much compressed, without discals; postscutellum and hypopleural bristles distinct; first, third, and fifth veins hairy; no acrostichals; facial ridges with fine hairs.

Townsend had identified the species correctly from Panama and Peru in the United States National Museum. I afterwards found a specimen in the collection from Costa Rica. The type and our three specimens are all females.

81. PACHYGRAPHIA VIRGATA Wiedemann

Dexia virgata WIEDEMANN, Auss. Zweifl., vol. 2, 1830, p. 382.

Pachygraphia virgata BRAUER and BERGENSTAMM, Denk. Wien. Akad. Wiss., vol. 58, 1891, p. 406, vol. 60, 1893, p. 132.—TOWNSEND, Ins. Ins. Menst., vol. 4, 1916, p. 8.

Brauer and Bergenstamm in both references included *Dexia virgata* Wiedemann and *Dexia fervens* Wiedemann under *Pachygraphia.* Townsend designated the former as type of this genus.

One female "Brasilien" labeled with genus and species but not the word "type"; an old specimen with no legs, very few bristles and only one third antennal joint; thorax in bad condition and abdomen roughly glued on. It is possible to ascertain immediately that my genus *Camptops*[5] is a synonym of *Pachygraphia.* The shape of the head in *virgata* is exactly like that of *unicolor*, genotype of *Camptops.* They agree in having one orbital bristle, the vibrissae above the lower edge of the head, and so forth, but *virgata* has quite black palpi as mentioned by Wiedemann. In *unicolor* there is a blackish changeable spot in the pollen of the upper part of the parafacial between the second antennal joint and the eye, which is entirely absent in *virgata.* The plumosity of the arista is longer in *virgata* and seems to continue to the extreme tip. The parafacial has a few small hairs, not in rows, just about as in *unicolor.* The only difference I can make out in the chaetotaxy is that *virgata* has two intraalars, of which the anterior is absent in *unicolor.* In both there is no postscutellum, the third vein has six widely separated setules reaching nearly to the cross vein; bend of fourth vein rectangular with short stump, last section of fifth vein shorter than hind cross vein. In *virgata* the first posterior cell is narrowly open a little before the tip.

The species is not represented in the National Museum.

82. ? PACHYGRAPHIA FERVENS Wiedemann

Dexia fervens WIEDEMANN, Auss. Zweifl., vol. 2, 1830, p. 383.

Pachygraphia fervens BRAUER and BERGENSTAMM, Denk. Wien. Akad. Wiss., vol. 58, 1891, p. 406; vol. 60, 1893, p. 132.

One male, labeled "Brasilien," "fervens W. Coll. Winthem," and "Pachygraphia fervens Wd." It does not bear the word type, but

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[5] Sarcophaga and Allies, 1916, p. 34.

agrees with Wiedemann's description in regard to the peculiar seal-brown median abdominal stripe, so I do not doubt that this is the type of the species. It does not belong to *Pachygraphia* (type *virgata* Wiedemann) already mentioned, but being in poor condition I will not attempt to establish a new genus upon this specimen. The best that I can do is to mention characters sufficient to identify the species when new material is obtained.

It is a rather slender, gray fly, nearly 6 mm. long, with a very striking seal-brown stripe on the last three abdominal segments, occupying about one-third of their width. Apparently a similar stripe exists on the thorax, since I can make it out on the scutellum and just before. The remainder of the abdomen is densely yellowish pollinose above; no median marginals on first and second segments; if any are present on the latter they must be very small; third with a marginal row of 6; the fourth has a marginal row of 6; and the fifth has a marginal row of the same number, but no discals whatever. In the specimen the abdomen is rather flattened and has a sharp margin on each side which seems to be correlated with the color pattern but may be an individual peculiarity. There are only two sternopleurals; no pteropleural; well-developed row of hypopleural; only two pairs of scutellar. No trace of postscutellum. The wings narrow, third vein with two minute hairs at base; fourth vein with angular bend which is rather close to hind margin, ending not very far before tip of wing; last section of fifth vein about one-seventh of the preceding. Head considerably shriveled, the front moderately narrow, apparently without ocellars; frontals extending slightly beyond base of antennae; parafacial rather narrow and apparently bare, the deeply shriveled facial ridges bare; vibrissae at oral margin; third antennal joint narrow, about twice the second, which is swollen toward the tip; arista pollinose to the tip, its extreme base enlarged. Palpi and proboscis rather small. Legs black, middle tibia with no bristles on outer front side; hind tibia with one on outer and one on inner hind side at the middle and one above the latter halfway to the base; also one on outer flexor side below middle.

The species is not represented in the National Museum nor in any other collections that I have seen.

83. CHAETODEMOTICUS CHILENSIS Schiner

Demoticus chilensis SCHINER, Novara, 1868, p. 324.
Chaetodemoticus chilensis BRAUER and BERGENSTAMM, Denk. Wien. Akad. Wiss., vol. 58, 1891, p. 385; vol. 60, 1893, p. 140.

One male, "Novara—R. Chili," labeled as type of species, which is the type of the genus. Eyes bare, front broad, 0.42 of the head width at vertex, which is not much narrower than the space between the eyes at the vibrissae; two large verticals, the inner especially strong; ocellars stout, divergent and reclinate; frontals about 11, the uppermost strongly divergent and reclinate, those below convergent, the lowest two or three extending down on the face and proclinate, the uppermost one of these being at the level of the base of the third antennal joint. About four pairs of proclinate orbital bristles present, the uppermost small and close to the divergent frontals, the lowest opposite insertion of antennae nearly in line with the proclinate frontals. Parafrontal narrow above, the median stripe very wide; just above the antennae however the stripe is only as wide as one parafrontal. Parafacial moderately wide with numerous smallish black hairs. Cheek about one-fourth the eye height, bare except below and posteriorly. Mouth a little protuberant so that the length of the head here is equal to that at the insertion of the antennae. Facial ridges bare, face flat transversely. Vibrissae at the oral margin arising from a cluster of smaller bristles; antennae fully three-fourths as long as face; second antennal joint about two-thirds as long as the third; arista short, thickened nearly to the tip, the basal joints short. Palpi normal; proboscis short, but quite slender beyond the joint. Back of head a little bulging, with only white hair except the orbital row and a few dark hairs near the mouth. Thoracic chaetotaxy: acrostichal, 3, 3 (?); dorsocentral, 3, 4; humeral, 4; posthumeral, 2; presutural, 2; notopleural, 2; supraalar, 3 (the middle large); intraalar, 2; postalar, 2; sternopleural, 2, 1; pteropleural, 0; scutellum with three marginal, no apical, but scars indicating 2 pairs of bristles irregularly placed just above the apex.

Abdomen rather thick toward apex, no median marginals on first segment, second with one pair but no discals, third with a marginal row of about 10, no discals; fourth with a marginal row smaller and a subdiscal row about at the last third. Legs black, rather stout and bristly; pulvilli moderately elongated; middle tibia with three or four stout bristles on outer front side, hind tibia with irregular and unequal bristles on outer hind side and inner hind side.

Wing subhyaline, first posterior cell ending far before the apex, first vein with coarse hairs to the tip, third vein with similar hairs extending beyond the cross vein; bend of fourth vein angular and slightly appendiculate; last section of fifth vein about one-third the preceding.

General color dark gray, the head subsilvery; palpi and second antennal joint reddish-yellow; stripes of mesonotum considerably damaged in the specimen but apparently not distinct. Abdomen bluish-gray on second and third segments, not tessellated, the hind margins shining black, fourth segment almost entirely shining black. Genitalia rather large, concealed in the specimen.

Length, 9 mm.

Not represented in the National Museum.

84. RHINOMACQUARTIA CHAETOPHORA Brauer and Bergenstamm

Rhinomacquartia chaetophora BRAUER and BERGENSTAMM, Denk. Wien. Akad. Wiss., vol. 58, 1891, pp. 373, 380, 404; vol. 60, 1893, p. 134.

One female, the type, collected by Natterer at Ypanema, Brazil, and so labeled in abbreviated form. The species is so remarkable that it can not be placed in very close association with any known to me. Brauer and Bergenstamm in 1891 placed it first in Group Pseudodexiidae. Within this group however they have several subdivisions to which they give the family ending, and they recognize Rhinomacquartiidae for this sole species on page 380; but on page 404 they have "subgroup Rhinomacquartia" consisting of this genus with a few others doubtfully added. In 1893, they divide "Sectio Pseudodexiidae" into 17 subsections one of which is Rhinomacquartia, containing only this single genus and species. As their "Group Pseudodexiidae" is very heterogeneous, they in effect indicate no close relatives of the present genus. They were puzzled as to the sex of the specimen; the somewhat distorted apex of the abdomen did not seem to show male characters, but the front had no orbitals, so they put it down as a male with an interrogation. I relaxed the specimen and examined the abdominal structure and find it a female.

The hypopleural bristles and postscutellum are well developed (I examined the latter while the specimen was relaxed). The arista is plumose above, below and in several other planes; it is hardly longer than the third antennal joint, and curved downward. The eyes are densely hairy. The head is flat behind and elongated forward, the length at antenna and epistoma are the same; this makes the parafacial unusually wide; it is nearly covered with uniform fine hair gradually becoming longer below. The front is quite prominent, broad, apparently without orbitals; ocellars broken off, outer vertical hairlike; the frontals very small above, the row ending at antennal insertion. On one side there is a scar on the parafrontal a little in advance of the anterior ocellus while on the opposite side the corresponding scar is considerably farther forward. Whether these represent a pair of reclinate verticals or a pair of orbitals I can not tell. Epistoma strongly thrust forward between the vibrissae, the face concave in profile, ridges bare. Proboscis short, fleshy, palpi normal. Third antennal joint with parallel sides, rather elongate, more than twice the second; basal joints of arista small. Micrometer measurements of the head are as follows: width, 55 units; length at antennae, 38, at epistoma the same; height, 48 (eye, 33, cheek, 15); vertex, 16 (or 0.29 of head width).

Thoracic chaetotaxy: acrostichal 3 anterior, posterior doubtful; dorsocentral, 3, 4 (the second posterior small and irregularly placed); humeral, 4; posthumeral, 2 (the hind one small); presutural, 1; notopleural, 2; supraalar, 3; intraalar, 2; postalar, 2; sternopleural, 2, 1; pteropleural, 0; scutellum with 2 lateral, 1 discal, scars of minute apical pair; prosternum bare. Hind calypter of good size, bare, a group of minute setules beneath it.

Abdomen ovate, with weak bristles; none on first segment, second with weak marginal pair, no discals; third with marginal row of 6 rather strong and some irregular bristly discal hairs; fourth segment with marginal row and a few small irregular on disk. Basal sternite visible, the others covered. Middle legs missing, hind tibia with very sparse and irregular cilia.

Wing subhyaline, fourth vein a little curved backward, the bend rounded and rather close to hind margin; first posterior cell open only slightly before extreme apex; third vein with 3–5 setules at base, all the other veins bare, including stem vein. No costal spine. Hind cross vein nearly three-fourths of the way from small cross vein to bend of fourth.

Head yellow, only the upper two-thirds of back, vertex, arista, and third antennal joint except base, black; cheeks with pale yellow hair, the bristles of epistoma beginning at about the middle. Thorax black, rather uniformly cinereous pollinose, scutellum concolorous.

Abdomen yellow with median black stripe as wide as the distance between the two largest scutellar bristles; this stripe widens on posterior half of second segment into a flat triangle almost reaching the sides; on the third segment it forms a larger triangle covering all but the outer front part; fourth segment wholly black above except narrow margins. Venter yellow with some brownish stains.

Legs yellow except tarsi, which are black.

Length, 9 mm.

I can find no near relative in the United States National Museum, but I venture to suggest *Booponus intonsus* Aldrich as having some similar characters, including bare prosternum.

85. ACHAETONEURA LATA Wiedemann

Tachina lata WIEDEMANN, Auss. Zweifl., vol. 2, 1830, p. 322.
Achaetoneura lata BRAUER and BERGENSTAMM, Denk. Wien. Akad. Wiss., vol. 58, 1891, 334.

One female, labeled "lata Wd. Coll. Winthem," and "lata Wd., Montevideo." Although Wiedemann stated that the type was in his own collection, Brauer at the very beginning of the series entitled "Zweiflügler des Kaiserlichen Museums" has explained that many of the types were in some way transferred from Wiedemann's to Winthem's collection. There is no reason to doubt that this specimen is the type of *lata*, although there are slight discrepancies in both existing descriptions.

Female.—Length, 9 mm. Eyes slightly but perceptibly hairy. Front broad, 0.37 of head width at the vertex, gradually widening as the face also does to lower curve of eye. Pollen of parafrontals, parafacials, and posterior orbit light golden yellow, which, however, does not extend upon the cheek. Middle of face cinereous, the ridges darker and bristly halfway (one side) or more (the other side); cheek one-third of eye height, hairy; proboscis short, fleshy; palpi of usual size, yellow, tips a little swollen. Antennae black, base of third joint reddish; third joint three times the second (not four, as stated by Brauer and Bergenstamm), rather thick at base and distinctly tapering to a small apex; arista bare, its penultimate joint short, thickened to middle. Frontal bristles damaged, only the scars left of many; the usual orbitals are indicated, one ocellar remains, but twisted (?) toward the side. Back of head with white beard, bushy below. Thorax black with bluish-gray pollen; the usual four stripes visible from behind, somewhat coalescing behind suture. Scutellum slightly reddish at tip. Anterior acrostichal 3 on one side, 2 on the other (lacking the one just before the suture on this side). Scutellum with three large lateral, the apical (scars) far apart and strong; one discal scutellar pair. Supraalar 2; sternopleural 1, 1 on one side, the other 2, 1, but the lower small. Abdomen with nearly uniform bluish-gray pollen, becoming distinctly more yellowish on fourth segment; the hair is coarse and almost suberect. First segment with one pair median marginals; second with one pair; third with a marginal row of about 10, and a submarginal irregular pair on the middle, too far back to be called discals; fourth segment with numerous erect small and large bristles beginning near base. In spite of Weidemann's statement, the abdomen shows very little tessellation. Legs black; middle tibia with two bristles on outer front side, the lower large; hind tibia with a row of erect almost uniform bristles on the whole length, just below the middle one considerably larger (on one side, the other has two less enlarged at this place). This does not quite agree with Brauer and Bergenstamm. Wing subhyaline, third vein with two small setules at base; fourth vein with oblique rounded bend, ending considerably before apex.

The species is exceedingly like *Frontina frenchii* Williston (synonym *hesperus* Brauer and Bergenstamm, type of *Achaetoneura*) of the United States, but the latter has bare eyes, four sternopleurals, three supraalars, and the third antennal joint is broad to the tip.

Not represented in the National Museum.

86. MICROCHIRA APERTA Brauer and Bergenstamm

Paradidyma aperta BRAUER and BERGENSTAMM, Denk. Wien. Akad. Wiss., vol. 60, 1893, p. 127.

Microchira mexicana BRAUER and BERGENSTAMM, Denk. Wien. Akad. Wiss., vol. 60, 1893, p. 128.—ALDRICH, Annals Ent. Soc. Amer., vol. 18, 1925, p. 121.

One male labeled "Bilimek, Mexico, 1883," undoubted type of the species. This is clearly the male of *Microchira mexicana*, described by Brauer and Bergenstamm on the following page from a female; I have previously reported on this specimen as indicated above. The male differs from the female principally in the shape of the head, having a narrower and much more prominent front and stouter antennae. The frontals extend in an irregular row down the parafacial to the transverse impression, about to the lower curve of the eye, and are considerably larger and more numerous than in the female; the hairs of the upper parafacial and lower part of parafrontal are coarse and bristly. The third antennal joint is considerably stouter than in the female and nearly four times the second. The arista is thickened on the basal two-fifths and distinctly pubescent. As in the female, the pollen of the head, thorax, and abdomen has a somewhat yellowish cast, especially on the lower part of the head and the last abdominal segment. The male differs from the female in having normal front tarsi with moderately elongated claws and pulvilli.

The National Museum contains two females of *aperta* from Federal District, Mexico, collected by E. G. Smyth on August 31, 1922.

87. HYSTRICIA COPULATA Wiedemann

Tachina copulata WIEDEMANN, Auss. Zweifl., vol. 2, 1830, p. 295.

Hystricia copulata BRAUER and BERGENSTAMM, Denk. Wien. Akad. Wiss., vol. 58, 1891, p. 409.—ENGEL, Zool. Jahrb., vol. 43, 1920, p. 306, fig.

The history of this species is very curious. Wiedemann described it from two Brazilian specimens which he evidently believed had been taken in copulation. He noted that the male had a dark face and blackish beard, while the female had a yellowish face and white beard. Both specimens are before me. His male bears a very old label, probably Wiedemann's, in ink brown with age, "copulata Wied. ♂ Brasilien," also a Brauer and Bergenstamm label, "Hystricia copulata Wied.," and a red label, "Type." The other specimen, also a male, is labeled "cop. ♀ " in the same handwriting and brown ink as the preceding; also "Brasilien" a Brauer and Bergenstamm label "Willistonia copulata Wied.," and "Coll. Winthem."

Brauer and Bergenstamm, 1891, in their systematic list of the material in the Vienna Museum, entered *Willistonia copulata* Wiedemann on page 403, and *Hystricia copulata* Wiedemann on page 409, but gave no indication that these were described as a single species by Wiedemann.

The supposed female is a male of a species of *Belvosia.* It lacks the fourth abdominal tergite almost completely, which greatly changes its appearance and misled Wiedemann. There are only one or two narrow vestiges of this tergite present, but they show characteristic dense white pollen; the fifth sternite is present and indicates the male sex, as the absence of fronto-orbitals also does.

The male (to which the species is hereby restricted) has been reported upon in detail and the genitalia well figured by Engel. He follows Brauer and Bergenstamm in placing it in the genus *Hystricia*, and I agree in this. On looking for the species in the National Museum, I found only a single female, which Townsend had placed under a manuscript specific name in his genus *Hystriciopsis.* This genus was proposed by Townsend[6] for the new species *obscura*, from Peru; the characters were as follows: "Runs to *Hystricia* in Brauer and Bergenstamm's tables. May be distinguished by the epistoma being only moderately salient, not nasute; by the thickly haired tegulae, and by the distinctly curvate character of the spinelike macrochaetae." On comparing *obscura* with *amoena* Macquart, the genotype of *Hystricia*, I find they are just alike in the pilosity of the calypter, while the other characters adduced seem too slight to establish a genus upon. *Hystricia* has, among other characters, bare parafacials, pilose eyes, palpi of good size but not excessively developed, lower calypter hairy, with numerous spinose bristles on scutellum and 2–4 abdominal tergites, also a few on the sternites.

Hystricia copulata is a smaller species than *amoena* and *obscura.* The pollen of the male is spoiled, but in the female in the National Museum it is slate colored on the parafrontals, pale plumbeous on parafacials, face and cheeks; the palpi are almost black, only the tips a little paler; anterior part of thorax with considerable cinereous pollen, becoming thinner toward scutellum, which is shining brown. Calypters dark brown with dense blackish hair. The abdomen is shining brown with some indications of reddish, and in a very oblique view a slight trace of brown pollen. Venter wholly shining. The narrowest part of the front is 0.15 of head width in male, and 0.22 in female. The cheek is about 0.4 the eye height in both sexes, the beard white behind but considerably mixed with black on upper and anterior part of cheek; several rather distinct bristles stand a

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[6] Ins. Ins. Menst., vol. 2, 1914, p. 85.

little outside the vibrissae, separated by a reddish downward prolongation of the transverse impression. Engel's description and figure supply sufficient details.

I leave Wiedemann's supposed female, really a male of *Belvosia*, without further identification, as it is in poor condition.

88. ZENILLIA THERMOPHILA Wiedemann

Tachina thermophila WIEDEMANN, Auss. Zweifl., vol. 2, 1830, p. 325.
Sisyropa thermophila BRAUER and BERGENSTAMM, Denk. Wien. Akad. Wiss., vol. 56, 1889, p. 163; vol. 58, 1891, p. 344; vol. 60, 1893, p. 113, 122.

One male, "thermophila Wied. Java," and "Coll. Winthem," also red "type" label. I asked to see this Java specimen in order to assure myself about the status of the genus *Sisyropa*, this being the type species.

The genus was established by Brauer and Bergenstamm in 1889 (p. 163), with only this species. In 1891 (p. 344), the authors gave a synopsis of a dozen species, from Java, Europe, Australia, and Brazil, prefacing with the remark, "We should probably have done better to unite the species of this genus with those in the genus *Parexorista*, with which, as also with *Chaetolyga*, they have the head structure in common." In 1893, however, they place *Sisyropa* in the section Blepharipoda (p. 122), and *Parexorista* in section Masicera (p. 113).

Since the standing of the genus depends entirely (aside from questions of priority) upon the characters of the type species, these will be briefly enumerated. The head of the specimen is obviously shrunken, so micrometer measurements are of doubtful value.

Male, front moderately wide, face considerably wider but not widening very much below middle; front not prominent, face moderately receding; cheek probably about one-sixth the eye height in normal specimen; parafacial bare, very narrow below; vibrissae at oral margin; clypeus wide, facial ridges bristly only one-fifth of the way. Ocellars small, proclinate, parallel; frontals about 10, the uppermost pair large and reclinate, succeeding ones small, then gradually larger near antennae, the lowest almost at level of arista; one or two smallish bristles outside the main frontal row near antennal insertion. Antennae reaching four-fifths of the way to the oral margin, third joint of medium width, a little more than twice the second; arista slender, only a little thickened on proximal half, basal joints short. Palpi normal, proboscis short, fleshy.

Thoracic chaetotaxy: acrostichal, 3, 3 (damaged, a little uncertain); dorsocentral, 2, 4; humeral, 3; posthumeral, 2; presutural, 2; notopleural, 2; supraalar, 3; intraalar, 3; postalar, 2; sternopleural, 2, 1; pteropleural minute; scutellum with 4 lateral, 1 rather large depressed apical, 1 discal.

Abdomen ovate; first and second segments with one smallish erect median marginal pair of bristles, third with a marginal row of about 12 larger; fourth with erect coarse hairs becoming bristly at hind margin; no discals on second and third, but the hairs on whole dorsal surface are rather dense, evenly placed, and become more erect near the median line. On the venter of the third segment, the inflexed tergite bears on each side a distinct rounded tuft of long hairs.

The legs are of ordinary structure, the claws and pulvilli moderately elongated; middle tibia with two bristles on outer front side and a smaller depressed one below them. The hind tibiae are obviously ciliated, with one bristle below middle row.

Wings ordinary; first posterior cell rather wide open well before tip of wing; third vein with three or four setules at base, the others bare.

The species is not represented in the National Museum. The North American species *Zenillia eudryae* Townsend shows hardly a single difference throughout; three instead of four lateral scutellar bristles is the only one I find. *Carcelia gnava* Meigen of Europe is also closely related, and as the genus *Carcelia* dates from 1830 it certainly includes *Sisyropa* as a synonym. Townsend based his genue *Oxexorista* on *eudryae*, but later restricted the genotype to a single specimen which he named *thompsoni.*[7] This specimen shows only slight differences from *eudryae*, hence *Oxexorista* also becomes a synonym of *Carcelia.* It was the judgment of Aldrich and Webber[8] that *Carcelia* itself should be a synonym of *Zenillia* Robineau-Desvoidy.

89. ZENILLIA RUFIVENTRIS Brauer and Bergenstamm

Sisyropa rufiventris BRAUER and BERGENSTAMM, Denk. Wien. Akad. Wiss., vol. 58, 1891, p. 346.

One male, "Beske, Brasilien," with Brauer and Bergenstamm label. Undoubted type. This goes readily in *Exorista* of authors (for which *Zenillia* is used by Aldrich and Webber). Not in National Museum. It is closely allied to *cheloniae* Rondani, and hence may be referred to the subgenus *Parexorista.* There is no outer vertical bristle. The body surface and chaetotaxy are considerably damaged, although the head is perfect. Front 0.24 of head width by micrometer. The apical half of the fourth abdominal segment is shining black, apparently contrasting with basal half. Most of the dorsum of the abdomen and nearly all the venter red. Middle tibia with one bristle on outer front side.

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[7] Proc. Ent. Soc. Wash., vol. 14, 1912, p. 165; and Proc. Biol. Soc. Wash., vol. 28, 1915, p. 21.

[8] Proc. U. S. Nat. Mus., vol. 63, art. 17, 1924, p. 7.

90. ZENILLIA PROSPERINA Brauer and Bergenstamm

Sisyropa proserpina BRAUER and BERGENSTAMM, Denk. Wien. Akad. Wiss., vol. 58, 1891, p. 347.

One male, "Brasilien," with Brauer and Bergenstamm label. The undoubted type. The species has been described by Brauer and Bergenstamm and shows few noteworthy additional characters. It is a large robust form, which would readily go in *Exorista* of authors (*Zenillia* as used by Aldrich and Webber). Palpi dark yellow, covered with dense black hairs; dorsocentral 3, 4; presutural 2; sternopleural 2, 1; scutellum with 3 lateral, 1 apical decussate and depressed; pteropleural minute. No discals on second and third abdominal segments, on which the dark pattern takes the form of a broad median stripe and a lateral triangle, which is contiguous and does not reach the front edge. The third tergite has no cluster of hairs below. Middle tibia with one bristle on outer front side; hind tibia ciliate; tarsi with long claws and pulvilli.

The species is not in the National Museum.

91. WINTHEMIA XANTHOCERA Wiedemann

Tachina xanthocera WIEDEMANN, Auss. Zweifl., vol. 2, 1830, p. 329.

Masipoda xanthocera BRAUER and BERGENSTAMM, Denk. Wien. Akad. Wiss., vol. 56, 1889, p. 163; vol. 58, 1891, p. 402; vol. 60, 1893, p. 123.

One female, "Brasilien"; an old folded label reads "xanthocera Wied. Coll. Winthem." Agrees with description except that the front is cinereous pollinose with dark red stripe, and the antennae are more reddish-brown than reddish-yellow. I believe it is one of the type series, of which Wiedemann had at least two. It is a true *Winthemia* (syn. *Masipoda*), in spite of the fact that even under a high power it shows not a single parafacial hair. Otherwise it has the characteristic structure of the genus throughout, including the tubular ovipositor. The second abdominal segment has a single large pair of marginals; the middle tibia has a single bristle on the outer front side near middle; there are only two sternopleurals.

One female in the National Museum, collected at Bartica, British Guiana, June 7, 1901, agrees remarkably throughout except that under a high power it shows two or three pale slender hairs on the parafacial. Provisionally I regard this as the same species. Only the discovery of the male can clear the species up any further.

92. URAMYIA PRODUCTA Robineau-Desvoidy

Uramyia producta ROBINEAU-DESVOIDY, Myodaires, 1830, p. 204.—BRAUER and BERGENSTAMM, Denk. Wien. Akad. Wiss., vol. 58, 1891, p. 130; vol. 60, 1893, p. 135.

Two males; one labeled "Schott Brasilien," the other "Bahia Coll. Winthem."

These are not types, but the species is the type of *Uramyia.* The specimens agree exactly with those identified by Townsend in the National Museum, and discussed by me.[9]

GYMNOSTYLIA Macquart

The status of this genus requires elucidation before proceeding to a discussion of the three species received under this generic name.

Macquart described the genus in his Histoire Naturelle de Diptères.[10] He included three species from Robineau's Myodaires of 1830—*Macromya depressa*, *Harrisia scutellaris*, and in a separate division with tomentose arista *Leschenaultia cilipes.* These were all Brazilian species. No genotype was indicated until 1916, when Townsend[11] designated *Macromya depressa.* On the same page he designated the same species as genotype of *Macromya* Robineau-Desvoidy[12] which originally contained this and one other Brazilian species. Thus *Gymnostylia* is a complete synonym of *Macromya.* The genotype of the latter, *depressa*, is totally distinct from anything placed in *Gymnostylia* by Brauer and Bergenstamm. It is a very large, robust, depressed, yellow species, 16 to 18 mm. long, which I have not seen and am unable to place from the meager description (Macquart's description is compiled from Robineau's).

93. OXYAPORIA ORNATA Brauer and Bergenstamm

Gymnostylia ornata Schiner, Brauer and Bergenstamm, Denk. Wien. Akad. Wiss., vol. 56, 1889, p. 128, fig.; vol. 58, 1891, p. 374, desc.; vol. 60, 1893, p. 130.

One male, type of species, from Venezuela (Lindig, 1864). Schiner never described the species, hence it should be attributed to Brauer and Bergenstamm. They gave in 1891 a good but brief description. The species forms a distinct genus which has been named

OXYAPORIA Townsend

Oxyaporia Townsend, Insecutor Ins. Menst., vol. 6, 1918, p. 170; Revista Mus. Paulista, vol. 15, 1926, p. 273. Type designated, *Gymnostylia ornata* **Schiner.**

Elongated and slender, allied to *Urodexodes* but with parafacials hairy. Hypopleural bristles and post scutellum well developed. Front rather narrow, a little prominent, face moderately receding; eyes bare, rather obliquely placed so that the lower part is considerably anterior to back of head; cheek one-fourth the eye height.

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[9] Ins. Ins. Menst., vol. 9, 1921, p. 85.
[10] Vol. 2, 1835, p. 216.
[11] Ins. Ins. Menst., vol. 4, p. 7.
[12] Myodaires, 1830, p. 322.

Vibrissae at oral margin, facial ridges with a few hairs below; parafacials rather narrow, with a few distinct hairs all along near facial ridge. Third antennal joint elongate, moderately slender, three times the second, basal joints of arista short. Palpi normal, proboscis short. Thoracic chaetotaxy: acrostichal 3, 1; dorsocentral 3, 4; humeral 3; posthumeral 1; presutural 2 (inner hairlike); notopleural 2; supraalar 3; intraalar 3; postalar 2; sternopleural 1, 1; pteropleural small; scutellum with 3 lateral, only a minute hair or two at apex, one smaller discal pair.

Abdomen slender; one large median marginal on first and second segments, marginal row on third and fourth; second and third segments with 2 pairs discals, fourth thinly covered with bristles. Genitalia small, concealed. Sternites after the first concealed by overlapping of tergites. Legs long, claws and pulvilli large.

Wings long and narrow, first posterior cell open only a little before extreme apex, fourth vein with rounded curve; veins bare except a few hairs at base of third.

Type of genus.—Gymnostylia ornata Brauer and Bergenstamm.

OXYAPORIA ORNATA Brauer and Bergenstamm

Male.—Black, abdomen broadly yellow on sides. Head cinereous, palpi yellow. Thorax with large black median spot, slightly divided in the middle before the suture by a silver line which widens a little posteriorly, and concave behind on account of a silvery spot before scutellum; a wide silvery stripe begins at the humerus each side and narrows above the wing, reaching the corner of scutellum, the latter black with a little brownish reflection.

Abdomen with thin silvery tessellation, more distinct on sides, not forming crossbands except when viewed directly from behind; a median ventral black stripe on the tergites.

Legs black, elongated, the tarsi longer than the tibiae. Middle tibia with one bristle on outer front side, hind not at all ciliated; with one bristle on outer side below middle opposite one on inner side, and nearly opposite a flexor one.

Wings brown, hardly paler behind; third vein with about four hairs at base.

Length, 10.5 mm.

Redescribed from the type in the Vienna Museum.

Not in the United States National Museum.

94. URODEXODES CINGULATA Schiner

Meigenia cingulata Schiner, Novara Reise, 1868, p. 327.

Gymnostylia cingulata Brauer and Bergenstamm, Denk. Wien. Akad. Wiss., vol. 58, 1891, p. 465.

The two type males are mentioned by Schiner, and agree with his description: Labeled, "Novara R. Brasilia."

This species is in the National Museum, as I find the following specimens: Three males, Rio Charape, Peru, 3,700–4,500 feet, September 17 and December 12 and 15 (Townsend); one male and one female, Casahuiri, Peru, February 4 and 14 (Townsend); one male, Las Cascadas, Panama, March 3, 1909 (A. H. Jennings). I refer the species to the genus *Urodexodes* Townsend, described in Proceedings of the U. S. National Museum,[13] with the single species *charapensis*, new, from Rio Charape, Peru. *U. cingulata* differs from *charapensis*, the genotype, in having yellow palpi, distinct but small ocellars, much more sharply defined silvery pollinose bands on the abdomen, and the wings hardly infuscated.

95. LIXOPHAGA FAMELICA Wiedemann

Tachina famelica WIEDEMANN, Auss. Zweifl., vol. 2, 1830, p. 331.
Gymnostylia famelica BRAUER and BERGENSTAMM, Denk. Wien. Akad. Wiss., vol. 58, 1891, p. 405.

One male, considerably broken, "Brasilien, Coll. Winthem," agreeing with Wiedemann's description. It is a *Lixophaga* closely related to *variabilis* of North America.

Black with yellowish-gray pollen. Front 0.254 of head width; without orbitals. Third antennal joint three and one-half times the second; arista with basal joints short. Palpi yellow. Acrostichal, 3, 3; dorsocentral, 3, 3; sternopleural, 2, 1. Mesonotum with rather dense yellowish pollen on which are two pairs of shining black stripes, the outer broader and interrupted.

Abdomen rather narrow, with basal crossbands of yellowish pollen on second, third, and fourth segments, which occupy nearly half the length, are slightly interrupted at median line, and bear numerous small black dots from which the hairs arise. No discals even on the fourth segment, one pair median marginals on first and second segments, a marginal row on third and fourth. Third segment with no matted or clustered hair on ventral side. A trace of yellow ground color on sides of second segment.

Legs black, claws and pulvilli moderately elongate; middle tibia with one bristle on outer front side, hind not ciliated.

The species hardly differs from *variabilis* except in having fully the posterior half of abdominal segments 2, 3, and 4 shining, while in *variabilis* the pollen covers all except a narrow hind margin.

Not in United States National Museum.

Length, 5 mm.

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[13] Vol. 56, 1919, p. 572.

96. CHAETONA LONGISETA Wiedemann

Dexia longiseta WIEDEMANN, Auss. Zweifl., vol. 2, 1830, p. 381.
Viviana citrina BIGOT, Annales Soc. ent. France, 1889, p. 262.—BRAUER, Sitzungsber. Kais. Mus., vol. 106, p. 7.
Chaetona longiseta VAN DER WULP, Biologia Dipt., vol. 2, 1891, p. 253, pl. 6, fig. 8.—BRAUER and BERGENSTAMM, Denk. Wien. Akad. Wiss., vol. 50, 1891, p. 378.

One female, "Brasilia," "longiseta Wd. coll. Winthem," and B. B. label. Undoubtedly the type, as the plumosity of the arista is matted together by treatment with a solution as Wiedemann says. A second specimen, a male, is erroneously labeled *icterica*, but does not agree with the type of that species; it is also from Brazil and in "coll. Winthem."

The genus *Chaetona* was established by Van der Wulp (see above) for this and another species. Coquillett designated *longiseta* as the genotype in his Type Species (1910, p. 521). A female in the National Museum from Caura Valley, Venezuela, was correctly identified by Townsend; and I have lately added a male, collected by me at La Providencia, Siquinala, Guatemala, April 16, 1926.

Van der Wulp's description and figure are very recognizable, but he shows the abdomen too broad near tip, and the profile shows the front too prominent and bulging. The exceptionally long arista with short, delicate plumosity is a very striking character.

97. CHAETONA ICTERICA Wiedemann

Tachina icterica WIEDEMANN, Auss. Zweifl., vol. 2, 1830, p. 321.
Chaetona icterica BRAUER and BERGENSTAMM, Denk. Wien. Akad. Wiss., vol. 58, 1891, p. 378.—TOWNSEND, Annals N. Y. Acad. Sci., vol. 7, 1892, p. 22.

Two males from the Winthem collection are so labeled, but not called types; both are from Brazil. One is *Chaetona longiseta* Wiedemann, but not the type specimen; this I eliminate from *icterica*. The other is a different species, and agrees with the description of *icterica*; undoubtedly the type.

Male.—Eyes bare; front narrow and rather prominent below, at narrowest 0.19 of headwidth by micrometer; a single pair of smallish verticals; ocellars small, proclinate; frontals about ten, the uppermost two reclinate, lowest at middle of second antennal joint (lower on one side than the other); parafrontals and parafacials yellowish pollinose, dull, the latter bare and as narrow as third antennal joint. Antennae black, slender, third joint nearly four times the second and slightly enlarged toward tip, arista slender except on basal fourth, less than twice as long as third antennal joint, with perhaps a slight pubescence in well-preserved specimens. Vibrissae slightly above oral margin, face not much receding, long and narrow, the ridges bare; palpi yellow, ordinary; cheek about one-third the eye height; proboscis short, fleshy.

Thorax considerably damaged; its ground color is black, the dorsum yellow pollinose, on which stand out the narrow intermediate and broad interrupted lateral stripes in black, also a black basal semicircle on scutellum. Chaetotaxy, as far as can be made out: acrostichal (?); dorsocentral, 2, 3; humeral, 2; notopleural, 2; posthumeral, 1; presutural, 1; supraalar, 3; intraalar, 3; postalar, 2; scutellum with two lateral, one long apical; sternopleural, 2, 1; no pteropleural; hypopleural, 6. Postscutellum well developed.

Abdomen yellow in ground color, tip of third segment and all but base of fourth black; bases of segments narrowly yellow-pollinose, in a very flat view the pollen grows much more extensive; first and second segments with one pair of median marginals, third and fourth with marginal row, no discals on any segment. Genital segments very small.

Legs black; claws and pulvilli a little elongated; middle tibia with a single bristle on outer front side; hind tibia not ciliated.

Wings quite uniformly infuscated, the veins on apical half bordered by a deeper shade, as Wiedemann says, fourth vein with oblique curve, then concave, the first posterior cell open not far before the apex; third vein with only two or three hairs at base.

Length, 8.6 mm.

The species is not in the National Museum. It is not the type of any genus.

98. NEOMINTHO MACILENTA Wiedemann

Tachina macilenta WIEDEMANN, Auss. Zweifl., vol. 2, 1830, p. 305.
Neomintho macilenta BRAUER and BERGENSTAMM, Denk. Wien. Akad. Wiss., vol. 58, 1891, p. 339; vol. 60, 1893, p. 120.

Two males, "Brazilien," and "macilenta, Coll. Winthem." They agree with the descriptions except that the white pollen of the scutellum and the two slender black lines on the anterior part of the mesonotum are visible from behind, not in front. Undoubtedly the types. The genus was established by Brauer and Bergenstamm (1891, p. 339) for this species and two others. Townsend designated *macilenta* as type in 1916,[14] carrying out the apparent intention of the authors, who mentioned only this species in their 1893 paper (p. 120). Wiedemann's description is fairly recognizable, especially

[14] Ins. Ins. Menst., vol. 4, p. 8.

when taken in connection with Brauer and Bergenstamm's. The latter mention the female, with flattened fore tarsi and smaller ocellars than the male; I do not have this sex.

Male.—Front at narrowest (vertex) 0.23 of head width. Front a little prominent, slightly shorter than face, which is receding. Head wider than high (48 to 37); vibrissae at oral margin; facial ridges bristly about half way; frontals descending to middle of second antennal joint; no orbitals; frontal stripe wide. Parafacials bare and silvery. One large pair of frontals reclinate; ocellars large, proclinate. Antennae long, third joint broadest in middle, three to four times the second; arista with basal joints short, slightly thickened for one-fifth its length. Palpi normal, yellow; proboscis fleshy, short. Back of head slightly bulging. Thorax somewhat damaged in both specimens, the disk nearly all black with broad white lateral border before wings. Pleurae almost silvery. Chaetotaxy: acrostichal, 2 anterior (none just before suture), posterior spoiled; dorsocentral, 3, 3; humeral, 3; posthumeral, 2; presutural, 1 large; notopleural, 2; supraalar, 3 (middle one large); intraalar, 3 (the front one minute); sternopleural, 3 in a small triangle rather far back; scutellum with 2 lateral (the posterior large) and one rather long, depressed apical pair; disk with upright bristly hairs and a few depressed ones behind. Post scutellum and hypopleurals well developed. Calypters moderately large, pure white. Abdomen narrow, shining black, the first segment nearly as long as the second; second and third with broad basal silvery band, including about half the segment above, less below; fourth segment wholly shining black. First segment with a pair of large strong median marginals; second the same; third with marginal row of same, but the median pair, as in the preceding segments, is not very close to hind margin; fourth segment with a marginal row placed as on third. The larger bristles of thorax and abdomen are flattened longitudinally at base, giving them a very stout appearance. There are no true discals on the abdomen.

Legs black, rather stout, front tarsi unusually so; all claws and pulvilli elongated. Middle tibia with three bristles on outer front side, the intermediate largest; hind tibia with a few irregular bristles on outer side.

Wing noticeably brownish, more so along veins, tips rounded, first vein hairy on its middle third, third vein hairy almost to small cross vein; bend of fourth vein oblique, slightly rounded; first posterior cell open in margin rather far before apex; third vein undulating beyond small cross vein, widening the first posterior cell near its middle.

The genus differs from *Phorocera* in having the head more rounded, first vein hairy, and abdomen narrow. The female probably has a piercer, as Brauer and Bergenstamm say the venter is "stufig" (in steps).

The genitalia (fig. 1) are much like those of *Phorocera* (*Euphorocera*, *Neophorocera*) *claripennis* Macquart, of the United States; the united inner forceps form a convex disk basally with a slight, shining median ridge, the apex drawn out into a slender process slightly curved up; the outer forceps are reduced to flat plates. Both pairs brown in color. The fourth abdominal segment is greatly shortened below, the sternite small and almost invisible.

FIG. 1.—NEOMINTHO MACILENTA WIEDEMANN

Not in the National Museum.

99. **PHOROCERA HEROS** Schiner

Phorocera heros SCHINER, Novara Reise, 1868, p. 325.
Neomintho heros BRAUER and BERGENSTAMM, Denk. Wien. Akad. Wiss., vol. 58, 1891, p. 339.
Phorocera coccyx ALDRICH and WEBBER, Proc. U. S. Nat. Mus., vol. 63, art. 17, 1924, p. 64.

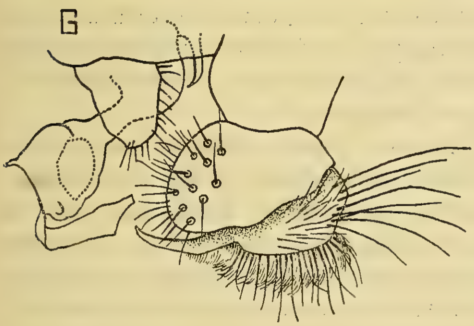

FIG. 2.—PHOROCERA HEROS SCHINER

Two males, "Brasilien," one is "Coll. Winthem" and the other is apparently from the same lot.

I have spread the genitalia of these males and find them to be of the same species described as *Phorocera coccyx* by Aldrich and Webber in 1924 from Virginia, New York, and Indiana. Specimens received later are from Maryland, Oklahoma, and Cordoba, Mexico. Since Schiner mentioned only a female in the original description, it might be thought that neither of the Brazilian specimens received from the Vienna Museum could be the type. However, it seems clear that Schiner made a mistake regarding the sex. He gives the length as 15 mm., agreeing with these males, while in this species the female has a shorter abdomen, our single specimen of this sex measuring only 9 mm. The description of *coccyx* is accessible and need not be repeated, but I add a figure of the unique genitalia (fig. 2, drawn by my colleague, C. T. Greene). I see only two slight points of difference between our northern males and the Brasilian ones—the latter have two small bristles outside the lower ones in the frontal row, as mentioned by Schiner, and they also have a somewhat narrower and more sharply limited basal pollinose crossband on the second and third abdominal segments. I do not consider these differences sufficient to maintain even a varietal standing for *coccyx*.

100. PHOROCERA BISERIALIS Schiner

Phorocera biserialis SCHINER, Novara Reise, 1868, p. 326.
Ctenophorocera biserialis BRAUER and BERGENSTAMM, Denk. Wien. Akad. Wiss., vol. 58, 1891, pp. 342, 402.

One male, one female, " S. Amerika " and " Rio de Janei ", both with puparia as indicated by Schiner.

Since Schiner referred the species to *Phorocera*, it is necessary to find out why Brauer and Bergenstamm placed it in a different genus.

Ctenophorocera was proposed by Brauer and Bergenstamm in 1891, and four species were placed in it—*Tachina experta* Wiedemann, from Cape of Good Hope; *Phorocera biserialis* Schiner from Brazil; *Tachina munda* Wiedemann, from Tranquebar; and *blepharipus*, new species, from Cape of Good Hope or Brazil. In 1893 (p. 84) they removed *munda* Wiedemann to *Achaetoneura*, remarking that the eyes were almost bare. In the same year in the keys they placed the genus *Ctenophorocera*, on page 119, in the Group Phorocera and on page 121, in Group Blepharipoda, both times referring directly to *experta* as if it were type. Townsend[15] designated *experta* as type.

I asked to see only the American species *biserialis* and the possibly American one *blepharipus*, which are before me. Unfortunately I did not ask for the type species of the genus.

I have, however, compared the two I have with the generic description. The characters possibly differentiating the genus from *Phorocera* (type *assimilis* Fallen) are three. First, the row of bristles extending up each facial ridge is accompanied on the outer side by a row of hairs. It requires only an examination of a dozen or so of related species to see that this has very slight value. Second, the length of the head at vibrissae is almost equal to that at antennae; in other words the face is hardly receding. This is true of *blepharipus* but certainly not of *biserialis*. The American genus *Murdockiana* might be considered here, but it has the epistoma strongly jutting forward between the vibrissae, unlike *blepharipus*. The third character is the ciliation of the hind tibiae, which is present in both of the species before me. This is a character which is best developed in males, runs through all possible degrees, and its

[15] Ins. Ins. Menst., vol. 4, 1919, p. 7.

validity, never high in this group, depends on the absence of connecting forms in the particular small series under consideration. Not having the genotype of *Ctenophorocera* at hand, I can express no positive opinion of the genus, but I would put *biserialis* back in *Phorocera*, where Schiner described it.

Front at narrowest 0.23 of the head width in male, 0.27 in female at vertex. Eyes densely hairy, cheek 0.3 the eye height. head with yellow pollen in male, gray in female; male without orbitals but with a few extra bristles outside the frontal row (whence the name) opposite the antennal insertion; female with orbitals but with simple frontal row; palpi yellow, obscured with rather dense dark hairs. Cheek and a considerable space behind lower part of eye with black hair. The row of hairs outside the bristles of facial ridge is but slightly developed, no more than in several North American species of related genera which I examined for comparison.

Mesonotum gray (tinged with yellow in male) with four shining black stripes. Chaetotaxy: acrostichal, 3, 3; dorsocentral, 3, 3; humeral, 4; posthumeral, 2; presutural, 2; notopleural, 2; supraalar, 3; intraalar, 3; postalar, 3 (1 large between 2 small); sternopleural, 1, 1 (2, 1 in male, the lower small); pteropleural, 0; scutellum with 3 lateral, 1 small apical (broken off) and 1 discal. Scutellum dark in ground color with only trace of lighter at tip, densely gray pollinose with a darker spot on disk beyond middle. Calypters yellowish-white. Abdomen black, densely gray pollinose, tessellated, more yellowish in male and with indistinct reddish ground color at sides; no discals except on fourth segment, which has dense yellow pollen in female, golden in male. Second segment with one pair median marginals. Male with no patch of hairs on venter of third segment, but with an oval area of very fine hair on the fourth segment below, extending nearly to the side and sharply differentiated there.

Legs black, tarsi not long, but with slightly elongated claws and pulvilli; middle tibia with one bristle on outer front side; hind tibia ciliated in male, much less so in female.

Wings subhyaline; fourth vein with rounded rectangular bend; first posterior cell open not very far before apex; third vein with 2–3 hairs at base, other veins bare.

Length, 8 mm.

Not in National Museum.

101. PHOROCERA CAERULEA Jaennicke

Phorocera caerulea JAENNICKE, Neue Exot. Dipt., 1867, p. 382.
Ctenophorocera blepharipus BRAUER and BERGENSTAMM, Denk. Wien. Akad. Wiss., vol. 58, 1891, pp. 342, 402.

The locality as given in the original description was left in uncertainty between Cape of Good Hope and Brazil, hence I asked to see the type. It is a male labeled "caffra. Coll. Winthem," and "89" on a red tag; also a large blue name label in Doctor Villeneuve's writing, upon which after the name he has written "(caerulea Jaenn. teste Brauer)". As Jaennicke's species was from Abyssinia, I conclude that *blepharipus* is African, and may be dropped from the American list.

102. PAMMAERUS LEPTOTRICHOPUS Brauer and Bergenstamm

Sisyropa leptotrichopa BRAUER and BERGENSTAMM, Denk. Wien. Akad. Wiss., vol. 58, 1891, p. 347.

Two males on same pin, from "Brasilien" and bearing the Brauer and Bergenstamm label. Undoubtedly the types, although taken for females by the describers on account of the presence of orbital bristles. I designate the species as the type of the following new genus.

PAMMAERUS, new genus

Allied to *Doryphorophaga* and *Muscinothelaira*. Eyes hairy; front broad in male with two pairs of orbitals; ocellar bristles of ordinary size, located rather far forward, so the anterior ocellus is exactly between them; ocellar triangle large; parafacials rather wide, very bright silvery pollinose; third antennal joint slender, four times the second, with long, thin arista, its basal joints short. Frontal bristles far apart (upper two pairs probably reclinate but missing), the lowest at middle of second antennal joint. Front not prominent, face receding; facial ridges feebly bristled almost to middle.

Palpi normal, proboscis short, cheek one-eighth the eye height. Thoracic chaetotaxy: acrostichal, 3, 3; dorsocentral, 3, 4; humeral, 4; posthumeral, 2; presutural, 2 (the inner minute); notopleural, 2; supraalar, 3 (stout, flattened); intraalar, 3; postalar, 2; sternopleural, 2, 1; pteropleural minute; scutellum with 3 lateral, one small decussate semierect apical, and one small discal.

Abdomen without discals on second, third, and fourth segments. One small pair median marginals on first segment, one large on second, a row on third and fourth. Third segment on ventral side with patch of dense, short hairs. Genitalia small.

Tarsi with minute claws and bristles; middle tibia with a single bristle on outer front side; hind tibia ciliated, with one bristle below middle of row in one specimen.

Wings of ordinary structure, first posterior cell open before apex, third vein with 5–8 coarse hairs at base.

Type of genus.—Sisyropa leptotrichopa Brauer and Bergenstamm.

PAMMAERUS LEPTOTRICHOPUS, Brauer and Bergenstamm

Male.—Front broad, 0.35 of the head width, with two large orbital bristles on each side. The ground color of the front is black, heavily overlaid with yellow pollen. The median stripe is brown, almost as wide as either parafrontal. Verticals one large and one small; frontals about six, the upper two pairs represented only by large scars, probably reclinate, the next ones much smaller, decussate, one pair large just at the root of the antennae, and one pair below these. The parafrontals are rather densely covered with short black hairs, which below the upper orbital are proclinate, but above it are reclinate, while near the median stripe they are directed toward the middle line. This peculiar arrangement of hairs I have never seen in any other species, and it is rather noticeable. Parafacial and posterior orbit, except the upper part, bright silvery pollinose; the former gradually narrowing to almost the level of the vibrissae, where it is about as wide as the third antennal joint. Antennae black, rather brownish at base; third joint decidedly slender and about three and one-half times as long as the second. Arista bare, very thin on the apical half, the basal third slightly thickened. Facial ridges with hairs and small bristles extending more than one-third of the way to the root of the antenna. Cheek one-sixth the eye height; palpi yellow; proboscis small; back of head flat with usual ruff of white hairs not very well developed, the lower part of the head having many black hairs extending from the cheek half-way up the orbit. Ocellar bristles small, proclinate.

Thorax and abdomen wholly black in ground color, the former with four subshining black stripes on gray pollen. The scutellum with yellowish pollen, black at base and a very slight reddish tinge in the ground color around the apex. Thoracic chaetotaxy: acrostichal, 3, 3; dorsocentral, 3, 4; humeral, 4; posthumeral, 3 (including one interhumeral); presutural, 2; notopleural, 2; supraalar, 3; intra-alar, 3; postalar, 2; sternopleural, 2, 1; pteropleural, 0; scutellum with 3 lateral and a small decussate pair of apicals.

Abdomen broadly pollinose on the last three segments, but not in very good condition to describe; the first segment has a very small pair of median marginals; the second a large pair; the third a marginal row of eight; the fourth a smaller marginal row of the same number. There are no discals on any segment; the fourth segment is densely pollinose on its whole upper surface as far as the row of bristles. Genitalia small; legs black; the knees narrowly reddish; all the claws and pulvilli small; middle tibia with one large bristle on outer front side; hind tibia with an even row of cilia and one larger bristle near the middle.

Wings hyaline; bend of fourth vein forming a rounded right angle, the cell open considerably before the apex; third vein with five to eight rather strong bristles at base; the costal segment between the auxiliary and the first vein rather longer than usual, about two-thirds of the following one.

Length, 11 mm.

Not in the National Museum.

103. PARAPORIA QUADRIMACULATA Macquart

Aporia quadrimaculata MACQUART, Dipt. Exot. Suppl., pt. 1, 1846, p. 296.—SCHINER, Novara Reise, 1868, p. 319.—BRAUER and BERGENSTAMM, Denk. Wien. Akad. Wiss., vol. 56, 1889, p. 130, fig. 222.

Two specimens from Vienna are male and female. They are labeled "Lindig 1864 Venezuela." They agree with Macquart and Schiner accounts, but are not types. The species is the type of *Aporia* Macquart, but that name was preoccupied. Townsend proposed to change it to *Neaporia*[16]; as this was later discovered to be preoccupied also, he changed it to *Paraporia*.[17] The species is not represented in the National Museum.

The specimens are not of the same species as those in the National Museum determined as *quadrimaculata* and so accepted by me.[18] These latter (two males) are much more like *Uramyia*, having an equally long but somewhat broader abdomen; they have on the second and third abdominal segments a large dark triangle with its truncated apex touching the preceding segment, leaving a cinerous spot on each side at base; these spots are not widely separated, and fade posteriorly, the rest of the dorsum of the segment being more or less reddish.

The true *quadrimaculata*, agreeing with Macquart's description and figure, is the species from Vienna; it has a much wider and shorter abdomen, velvet black in color, the two pairs of spots farther apart, smaller and much more sharply outlined. It is this form which is the genotype of *Paraporia*; there is no doubt of this, as Townsend proposed *Neaporia* long before he had seen a specimen, and it merely replaced *Aporia*, to be itself replaced by *Paraporia*. Neither genus was based on the specimens now in the National Museum. In this sense I think the genus *Paraporia* is a valid one, although in 1921, supposing the specimens in the National Museum to be of the type species, I placed it as a synonym of *Uramyia*.

The species which was called *quadrimaculata* by me in 1921 I would now call *Uramyia acuminata* Van der Wulp, which I erroneously placed as a synonym.

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[16] Muscoid Flies, 1908, p. 67.
[17] Ent. Soc. Wash., vol. 14, 1912, p. 48.
[18] Ins. Ins. Menst., vol. 9, 1921, p. 85.

Length, 16 mm., the same in both.

Macquart's figure of *quadrimaculata* shows the arista plumose, whereas it is merely pubescent on the basal half, bare apically; his text, however, calls it tomentose.

104. EUANTHA LITURATA Olivier

Ocyptera liturata OLIVIER, Encycl. Methodique, Hist. Nat., vol. 8, p. 423.
Dexia dives WIEDEMANN, Auss. Zweifl., vol. 2, 1830, p. 377.
Sericocera pictipennis MACQUART, Dipt. Exot., pt. 2 (3), 1843, p. 67, pl. 7, fig. 5.
Euantha dives VAN DER WULP, Tijdsch. v. Ent., vol. 28, 1885, p. 198; Biologia Dipt., vol. 2, 1891, p. 248.—BRAUER and BERGENSTAMM, Denk. Wien. Akad. Wiss., vol. 56, 1889, p. 137; vol. 60, 1893, p. 128.—TOWNSEND, Ann. Mag. Nat. Hist., vol. 19, 1897, p. 34.
Euantha pulchra VAN DER WULP, Biologia, Dipt., vol. 2, 1891, p. 249.
Euantha liturata COQUILLETT, Revis. Tachin., 1897, p. 86.—HOWARD, Ins. Book, 1902, p. 162.—JOHNSON, Psyche, vol. 19, 1912, p. 103.

One male, one female, both labeled "S. America, Coll. Winthem" and "dives Wd. Type BB." They agree with the description and are old specimens, but in good condition; presumably they are from the same period if not actually types. They agree with Van der Wulp's figure in Biologia except that he has the vibrissae too high up. There is a distinct costal spine, as noted by Townsend. The National Museum has ten specimens of both sexes, from Guatemala (Aldrich), Vera Cruz (Townsend), Florida, and Colorado, the last identified by Brauer and Bergenstamm. Coquillett made *dives* a synonym of *liturata* Olivier, which I believe on examining the original description is no doubt correct.

The female has the front shining, precisely as Van der Wulp indicates for his species *pulchra*; apparently he mistook some males of *dives* as females, as he says in this species the female does not have orbitals as it does in *pulchra*. It therefore seems certain that *pulchra* is a synonym. *Dives* is the genotype of *Euantha*.

105. EUANTHA AUCTA Wiedemann

Dexia aucta WIEDEMANN, Auss. Zweifl., vol. 2, 1830, p. 377.
Euantha aucta BRAUER and BERGENSTAMM, Denk. Wien. Akad. Wiss., vol. 58, 1891, p. 405.

One female, labeled "Brazilia," "Coll. Winthem," and "Euantha aucta Wd." It agrees precisely with the description.

The species differs from *liturata* in having no yellow in wings, general darker color, and legs black except at bases of femora. The front of the female is wholly pollinose except a small area including the bases of the orbital bristles. As Wiedemann says, the pollen of the bands on the base of second and third abdominal segments does not extend down the sides. The National Museum has two females from San Bernardino, Paraguay (Fiebrig), and one male from Yahuarmayo, Peru (Townsend). In the male the two abdominal bands extend down the sides to the margins of the tergites.

I add a third species with key to all three.

KEY TO SPECIES OF EUANTHA

1. Fourth vein with long appendage at bend; pollinose bands of second and third abdominal segments not interrupted in middle ---------- 2
   Fourth vein without appendage at bend or with a mere trace of one; abdominal pollinose bands interrupted in middle ---------- **interrupta**, new species.
2. Wing blackish without yellow region; male with black femora and abdomen. Female with abdominal bands not extending down the sides. **aucta** Wiedemann.
   Wing blackish apically, broadly yellow in middle; male with yellow femora and most of second and third abdominal segments reddish; female with abdominal bands extending down the sides (*dives* Wiedemann). **liturata** Olivier.

EUANTHA INTERRUPTA, new species

The male is similar in appearance to the two known species, but the yellow blotch in the wing is more squarely cut off just beyond the small cross vein, and the abdomen does not show the red ground color which is prominent in *liturata*. The abdominal bands are narrowly but distinctly interrupted in the middle line.

The female has quite black wings, with the discal cell nearly to its tip whitish, strongly contrasting. The abdominal bands are narrow and widely interrupted. It is much easier to pick the females as a distinct species than the males. The front of the female is indistinctly shining or very thinly pollinose along the middle stripe.

Legs black in both sexes.

Length of male, 11.2 to 13.6 mm.; of females, 9.2 to 11.8 mm.

Described from four males and three females. Collected at Higuito, San Mateo, Costa Rica, by Pablo Schild. One specimen is dated August 6, 1914.

Type.—Male, Cat. No. 40395, U.S.N.M.

106. PSEUDODEXIA EQUES Wiedemann

Dexia eques WIEDEMANN, Auss. Zweifl., vol. 2, 1830, p. 378.

Pseudodexia eques BRAUER and BERGENSTAMM, Denk. Wien. Akad. Wiss., vol. 58, 1891, pp. 372, 378; vol. 60, 1893, p. 131.

One male, labeled "Bahia" "eques Wd. Coll. Winthem." Undoubtedly type of the species *eques*, which is the genotype of Pseudodexia. Agrees exactly with Wiedemann's description; the specimen is characterized by a very peculiar wing, reproduced in Figure 3, which has been carefully drawn by C. T. Greene. The apical half of the wing is remarkably elongated, and there is a marked although slight concavity in the costa before the extreme apex; the third vein has only one bristle at base above and below. The species is not represented in the National Museum, although Dr. C. H. T. Townsend had identified a closely related form with less elongated wing as "*eques* subspecies with golden squamae." Mr. Malloch had named the same species *Morinia longitarsus* Wulp, but I do not think it fits the description very well. The color of the thorax is sharply divided at the suture, being golden in front and dark brown behind. The slender abdomen is subshining black, with silver fasciae at base of second and third segments, narrower across the dorsum but broad laterally; the fourth segment is wholly silvery except a narrow black tip which bears a considerable tuft of bristles. There are no discals on the second and third segments. The first segment is uncommonly long, exceeding the second, but has no median marginal bristles; the second has one pair and the third a row of about six; the fourth has no discal bristles.

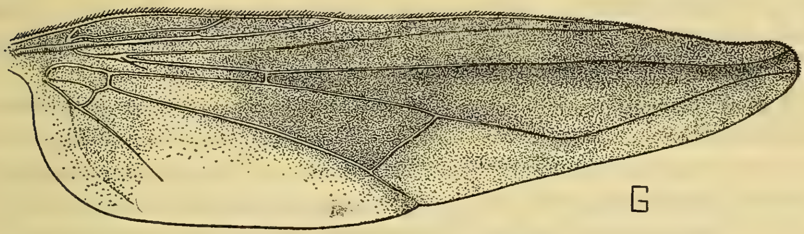

FIG. 3.—PSEUDODEXIA EQUES WIEDEMANN

The head is almost circular when viewed from in front and the antennæ attached slightly below the level of the middle of the eye, the third joint slender, over three times the second; arista rather short-plumose almost to its tip. Front golden pollinose almost to the antennae, at narrowest hardly wider than ocellar triangle, the frontal bristles beginning at the narrowest place and barely reaching the base of the antennae; parafacials narrow, silvery; vibrissae at margin of mouth, a few small bristles extending up almost halfway on the facial ridges; face rather flat and considerably receding; palpi normal, yellow; proboscis small, fleshy.

Thoracic chaetotaxy so badly damaged that it can not be made out. Hind calypters very large, postscutellum and hypopleurals present. Legs black; middle tibia with two bristles on the outer front side; hind tibia with a partial row of quite small bristles on the outer hind side, one below the middle a little larger, standing directly opposite to one of equal size on the inner hind side. Claws and pulvilli elongate.

Length of body, 8.4 mm.; of wing, 10 mm.

Undoubtedly the female would have a normal or nearly normal wing.

107. BLEPHARIPEZA LEUCOPHRYS Wiedemann

Tachina leucophrys WIEDEMANN, Auss. Zweifl., vol. 2, 1830, p. 308.
Blepharipeza rufipalpis MACQUART, Dipt. Exot., pt. 2 (3), 1843, p. 211.—VAN DER WULP, Tijdsch. v. Ent., vol. 26, 1883, p. 25.
Tachina latifrons and *nigrorufa* WALKER, Dipt. Saund., 1852, p. 284.
Blepharipeza leucophrys SCHINER, Novara Reise, 1868, p. 336.—WILLISTON, Trans. Amer. Ent. Soc., vol. 13, 1886, p. 304.—GIGLIO-TOS, Ditt. del Mess., pt. 3, 1894, p. 28.—BRAUER and BERGENSTAMM, Denk. Wien. Akad. Wiss., vol. 60, 1893, p. 120.—COQUILLETT, Revis. Tachin., 1897, p. 124.
Belvosia leucophrys VAN DER WULP, Biologia, Dipt., vol. 2, 1888, p. 30.

One male, labeled "Winthem Coll."; has three labels of "*leucophrys*," one very old. The word "type" does not occur on any. The specimen is in fine preservation and one would hardly think it could have ever been seen by Wiedemann; it does not look old enough and the pin looks modern. (It has not been repinned.) However, being from Brazil and agreeing exactly with the Wiedemann description, it is undoubtedly authentically determined.

Width of front 0.25 of head by micrometer. Ocellars proclinate, parallel, not very large, one broken off. Frontals 2 reclinate, about 11 decussate, some small, just outside middle of row, inclined mesally. Lowest frontal at level of tips of second antennal joints, below it only 2–3 very minute hairs. Parafrontal lead colored, densely pollinose; parafacial pure white, not silvery; transverse impression and lower posterior orbit the same; cheek with black hairs nearly to eye and covered with very dense long white pollen, the little white scales suberect and distinct under high power. Antennae black, the third joint a little more than twice the second, moderately slender, not reaching vibrissae; arista rather long, evenly tapering, basal joint short. Palpi yellow at least on apical half. Back of head white pollinose and pilose with one row black above and 2–3 below. One pair of verticals, not decussate, reclinate. Facial ridges with coarse erect bristles not quite to the level of lowest frontal.

Thorax thinly slaty or plumbeous above to scutellum, the latter brown. A fine brown line each side halfway between acrostichal and dorsocentral, also an interrupted short line outside dorsocentral. Chaetotaxy: humeral, 3; posthumeral, 2; acrostichal, 3, 3; dorsocentral, 3, 4; notopleural, 2 (hairy around them); supraalar, 3; intraalar, 3; postalar, 2; scutellum with 4 long marginals each side curved down, one widely separated discal also curved down; disk spiny, less so in front, one pair slanting spines almost apical in position.

Sternopleural, 2, 1, the lower anterior small; pteropleura with dense tuft and one small bristle; hypopleural, 8. Can not see under calypter, which is brown but not so dark as scutellum and abdomen.

Abdomen uniformly brown, subshining, first segment with row of small spines along middle of hind edge, hardly noticeable; second segment with about a dozen small erect blunt spines along the middle region and four larger on hind edge (2 pairs) a wide space between these and the lateral one; third segment with a few very irregular discal erect spines, longer than those on second and confined to posterior half of segment; hind edge with row of stout, blunt spines about as long as the segment. The hair of the segment is more dense and erect at each side behind middle but does not form a matted patch below, though it is dense there; fourth segment with erect bristles all over, those on disk more spiny, at apex with only small bristles; genital segments brown.

Prosternum with soft dark hair, a deep depression in its middle.

Legs black, pulvilli yellowish-brown, rather long on all tarsi; middle tibia with row of about four long bristles on outer front side; hind tibia with characteristic large row of flattened hairs fringing outer hind side.

Wings brownish, especially at base; epaulet and subepaulet brown; third vein with 2–3 hairs.

Length, 14 mm.

The species is represented in the National Museum by a series of specimens, collected in Panama, Guatemala, and northward to Massachusetts.

108. SPALLANZANIA AMERICANA Schiner

Cnephalia americana SCHINER, Novara Reise, 1868, p. 327.

One female "Novara R. Chili," the undoubted type of Schiner, agreeing with the description and having the abdomen damaged in the same way. This is a true *Spallanzania*. It is well described by Schiner and I add only a few items.

The vertex is 0.41 of the head width, the eyes diverging only a little and slightly converging again at the lowest part. The ocellar bristles are broken off but without much doubt they were reclinate. The bristles of the front are also mostly broken off, but the scars show two or three rows, the outer quite irregular; the parafacial has a row of about five rather strong bristles nearly in the middle, the space between them and the orbit bearing coarse hairs, but between them and the facial ridges the surface is bare. The pollen of the head is silvery when viewed from in front, with irregular blackish pollen along the orbits above; when viewed from above, however, the parafrontals appear black almost to the level of the antennae.

In an oblique side view a silver streak passes from the antennae to the orbit bordered above and below by blackish streaks; the antennae and palpi are black, the facial depression is rather shallow and the ridges have only four or five small bristles above the vibrissae. The length of the head is the same at the antennae and at the vibrissae (45 units), not including the epistoma which juts farther forward; the height of the head is 55 units. The second antennal joint is 11 units long and the third 16.

The thorax is very distinctly striped, the abdomen mostly shining black with distinct median pollinose vittae; the apical third of the fourth segment is orange red in color, more conspicuous at the extreme tip beyond the small bristles. There are four sternopleurals on one side, three on the other.

Length, 10 mm.

Not in the National Museum.

109. BELVOSIA ESURIENS Fabricius

Musca esuriens Fabricius, Syst. Antl., 1805, p. 301.
Tachina esuriens Wiedemann, Auss. Zweifl., vol. 2, 1830, p. 309.
Willistonia esuriens Brauer and Bergenstamm, Denk. Wien. Akad. Wiss., vol. 56, 1889, p. 97; vol. 58, 1891, pp. 349, 403; vol. 60, 1893, pp. 123, 204.

Two males from Brazil, both "Coll. Winthem." and bearing the small, square red tag without writing, which Brauer says indicates Wiedemann's original specimens. One is labeled "esuriens Wd. (Fab.?)" on a very old label; the other has a B. B. label "*Willistonia esuriens* Wd."

Neither of these can be a Fabrician type, as the Winthem Collection contained none. The two specimens unfortunately are not of the same species, and it becomes a serious question whether either can be regarded as an undoubted *esuriens*. Wiedemann apparently saw the Fabrician type when he redescribed the species; his first specimen mentioned above fits his own and the Fabrician description better than the second, and in spite of the question mark I think it must be regarded as the authentic specimen. It has the two whitish abdominal crossbands as mentioned by Fabricius, and the one on the third segment is obviously interrupted as mentioned by Wiedemann. I therefore describe this specimen as the true *esuriens*, since there are probably no Fabrician specimens in existence.

Male (Wiedemann erroneously calls it a female). Front at vertex 0.31 of head width; the eye rather broadly rounded above so that the narrow part continues a little forward from the ocelli then rapidly widening; parafrontal with three very irregular rows of bristles inclined toward the center, the pollen gray becoming very thin toward the vertex. Face and parafacials pure white, the latter somewhat silvery; hairs below the lowest frontals black, in certain lights two or three may have a pale reflection; cheek white pollinose and with white hairs among which three or four are black. Cheek two-fifths of the eye height. Vibrissae almost the length of the second antennal joint above the oral margin; facial ridges with seven or eight strong bristles, the row almost reaching level of arista; third antennal joint three times the second, which is brown in color; palpi yellow. Thorax black with thin gray pollen anteriorly; the scutellum subshining with a brown tinge. Calypters decidedly brown. Sternopleurals 4.

Abdomen black, subshining; second segment with narrow basal band of light yellow pollen; third segment with a distinctly interrupted band of almost white pollen covering a little more than the basal half and extending on the venter; fourth segment decidedly pollinose except the tip where the bristles arise which is black; there is also a slender black median line scarcely interrupting the pale pollen. First and second segments with one pair of median marginals; third and fourth with a marginal row.

Legs black, the front claws and pulvilli elongated, the latter slightly longer than the last two tarsal joints. Hind tibia with several rather large suberect bristles on the outer side on the upper half, the lower half with uniform row of smaller bristles. All these bristles stand along the outer side of some more depressed hairlike ones.

Wings rather light brown in color, narrow toward apex, bend of fourth vein rectangular but rounded, a little nearer the margin of the wing than usual; base of third vein with three or four hairs.

Length, 11.5 mm.

Four specimens of this species, a male and three females, have been received from the American Museum of Natural History; they were collected at Chapada, Brazil, by H. H. Smith. The male has a longer third antennal joint and a narrower band on the third abdominal segment than the Vienna specimen, but the females are like the latter.

The second specimen received under the name of *esuriens* will be included as a paratype of a new species, in a revision of the genus soon to appear.

110. BELVOSIA POTENS Wiedemann

Tachina potens Wiedemann, Auss. Zweifl., vol. 2, 1830, p. 299.
Willistonia potens Brauer and Bergenstamm, Denk. Wien. Akad. Wiss., vol. 58, 1891, p. 403.

One male, Rio Janeiro, "Coll. Winthem," and an old label "*Tachina potens* Wd." Wiedemann described the head of this specimen so well that it must be the type, although he strangely neglected to mention the striking marks of pollen on the abdomen.

Front, at vertex, 0.34 of the head width, the narrowest point being directly across the anterior ocellus; the entire front of the head and the posterior orbits are silvery pollinose, the frontal stripe, however, brown. In this specimen the reddish ground color of the parafacials, facial ridges, and cheeks shows through to a noticeable extent and the suture is distinctly bordered with a darker tinge to its lowest end. Frontal bristles in a single row, the hairs below the lowest are black, as are also the hairs of the cheek. Face considerably depressed in the middle, the vibrissae about the length of the second antennal joint above the oral margin; facial ridges with well-developed bristles up to a point above the middle of the third antennal joint. Antennae black, second joint more dark brown, with a tinge of red at the junction with the third, which is three times as long as the second and a little tapering. Palpi dark yellow, cheek almost half the eye height, beard white.

Thorax brownish black with usual thin pollen more distinct in front. Scutellum brown, with four pairs of bristles, the median pair of the same appearance as the others. The disk has about a dozen depressed small bristles. Calypters brown. Sternopleurals 4 on one side, 5 on the other.

Abdomen black, with faint reddish tinge at the sides; third segment with only a very narrow basal interrupted, white, pollinose, crossband, hardly more than a line; fourth segment with dense pale yellow pollen, the apical third black.

Legs black, front pulvilli slightly longer than last two tarsal joints; hind tibia on outer side with a row of small, suberect bristles mixed with a few hairs not so bushy in appearance as in many species.

Wing brown throughout, narrow at apex, bend of fourth vein rectangular and rounded, its distance from the hind margin less than half of that to the large cross vein; third vein with two bristles.

Genitalia smaller than in most of the species, the inner forceps black, closely pressed together near tip and bent forward almost with an angle; outer forceps hardly so long, dark yellow in color, flat and bluntly rounded at tip.

Length, 10 mm.

Represented in the National Museum by two females from Ypiranga, Sao Paulo, Brazil ("Fonseca leg."). In these the single row of frontals is as characteristic as in the male, and they have four proclinate orbitals in a row, rather far from the eye. The pollen on the parafrontal becomes very thin or almost absent on an oval area that does not include the frontals but touches the eye near the vertex; this area is more or less subshining black, but less in one specimen than the other. The vertex is 0.40 of the head width, the same in both.

SUMMARY OF CHANGES OF NOMENCLATURE PROPOSED

NEW GENUS

Pammaerus for *Gymnostylia leptotrichopa* Brauer and Bergenstamm.

NEW SPECIES

Euantha interrupta Aldrich, from Costa Rica.

NEW SYNONOMY

Camptops Aldrich equals *Pachygraphia* Brauer and Bergenstamm.
Hystriciopsis Townsend equals *Hystricia* Macquart.
Sisyropa Brauer and Bergenstamm equals *Zenillia* Robineau-Desvoidy.
Gymnostylia Macquart equals *Macromya* Robineau-Desvoidy.
Phorocera coccyx Aldrich and Webber equals *Phorocera heros* Schiner.

PREVIOUS SYNONOMY CORRECTED

Paraporia Townsend is not a synonym of *Uramyia* Robineau-Desvoidy.

NEW COMBINATIONS

Zenillia thermophila Wiedmann for *Tachina thermophila* Wiedemann.
Zenillia rufiventris Brauer and Bergenstamm for *Sisyropa rufiventris* Brauer and Bergenstamm.
Zenillia proserpina Brauer and Bergenstamm for *Sisyropa proserpina* Brauer and Bergenstamm.
Urodexodes cingulata Schiner for *Gymnostylia cingulata* Schiner.
Lixophaga famelica Wiedemann for *Tachina famelica* Wiedemann.

O

NEW PARASITIC HYMENOPTERA OF THE SUBFAMILY ANTEONINAE FROM THE AMERICAS

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In the following paper are presented descriptions of 23 new species and one new variety of parasitic Hymenoptera of the subfamily Anteoninae. Most of the material studied was from the miscellaneous collection of the U. S. National Museum, and was collected in the New World. Reference to Kieffer's keys is made in many places throughout this paper. The keys referred to are those published in Das Tierreich, family Bethylidae (vol. 41, 1914).

LESTODRYINUS DICHROUS, new species

Because the parapsidal furrows are greatly reduced, this species traces to *Neodryinus* in Kieffer's key. It is placed in the genus *Lestodryinus* because it agrees with all the characters of this genus except the reduced parapsidal furrows.

Female.—Length 6 mm. Color testaceous and black as noted below. Head testaceous, broader than long (13:7); vertex concave, surface with fine longitudinal striations; lateral ocelli located far back on vertex almost to occiput and are approximate, anterior ocellus distant from these, being near frons; head not produced beyond the eyes; occiput truncate; antennae testaceous, third joint unusually long, being more than twice length of scape and second together, and almost three times length of fourth; fifth same length as fourth, thickened distally; sixth to ninth each somewhat shorter than preceding; tenth not quite twice length of ninth. Prothorax testaceous, shining with series of fine transverse striations and a fine thick whitish pubescence; mesoscutum and scutellum black, coarsely rugulose with distinct short white pubescence; postscutellum black with same sculpturing as scutellum, except a smooth area on the disk; legs testaceous, except hind coxae and small areas on middle and hind femora, which are black; chela with median arm extending to second tarsal joint, lamellate at tip and a double row of lamellae extending from here to articular cavity, claw nearly parallel sided and straight except at the tip where it is sharply bent, provided with a single row of toothlike lamellae from near articulation with median arm to subapical tooth; wings with subcostal, median and submedian cells, bifasciate, the larger band extending transversely across the wing from the pterostigma. Propodeum black, surface strongly rugose, the raised lines running longitudinally and not being connected with transverse ridges; with same type of pubescence as on thorax. Abdomen smooth, black, with testaceous markings on each side of the segments.

Type locality.—Chapada, South America. Paratype from Santarem, South America.

Described from two specimens collected in April.

Type.—Cat. No. 40182, U.S.N.M. Paratype in writer's collection.

LESTODRYINUS STRIATUS, new species

Fig. 1

The antennae are missing from this specimen, but otherwise it answers the description of *Lestodryinus*. The species is nearest *Lestodryinus tarraconensis* (T. A. Marsh).

Female.—Length 6 mm. Color black, except legs, which are fuscous to testaceous. Head black on vertex, testaceous ventrally, broader than long (20:9); vertex moderately and broadly concave, surface with more or less irregularly longitudinal striations appearing rugulose; lateral ocelli closer together than to the anterior one; head not produced beyond the eyes; occiput truncate; antennae missing. Entire thorax more or less pubescent; prothorax shining with numerous fine striations, which are more or less transverse on the disk, becoming longitudinal on the sides; lower sides smooth and shining without visible sculpturing; mesoscutum with distinct deeply impressed longitudinal striations, which almost conceal the parapsidal furrows, these are only slightly convergent and extend to margin; scutellum very similar in surface sculpture to mesoscutum except that the striations are more irregular; postscutellum with finely granulated surface partly concealed by white pilosity; legs testaceous to ferruginous, anterior femora, tibiae and tarsi more or less fuscous, middle and hind legs lighter, but with fuscous markings; chela as in Figure 1; wings similar in venation to *Lestodryinus dichrous* but darker in color, being smoky, with a lighter band extending transversely across the fore wing from the pterostigma. Surface of propodeum with a coarse reticulated sculpturing on the disk and sides, and with a microscopic white pubescence.

Type locality.—Santarem, South America.

Described from one specimen.

Type.—Cat. No. 40183, U.S.N.M.

PSILODRYINUS GRACILIS, new species

Fig. 15

Female.—Length 3.7 mm. General color black. Head black, wider than long (10:6); vertex very slightly concave, surface dull without definite sculpturing, a carina extending from median ocellus to bases of antennae; clypeus and mandibles testaceous; antennae long, slightly subclavate, four basal joints, basal part of fifth, and tenth testaceous, rest fuscous, structure as in Figure 15. Prothorax longer than wide (15:13), with scattered pilosity, divided by an arcuate transverse impression into two lobes, of which the anterior is shorter and wider, the posterior elevated; the entire pronotum is broader anteriorly and narrows posteriorly, so that there is a constriction between it and the mesoscutum, anterior part with many fine striae running outward and downward from the dorsum, posterior portion with indistinct areolation on sides, central elevated part smooth; mesoscutum much wider than prothorax, roughly triangular in outline, covered with scattered fine white hairs, shallowly punctate, without parapsidal furrows; scutellum almost rectangular, shallowly punctate except on its posterior third which is smooth and polished; legs testaceous, posterior unusually long, anterior trochanters and coxae extended; chela well developed; wings brown except unpigmented area extending across the middle from below the pterostigma to the margin of the wing and also apical portion, the pigmented area in this case extending from the radius across the apical cells but not reaching the margin. Propodeum black, in profile the posterior part truncate and with this portion flat, longitudinally striate with smaller cross striations between the longitudinal ones.

Type locality.—Bermuda.

Described from one specimen reared April 7, 1923, from a cocoon on *Passiflora* leaves from Bermuda. Cocoon intercepted June 29, 1922, by R. G. Cogswell and assigned Federal Horticultural Board, New York No. 1079.

Type.—Cat. No. 40196, U.S.N.M

CYRTOGONATOPUS CLAVICORNIS, new species

This species traces to *Cyrtogonatopus* in Kieffer's key because the fourth joint of fore tarsus is less than one-half as long as metatarsus. It differs from Kieffer's brief description of this genus in the following characters: The vertex is not convex, but is practically flat, appearing very slightly indented in front view where the ocelli are located. The maxillary palpi are apparently six-jointed with four joints visible beyond the geniculation.

Female.—Length 3 mm. General color black with scattered short white pilosity. Head wider than long (10:6); vertex with dense fine sculpturing appearing areolate under high power; ocelli approximate, equidistant from each other in an equilateral triangle; clypeus fuscous; antennae short, subclavate, scape and second joints fuscous, rest dark brown, almost black, comparative lengths as follows: 4, 2½, 6, 3, 2½, 2½, 2½, 2½, 2, 3. Pronotum smooth and shining without visible sculpturing, posterior half distinctly elevated with a hump in profile and narrower than anterior portion; thoracic constriction about as wide as long, finely rugulose; legs dark reddish brown, anterior coxae and trochanters moderately lengthened, latter with stalk shorter than club; chela with median arm, extending back beyond fourth joint to third, slightly curved and provided with three to four small lamellae, which are replaced by hairs on rest of arm, claw curved, somewhat shorter than median arm. Propodeum anteriorly on dorsum with same type of sculpturing as on head, with distinct transverse carinae, in profile strongly humped, posteriorly sloping gradually to petiole. Abdomen smooth, polished, black.

Type locality.—Brownsville, Tex.

Described from two specimens collected at Brownsville, Tex., May 1, 1904, by H. S. Barber.

Type.—Cat. No. 40199, U.S.N.M. Paratype in writer's collection.

DICONDYLUS LONGICHELATUS, new species

Figs. 16 and 2

Female.—Length 3.5 mm. General color black, except as noted below. Head almost twice as wide as long (11:6); vertex reddish brown in color, with microscopic areolation, minutely rugulose around ocelli; carina from median ocellus to betweeen bases of antennae; head produced behind the eyes, sides convergent; face, clypeus and mouth parts testaceous, teeth of mandibles dark amber colored; antennae of medium length, fusco-testaceous, the scape, ninth and tenth joints being lighter than the rest (fig. 16). Pronotum ferruginous on sides, in dorsal view black with central ferruginous area, with impressed transverse sulture which divides it into a shorter and wider anterior part and a narrower humped and longer posterior division, with scattered erect hairs, shining, smooth with miscroscopic indistinct punctation; thoracic constriction black, somewhat longer than wide (7:5), with indistinct longitudinal rugulosity; legs ferruginous, stalk of hind femora of same length as club, anterior metatarsus five times as long as thick, second and third joints of anterior tarsi not much longer than thick, much shorter than metatarsus, fourth anterior tarsal joint same length as latter; chela as in Figure 2. Propodeum black with scattered white erect hairs; anteriorly on dorsum with finely areolate surface sculpture, this becoming less distinct on the raised central portion or disk, posteriorly with fine transverse striations, which extend down the sides. Abdomen polished, brownish black, with scattered white erect hairs.

Type locality.—Bonito Province, Pernambuco, Brazil.

Described from one specimen.

Type.—Cat. No. 40184, U.S.N.M.

PSEUDOGONATOPUS VARIISTRIATUS, new series

Figs. 17 and 4

Female.—Length 3 mm. General color testaceous. Head wider than long (8:5); vertex moderately concave, shining with a microscopic areolation; antennae testaceous, as long as head, thorax, and thoracic constriction together. (Fig. 17.) Prothorax and thoracic constriction with microscopic aerolation; chela as in Figure 4. Propodeum finely transversely striate anteriorly before spiracles, striations run longitudinally between these, turning and extending down the sides and also some surrounding the spiracles; posterior part of propodeum transversely, arcuately striate, the convex side of the striae posterior. Abdomen smooth, polished.

Type locality.—Rio Piedras, Porto Rico.

Described from one specimen collected January 18, 1913, by T. H. Jones.

Type.—Cat. No. 40198, U.S.N.M.

EUCAMPTONYX SECUNDUS, new species

Figs. 18 and 3

This species agrees well with Perkin's description of this genus, except that the chelar claw is curved and has a subapical tooth and the vertex is flat.

Female.—Length 5.4 mm. General color ferruginous. Head broader than long (13:8); vertex flat, surface densely aerolate; ocelli approximate and forming an equilateral triangle, a carina extends from the median ocellus to between bases of antennae, and also one from each lateral ocellus part way to the sides of the vertex; face, clypeus and the four-dentate mandibles testaceous; antennae long and slender, scape, second, seventh to tenth joints testaceous, the rest being fuscous. (Fig. 3.) Pronotum with transverse impression before the middle, sculpture same as that on head becoming more indistinct on the disk of the posterior division; thoracic constriction longer than wide, lighter in color than either prothorax or propodeum, being testaceous, surface densely areolate as head and pronotum; legs unusually long, testaceous to ferruginous with darker fuscous markings on the middle, hind coxae, all femora and tibiae; anterior coxae and trochanters unusually long, stalk of latter at least as long as the swollen tip, metatarsus and fourth tarsal joints longer than the second, third, or fifth, the fourth being longer than the first; the second joint is shorter than the third, being small and transverse; chela as in Figure 18. Propodeum finely transversely striated in front and in back, minutely areolated on the disk, areolations also present between transverse striations, the latter extending down the sides then gradually becoming indistinguishable except posteriorly. Abdomen smooth, polished.

Type locality.—Western Ohio.

Described from one specimen collected July 7, 1917, by J. S. Houser in wheat field. One specimen received later, collected by E. D. Ball, Sanford, Fla., on June 2, 1926.

Type.—Cat. No. 40203, U.S.N.M.

PACHYGONATOPUS MINIMUS, new species

This minute species answers to the description of this genus by Perkins, but the maxillary palpi are invisible or broken.

Female.—Length, 2 mm. General color testaceous, abdomen somewhat darker. Head wider than long (6:4); vertex flat with a slight impression in the middle, surface smooth without visible sculpture; the lateral ocelli closer together than the distance from one of them to the anterior ocellus; head produced behind the eyes, but sides only slightly convergent; antennae short, not extending beyond the prothorax, scape wider than two, three the thinnest and longest joint, but not much difference in thickness of any; apical joints about twice as long as thick, comparative antennal lengths as follows: 7, 4, 7, 5, 5, 4, 4, 4, 4, 6. Pronotum smooth, polished, without visible sculpture except on sides where it is minutely areolated; thoracic constriction about same width as length, with a microscopic areolation; legs testaceous, anterior coxae and trochanters not greatly lengthened; median arm of chela extending as far as base of third tarsal joint, lamellate at tip, with a row of small lamellae extending from near here to articular cavity, claw unarmed, curved without subapical tooth. Propodeum with fine microscopic areolation, smooth on the disk. Abdomen testaceous appearing light fuscous in some lights, smooth, polished, with scattered short decumbent pilosity.

Type locality.—Elk Point, South Dakota.

Described from one specimen reared from a jassid by C. N. Ainslie, September 3, 1914.

Type in writer's collection.

PACHYGONATOPUS NEARCTICUS, new species

Female.—Length 2.4 mm. General color black, except as noted below. Head black, except lower face, clypeus and mandibles, which are testaceous, wider than long (7:5); vertex flat with a slight impression in the middle, where it is indented in a narrow line extending from the median ocellus to near bases of mandibles, surface polished, indistinctly aerolate; lateral ocelli closer together than to median ocellus; head produced behind the eyes, but sides only slightly convergent; antennae somewhat longer than head and prothorax together, subclavate, fuscous except scape and second joint, which are testaceous; scape thicker than two, which in turn is wider than three, which is the longest joint, four thickened distally, five to ten thicker than four, each somewhat broader than the one preceding, apical joints somewhat more than twice as long as wide; comparative antennal lengths as follows: 9, 3, 10, 5½, 5½, 5, 5, 5, 5, 7. Prothorax minutely areolated, with a distinct transverse impression dividing it into two divisions, of which the posterior is longer and narrower and is strongly elevated or humped; thoracic constriction broad, about as wide as long, with fine areolation, which is more distinct than on pronotum; legs fuscous with lighter testaceous markings; median arm of chela extending as far as third tarsal joint, lamellate at tip, with a row of very small, short, widely spaced lamellae extending along the incrassate part nearly to articular cavity. Propodeum smooth, polished on the disk posteriorly indistinctly areolate. Abdomen smooth, polished.

Type locality.—Sioux City, Iowa.

Described from one specimen reared from a jassid September, 1919, by C. N. Ainslie.

Type in writer's collection.

CHALCOGONATOPUS AREOLATUS, new species

Female.—Length 4.7 mm. General color ferruginous with darker fuscous markings. Head ferruginous with central infuscated area on vertex, wider than long (13:8); vertex broadly concave, surface minutely and densely areolate; ocelli located near occiput, the lateral ones being somewhat closer together than to median one; mandibles, except amber-colored teeth, scape, second and basal part of third antennal joints testaceous, rest of antennae fuscous, comparative antennal lengths as follows: 5, 2, 12, 9, 5, 5, 5, 4, 4, 5. Prothorax divided by a deep impression into a transverse anterior part and an elevated longer posterior lobe, surface sculpture same as vertex of head; thoracic constriction about as wide as long (7:6), with same type of surface sculpture as prothorax; legs long, brownish-testaceous, fore trochanters with stalk shorter than club, hind femora and tibiae unusually long; median arm of chela lamellate at tip and with a double row of lamellae extending from near tip almost to articular cavity, these increasing slightly in length and spacing toward the latter; claw slightly curved, without subapical tooth and provided with a row of very small widely spaced teeth. Propodeum surface with same type of sculpture laterally as prothorax but anterior portion and posterior half with transverse striations extending only part way down the sides. Abdomen fuscous to ferruginous.

Paratype similar in structure but different in color, being a clear ferruginous without the darker fuscous markings of the type.

Type locality.—Falls Church, Va.

Described from two specimens, type collected July 19, 1923, by R. A. Cushman, and paratype collected July 19, 1906, by D. H. Clemons.

Type.—Cat. No. 40189, U.S.N.M. Paratype in writer's collection.

CHALCOGONATOPUS RAPTOR, new species

Figs. 19 and 5

Female.—This is a large, very striking species, being 6 mm. in length. General color black, except legs and abdomen which are ferruginous to fuscous. Head broader than long (19:10), with short dark scattered pilosity; vertex broadly concave, surface densely areolate; ocelli in equilateral triangle, the lateral ones being situated almost to occiput, carina from median ocellus to between bases of antennae; mandibles except teeth, and clypeus, fuscous; antennae long, fuscous; scape, second, third, and tenth joints lighter in color than rest. (Fig. 19.) Pronotum without transverse impression, appearing rounded in profile, with sparse erect white hairs, densely areolate; thoracic constriction stout, not much longer than wide, gradually widening posteriorly to merge with propodeum, densely areolate, pilose as on pronotum; legs fuscous to testaceous, anterior coxae and trochanters long, latter thickening abruptly proximally so that their basal part or stalk is much shorter than swollen part; chela as in Figure 5. Propodeum indistinguishably merged with thoracic constriction, densely areolate and with same type of pilosity as rest of body. Abdomen fuscous with long distinct, more or less erect sparse pubescence.

Type locality.—Porto Bello, Panama.

Described from one specimen, collected by A. Busck.

Type.—Cat. No. 40190, U.S.N.M.

EPIGONATOPUS TENUIS, new species

Figs. 21 and 6

Female.—This is a very slender species. Length, 3.3 mm. General color testaceous to fuscous. Head broader than long (9:6); vertex moderately concave, surface sculpture a feeble microscopic areolation in some parts, mostly smooth and shining; carina extending from median ocellus to between bases of antennae, lateral ocelli nearer together than to median; antennae moderately long, subclavate, scape and second joint testaceous, rest of joints fuscous. (Fig. 21.) Prothorax much narrower than head, with a short, sparse, indistinct pilosity, divided by a deeply impressed arcuate suture into a broader shorter anterior division and a longer narrower elevated posterior part, testaceous but infuscated around pronotal suture, with same surface sculpture as found on vertex of head; thoracic constriction longer than wide, testaceous except infuscated area near union with prothorax, with same surface sculpture as noted; chela as in Figure 6. Propodeum fuscous except small area on dorsum near thoracic constriction which is testaceous, with sparse distinct erect hairs, dorsum and sides with distinct fine areolate sculpturing, smooth on disk. Abdomen fuscous, smooth, polished with scattered erect hairs.

Type locality.—Lafayette, Indiana.

Described from one female reared August 21, 1885, from straw. Collected by F. M. Webster and recorded under Bureau of Entomology No. 3413^{06}.

Type.—Cat. No. 40201, U.S.N.M.

EPIGONATOPUS PLESUIS, new species

Similar in general appearance, color, and size to *Epigonatopus americanus* Fenton, but different structurally.

Female.—Length, 2.2–2.6 mm. General color black except as noted below. Head wider than long (6:5); vertex broadly but slightly concave, shining with faint areolate sculpturing visible only under high power; lateral ocelli farther apart than the distance from one of them to median ocellus; clypeus and mandibles testaceous; antennae testaceous to ferruginous, becoming darker towards tip somewhat longer and more slender than in *Epigonatopus americanus*, comparative antennal lengths as follows: 6, 5, 8, 6, 6, 6, 5, 5, 5, 7. Pronotum without any transverse impression, shining with fine, closely spaced, indistinct punctation, smooth on disk and posteriorly; thoracic constriction about as wide as long, with microscopic areolation; anterior coxae, trochanters, stalk of femora, tibiae, and tarsus testaceous; incrassate part of femora fuscous; middle legs testaceous, more or less infuscated, especially coxae and femora; hind coxae black, fading to fuscous at tip, darker than rest of legs, of which the trochanters, stalk of femora, tibiae except tip, and tarsi are testaceous; median arm of chela extending to tip of second tarsal joint, lamellate at tip and with row of lamellae extending from near here almost to articular cavity, claw curved without subapical tooth. Propodeum not strongly humped, minutely granulated on top and sides, with distinct suture between meso and metapleura. Abdomen smooth. polished.

Type locality.—Elk Point, South Dakota.

Described from three speciments reared from jassids August 24, 1914, by C. N. Ainslie.

Type.—Cat. No. 40202, U.S.N.M. Paratypes in writer's collection.

AGONATOPUS SUTURALIS, new species

Fig. 7

Female.—Length, 4.2 mm. General color ferruginous, except abdomen which is blackish brown. Head ferruginous, wider than long (11:7); vertex shallowly concave with surface sculpture a fine microscopic areolation; a carina extends from the median ocellus to between the bases of the antennae; first five joints of antennae ferruginous (last five broken off), comparative lengths of antennal joints as follows: 6, 4, 11, 11, 8, third to fifth joints much longer than wide (11:1), indicating that the antennae are very long and slender. Pronotum divided into a wider, shorter anterior part, and a narrrower elongated elevated posterior division, very similar to *Chalcogonatopus*, with a fine areolate sculpturing; thoracic constriction much longer than wide (7:2); with fine areolate surface sculpture; chela as in Figure 7. Propodeum in profile and on sides rounded, so that it is hemispherical in shape, separated laterally by a distinct suture into the meso and metapleura and arising above the thoracic constriction, sparsely pilose and finely areolate on surface. Abdomen minutely areolate, blackish brown.

Type locality.—Tucson, Arizona.

Described from one specimen collected by H. G. Hubbard.

Type.—Cat. No. 40200, U.S.N.M.

DEINODRYINUS VARIABILIS, new species

Female.—Length, 6.3 mm. General color black except as noted below: Head black except face, clypeus, and mandibles, which are testaceous, teeth of latter dark; vertex rugose with scattered fine white hairs; antennae slender, testaceous except five terminal joints which are fuscous to black, comparative length of joints as follows: 7, 5, 14, 10, 7, 7, 5, 5, 5, 6. Prothorax slightly wider than long, notched at union with mesoscutum, narrower than latter, surface with dense coarse punctation and with white pilosity, latter being thicker on sides than on dorsum; pronotum black with narrow testaceous band on posterior margin next to mesoscutum; latter smooth, polished, with scattered fine white pubescence, black except ferruginous areas along parapsidal furrows, these deep, somewhat converging, and extending almost the length of the mesoscutum; scutellum black, polished, smooth, posterior margin arcuate; postscutellum black, smooth; legs ferruginous except small infuscated area on hind coxae; chela with median arm long, extending to tip of second tarsal joint, lamellate on tip and with a double row of lamellae extending almost to articular cavity, claw, curved, unarmed, without subapical tooth. Propodeum rugose with fine white hairs. Abdomen smooth, polished, black, appearing dark fuscous in some lights.

The paratypes are similar in size and structure, but coloring is very different and is as follows: General color ferruginous, a larger area on vertex being black and face and antennae testaceous to ferruginous. In one specimen there is a black area on sides of the collar of the pronotum, and the carinae are indistinct, while in the other, three distinct carinae are present extending from the ocelli to the base of the clypeus and also bordering the eyes.

Type locality.—Falls Church, Virginia.

Described from three specimens, type collected July 27, 1920, by C. T. Greene at Falls Church, Virginia; paratypes July 19, 1923, by R. A. Cushman, at the same locality.

Type.—Cat. No. 40191, U.S.N.M. Paratypes in U.S.N.M. and writer's collection.

DEINODRYINUS VARIABILIS CARINATUS, new variety

Female.—Size smaller than *Deinodryinus variabilis*, being 5 mm. in length. General color ferruginous. Head black except below ocelli in type and as far as clypeus in the paratype, where the black pigmentation fades into ferruginous; three distinct carinae are present on the face extending from ocelli to the base of the clypeus; the two lateral ones are more distinct, curved inward on the face so that they meet the median; there is also a carina which bounds the inner margin of each eye; the comparative lengths of the antennal joints are somewhat different than *variabilis* and the punctures on the pronotum are finer. Abdomen fusco-piceous.

Type locality.—Flatbush, New York.

Described from two specimens, type collected at Flatbush, New York, August 2, 1895, by J. L. Zabriskie; paratype collected at Lawrence, Kansas, July 7, 1896, by Hugo Kahl.

Type.—Cat. No. 40192, U.S.N.M. Paratype in writer's collection.

DEINODRYINUS PILOSIFRONS, new species

Fig. 20

Female.—Similar in size, general coloring, and structure to *Deinodryinus variabilis*, but with the following differences: Head black except face below bases of antennae, which is testaceous; one carina extends from median ocellus to clypeus; face densely pilose; antennae entirely testaceous, structure as in Figure 20. Thorax testaceous with both small and large punctations irregularly placed; mesoscutum black with shallow punctures regularly placed, parapsidal furrows deep and converging; scutellum and postscutellum black, smooth, and shining; legs testaceous except middle and hind femora and parts of coxae, which are brownish; wings bifasciate, as is characteristic of genus, but bands much lighter in color than in *variabilis*. Propodeum black, rugose, with scattered white pilosity. Abdomen reddish brown.

Type locality.—Alta Vera, Paz, Guatemala.

Described from one specimen collected by G. P. Goll, April, 1905.

Type.—Cat. No. 40193, U.S.N.M.

DEINODRYINUS BILOBUS, new species

Figs. 22 and 8

This species in general answers to the description of *Deinodryinus* as characterized by Perkins, but the following differences are noted: The head is not greatly produced behind the eyes; the pronotum is not elongate, being wider than long (14:8), is transversely impressed at about the middle, and is produced into two distinct lobes back of the impression. These are cariniform and separated from each other at the center. They project upward and forward so that their posterior surface is almost parallel to the mesoscutum. The posterior angles of the pronotum do not quite reach the tegulae and the parapsidal furrows are not distinct, being shallow, convergent, and not reaching to the hind margin of the mesoscutum.

Female.—Length, 7 mm. Prevailing color black except as noted. Head unusually large, black, except clypeus which is ferruginous and mandibles which are testaceous with dark brown teeth, with short white pubescence; vertex rugose with carina extending from median ocellus to bases of antennae and two other carinae extending parallel with the inner margin of the eyes down the face; antennae testaceous except seventh to tenth joints, which are fuscous. (Fig. 22.) Prothorax testaceous, impressed in the middle, posteriorly bilobed as described, pilose, slightly longer than pronotum; mesoscutum black, shining, sparsely pilose and punctate, parapsidal furrows convergent, not deeply impressed and not reaching posterior margin; scutellum black, sparsely punctate and pilose; postscutellum narrow, transverse, black, polished; fore legs testaceous, middle and hind legs much paler testaceous with black markings on coxae and inner face of femora, the black area extending to the outside of the distal third of the posterior femora; middle and hind tibiae and tarsi almost entirely black to brown; the posterior femora testaceous dorsally and on sides of swollen part, black on stalk and ventrally on club; chela as in Figure 8; wings smoky, bifasciate, venation dark brown. Propodeum black, pilose, rugose. Abdomen brownish, with lighter brown markings, smooth, polished.

Type locality.—Santarem, South America.

Described from one specimen.

Type.—Cat. No. 40194, U.S.N.M.

DEINODRYINUS PILOSUS, new species

Figs. 23 and 9

This specimen is very similar in structure to *variabilis* but has the following differences:

Female.—Color black except scape of antennae, mandibles, inner side of fore tibiae, fore tarsi including chelae, middle and hind tarsi, which are fuscous to testaceous. The punctation on the pronotum is finer and more even than in *variabilis* and it is not notched at junction with mesoscutum; chela as in Figure 9; antennae as in Figure 23. The entire body is more or less clothed with short, fine, white hairs.

Type locality.—Chiricahua Mountains, Ariz.

Described from one specimen collected by H. G. Hubbard.

Type.—Cat. No. 40195, U.S.N.M.

CHELOGYNUS PROPODEALIS, new species

Figs. 25 and 10

Female.—Length, 2.7 mm. General color black except as noted below. Head wider than long (8:5); surface of vertex polished with scattered very fine hairs; ocelli in equilateral triangle, lateral ones same distance from occiput as eyes, a distinct carina extends from the median ocellus to between the bases of the antennae; head extended and sides strongly convergent behind the eyes; occiput truncate, mandibles fuscous; antennae testaceous, short, being scarcely longer than head. (Fig. 25.) Pronotum, mesoscutum and scutellum smooth and polished with no visible sculpturing and with fine scattered white hairs; pronotum narrower than mesoscutum and slightly shorter than this (4:5); mesoscutum without parapsidal furrows; scutellum transverse, much wider than long, rugose along its posterior margin; postscutellum rugose, shorter than scutellum, being almost linear; legs testaceous except posterior femora and tibiae and also middle tibiae, which are brownish, posterior femora darker on the stalk than the club; chela as in Figure 10; wings with two transverse darker bands, the first and larger extending from the pterostigma half way to the tip and almost to opposite margin of wing, the second and smaller extending across the apex of the basal cells, radius angular, proximal part much longer than distal. Propodeum rugose, posteriorly sharply truncate, this part having a large, smooth, median area, bounded by a carina, the enclosed area being in the shape of a five-sided polygon, the sides of which are longer than the divisions at either end. Abdomen fusco-piceous, smooth, polished.

Type locality.—Santarem, South America.

Described from one specimen.

Type.—Cat. No. 40185, U.S.N.M.

CHELOGYNUS MINIMUS, new species

Figs. 24 and 11

Female.—Length, 2.1 mm. General color black, except as noted below. Head wider than long (8:5); surface of vertex dull with short scattered dark hairs; ocelli in an equilateral triangle, lateral ones being about same distance from occiput as eyes, a distinct carina extends from median ocellus to between bases of antennae; head convergent and rounded behind the eyes; occiput truncate, arcuate; mandibles black except teeth, which are brown; antennae fuscous, except sixth to ninth joints, which are testaceous, short but noticeably longer than in *propodealis.* (Fig. 24.) Pronotum, mesoscutum and scutellum smooth with scattered short dark hairs; pronotum narrower than mesoscutum and shorter than this (2:3); mesoscutum with parapsidal furrows convergent and extending about half way towards its posterior margin; scutellum transverse, two-thirds length of mesoscutum; coxae, trochanters and femora dark brown, tibiae and especially tarsi lighter brown; anterior tarsus with first joint shorter than fourth, second and third subequal much shorter than first; chela as in Figure 11; wings diaphanous, radius angular, proximal part much longer than distal. Propodeum rugose with fine scattered dark pubescence, posteriorly sharply truncate, this part with median area rugose within, the field in the shape of an oblong polygon, the sides of which are much longer than either end, the upper carina of the field arched with arched extensions extending beyond on either side so that posteriorly the propodeum appears to have three fields. Abdomen fusco-piceous.

Type locality.—Barneveld, New York.

Described from one specimen collected June 13 by G. N. Wolcott.

Type.—Cat. No. 40186, U.S.N.M.

CHELOGYNUS RUGULOSUS, new species

Figs. 26 and 12

This species traces to *Chelogynus canadensis* Ashmead in Kieffer's key, but does not agree with the description of this or any other Nearctic species.

Female.—Length, 3 mm. General color black, except as noted. Head reddish brown in color, wider than long (8:5); surface of vertex smooth and shining with a few irregularly placed fine punctures; ocelli in an equilateral triangle, the lateral being somewhat closer to occiput than eyes; head produced and sides convergent behind eyes; face with white hairs, clypeus and mandibles testaceous; scape and second joints of antennae testaceous, rest fuscous. (Fig. 26.) Pronotum longer than wide (5:4), narrower than mesoscutum, shining with large closely placed punctures anteriorly, so that it appears rugose there, punctations become smaller and more widely spaced posteriorly, with scattered white pubescence; mesoscutum smooth, polished, with distinct parapsidal furrows converging and extending half way towards scutellum; legs testaceous with fuscous shadings on the fore femora and stalk of hind tibiae; chela as in Figure 12; wings diaphanous, radius with only a very short distal part appearing almost straight. Propodeum densely rugose, posteriorly truncate with median field bounded by carinae, rugose within, much longer than wide. Abdomen smooth, polished, black.

Type locality.—Saint John, New Brunswick.

Described from one specimen collected July 18 by A. G. Leavitt.

Type.—Cat. No. 40187, U.S.N.M.

CHELOGYNUS VIRGINIENSIS, new species

Figs. 27 and 13

Female.—Length, 3.6 mm. General color black, except as noted below. Head wider than long (10:6); vertex black near occiput and around ocelli, this merging into brownish red and to testaceous anteriorly, surface roughened, covered with short sparse hairs, these becoming more dense on the face; ocelli in equilateral triangle; head produced and sides convergent behind the eyes; occiput truncate, arcuate; face, clypeus and mandibles except dark amber colored teeth of latter, testaceous, without median carina and densely pilose; antennae testaceous, moderately long. (Fig. 27.) Prothorax wider than long (6:3), narrower than mesoscutum, coarsely punctate, posterior margin notched at border of mesoscutum, finely pilose on sides; mesoscutum punctate anteriorly, punctures being finer than on pronotum and becoming still smaller and more scattered posteriorly, parapsidal furrows distinct, converging and extending halfway down mesoscutum, scutellum with less distinct punctation than mesoscutum; legs testaceous; chela as in Figure 13; wings diaphanous with venation light, proximal part of radius much longer than distal. propodeum black, pilose, rugose, posteriorly with distinct median field bounded by carinae, carina bordering upper portion of field extended so that upper parts of two lateral fields are visible, posterior face thus appearing to have three fields. Abdomen polished, black; first segment near petiole brownish.

Type locality.—Rosslyn, Va.

Described from one specimen collected July 1, 1913, by R. C. Shannon.

Type.—Cat. No. 40188, U.S.N.M.

PRENANTEON MICROPUNCTATUS, new species

Figs. 28 and 14

This specimen traces to the genus *Prenanteon* in Kieffer's key and agrees well with his description of that genus. Thus, the parapsidal furrows fail to reach the posterior margin of the mesoscutum, extending only halfway to that point; the metatarsus is somewhat longer than the fourth tarsal joint; the median chela arm is provided with lamellae; and the radius is only slightly angled, with the proximal part somewhat shorter than the distal. In the description of the two Nearctic species, this specimen comes closest to *Prenanteon bakeri* (Kieffer).

Female.—Length, 3.8 mm. General color black, except as noted, body covered with fine microscopic scattered whitish pilosity. Head black, antennae and clypeus testaceous, scape of former lighter; mandibles testaceous, teeth dark amber color; vertex smooth and polished with fine scattered punctation; no median carina present; antennae as in Figure 28. Pronotum not quite as long as mesoscutum, smooth and shining with very fine punctation, which, however, is coarser than on vertex; mesoscutum with parapsidal furrows converging, but extending less than halfway to posterior margin, with fine punctation as on vertex; legs testaceous except posterior coxae which are infuscated basally; chela as in Figure 14; wings clear. Propodeum coarsely rugose, in contour gradually rounding off to abdominal petiole, a posterior median area bordered by carinae, but surface dull within this. Abdomen black, smooth, polished.

Type locality.—Nerepis, New Brunswick.

Collected August 22 by A. G. Leavitt.

Type.—Cat. No. 40197, U.S.N.M.

EXPLANATION OF PLATES

Plate 1

Fig. 1. Chela of *Lestodryinus striatus*, new species.
2. Chela of *Dicondylus longichelatus*, new species.
3. Chela of *Eucamptonyx secundus*, new species.
4. Chela of *Pseudogonatopus variistriatus*, new species.
5. Chela of *Chalcogonatopus raptor*, new species.
6. Chela of *Epigonatopus tenuis*, new species.
7. Chela of *Agonatopus suturalis*, new species.
8. Chela of *Deinodryinus bilobus*, new species.
9. Chela of *Deinodryinus pilosus*, new species.
10. Chela of *Chelogynus propodealis*, new species.
11. Chela of *Chelogynus minimus*, new species.
12. Chela of *Chelogynus rugulosus*, new species.
13. Chela of *Chelogynus virginiensis*, new species.
14. Chela of *Prenanteon micropunctatus*, new species.

Plate 2

15. Antenna of *Psilodryinus gracilis*, new species.
16. Antenna of *Dicondylus longichelatus*, new species.
17. Antenna of *Pseudogonatopus variistriatus*, new species.
18. Antenna of *Eucamptonyx secundus*, new species.
19. Antenna of *Chalcogonatopus raptor*, new species.
20. Antenna of *Deinodryinus pilosifrons*, new species.
21. Antenna of *Epigonatopus tenuis*, new species.
22. Antenna of *Deinodryinus bilobus*, new species.
23. Antenna of *Deinodryinus pilosus*, new species.
24. Antenna of *Chelogynus minimus*, new species.
25. Antenna of *Chelogynus propodealis*, new species.
26. Antenna of *Chelogynus rugulosus*, new species.
27. Antenna of *Chelogynus virginiensis*, new species.
28. Antenna of *Prenanteon micropunctatus*, new species.

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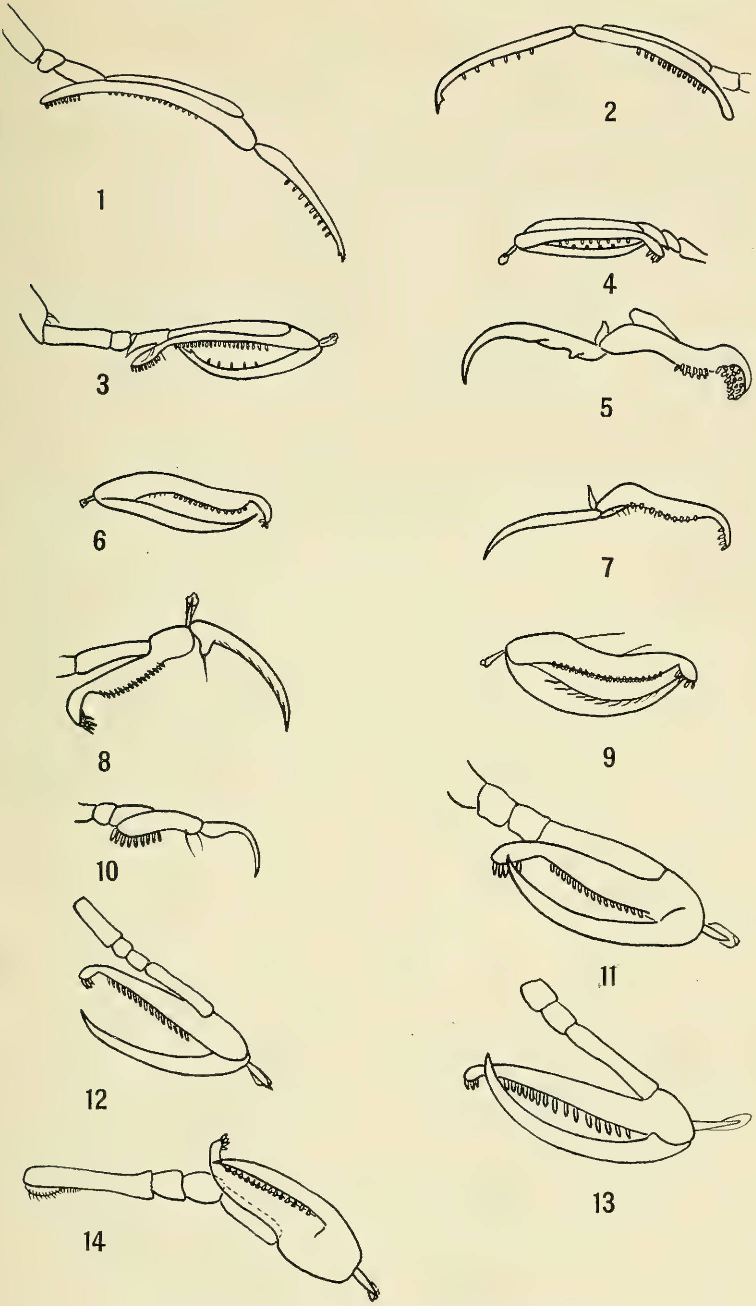
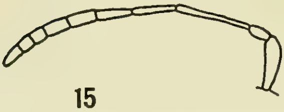


CHELA OF NEW SPECIES OF ANTEONINAE

FOR EXPLANATION OF PLATE SEE PAGE 16



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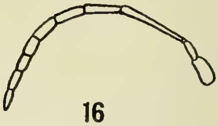

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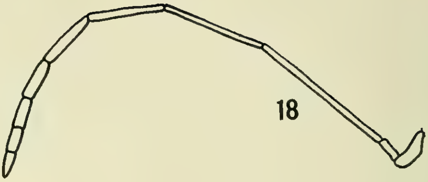

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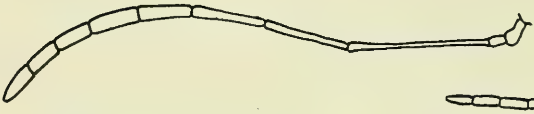

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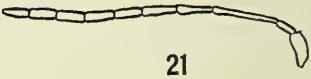

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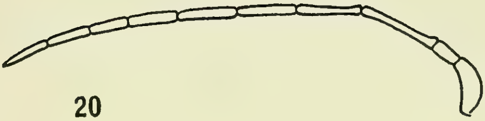

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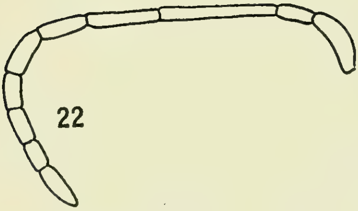

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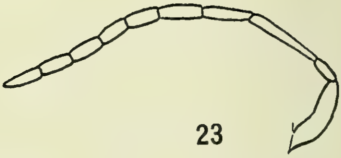

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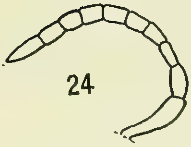

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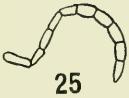

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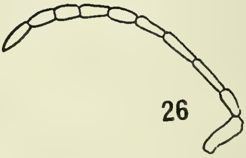

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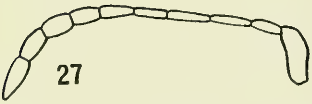

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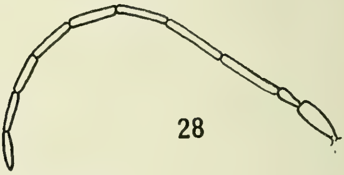

28

ANTENNA OF NEW SPECIES OF ANTEONINAE

FOR EXPLANATION OF PLATE SEE PAGE 16

NEW SPECIES OF TWO-WINGED FLIES OF THE FAMILY CYRTIDAE, WITH A NEW GENUS FROM THE PHILIPPINES

By J. M. Aldrich

Associate Curator, Division of Insects, United States National Museum

The present paper contains two new species of the genus *Lasia* from Costa Rica, and a new genus and species from the Philippines.

LASIA COLEI, new species

Male.—Length, 12.5 mm.

Bright metallic green; posterior part of abdomen more coppery. Legs black, tarsi pale yellow.

Head flattened in front; eyes densely covered with light yellow pile; back of head and ocellar triangle shining green, the latter not elevated but with two large and distinct ocelli. Eyes contiguous to the middle of the head in front, where the antennae are situated; these are small and slender, second joint except base and small portion of the base of the third joint yellow, remainder of third joint black, its tip sharply pointed. Proboscis when folded back slightly longer than the abdomen; no visible palpi. Pile of thorax yellow, rather dense, with some black hairs on the posterior part and on the scutellum. Abdomen in side view with erect black pile on the posterior part of segments one to four. This pile scarcely shows at all in the direct view. On the anterior portion of these segments there is some yellow pile which is continuous along the sides. Venter blue and violet with distinct pale hind margins of the segments; coxae shining green. Calypters with dense yellow pile, subhyaline in the middle with blackish rim.

Wing light brownish, the first and second veins coalescent before their tip; the petiole is joined at right angles just at the costa, by the upper branch of the fork of the third vein; the second and third branches of the fourth vein reach the margin. Halteres with brown knob crossed by a yellow streak.

Described from one specimen collected at Higuito, San Mateo, Costa Rica. (Pablo Schild.)

Type.—Male, Cat. No. 40392, U.S.N.M.

The species differs from *kletti* and *scribae* in having the tarsi light yellow, but resembles them in the venation.

LASIA ROSTRATA, new species

Male.—Length, 8.5 mm.

Color golden green, the humeri and scutellum more coppery. Head convex in front, the vertical triangle coppery; without ocelli. Antennae black, the third joint blunt, distinctly yellow at extreme base; eyes with long pale pile. Thorax densely covered throughout with furry light yellow pile through which the ground color is visible rather indistinctly. Abdomen golden green; first three segments with pile similar to that on the thorax, but a little deeper yellow on the sides of the segments tending to become brown. Last segment with long, silky, pale yellow hairs, especially on the sides. Front coxae green; femora and tibiae dark brown; knees and tarsi yellow. The femora and tibiae are covered with almost white pile. Calypters translucent light yellow with yellow rim and covered with dense pale pile.

Wings hyaline, first and second veins joining the costa separately; the anterior branch of the third vein joins the costa distinctly beyond the second vein; so that the venation is like the figure given by Wiedemann for *splendens*.[1]

The proboscis is remarkably long, so that it projects behind the abdomen about two-fifths of its own length.

Described from one male, collected at Higuito, San Mateo, Costa Rica (Pablo Schild).

Type.—Male, Cat. No. 40393, U.S.N.M.

This species agrees so well with Wiedemann's description and figure of *splendens* that I would have identified it as that species if I could have seen anything corresponding to the thoracic stripes which Wiedemann mentions and figures. They are entirely absent on this specimen.

A female specimen from the same place and taken by the same collector agrees in most characters, including head structure and venation. The proboscis, however, is much shorter, projecting only a little beyond the tip of the abdomen; while the ground color of the abdomen is blackish with very little metallic reflection; the pile of the abdomen is largely dark brown. Although it is probable that this belongs to the same species I did not venture to label it as the allotype.

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[1] Auss. Zweifl., vol. 1, 1830, pl. 4, fig. 3*d*.

RHYSOGASTER, new genus

In subfamily Panopinae. Eyes densely hairy, contiguous above antennae for two-thirds the height of the head, ocellar tubercle minute, the ocelli vestigial. Antennae inserted only a little above mouth, first two joints distinct, third missing. Eyes not approximated below antennae. Proboscis rudimentary but projecting below the head about one-third head height, without labella, but with distinct two-jointed palpi. Thorax moderately inflated, humeri large but widely separated, mesopleura protuberant above, hind part of pteropleura (before spiracle) projecting in globose form; calypters hairy above.

Abdomen folded beneath (in female) the terminal segments adherent to the middle portion so that the genitalia are only a little beyond the hind coxae, as figured. The sternites are greatly narrowed, but six can be easily counted before the genitali, in the form of wrinkles. The abdominal spiracles are large and ring-like, a row of five extending backward and two more conforming to the folding of the segments, lying mesially from the hinder part of the row. The venter is shown in Figure 1, drawn by R. E. Snodgrass.

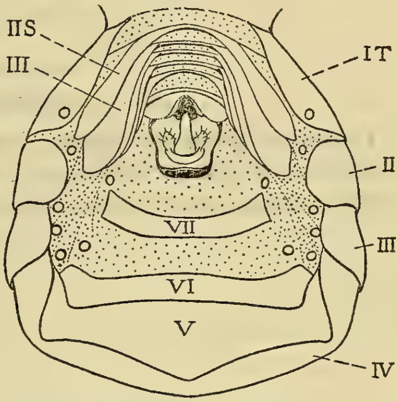

FIG. 1.—RHYSOGASTER IMPLICATA, NEW SPECIES. ABDOMEN, VENTRAL VIEW. T. TERGITE. S. STERNITE

Venation almost as in Eulonchus, but even more as figured by Westwood for *Apsona muscaria.* Pulvilli and empodium well developed as usual.

Type of genus.—Rhysogaster implicata, new species.

RHYSOGASTER IMPLICATA, new species

Female.—Head black about mouth; palpi and apical half of proboscis black, base of latter yellow. Thorax brownish-black with yellow tinge about the sutures, covered with dense yellow hair except just above middle and hind legs. Abdomen yellow with six black crossbands which do not reach the margins of the tergites in any direction except the last two, which reach the sides; there is also a narrow black margin embracing the genitalia, which are large and show three pairs of soft hairy, palpus-like organs behind the opening.

Legs yellow, tibiae tinged with black and tarsi entirely black.

Wings glabrous, yellowish, the veins black and the anterior ones heavy, venation as in Figure 2, drawn by S. P. Kyner.

Length, 12 mm.

FIG. 2.—RHYSOGASTER IMPLICATA. WING

Described from one female, Pena Blanca, Cagayan, Luzon, Philippine Islands (R. C. McGregor).

Type.—Female, Cat. No. 40303, U.S.N.M.

O

ADDITIONS TO THE UPPER CRETACEOUS INVERTEBRATE FAUNAS OF THE CAROLINAS

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INTRODUCTION

The marine invertebrate Cretaceous faunas of North Carolina, with the exception of those of microscopic size, which have not yet been studied, were described in the fifth volume of the North Carolina Geological Survey, issued in 1923.[1] A few species from the adjoining State of South Carolina were included in the descriptions. Since the appearance of that volume additional material has become available from two localities, one in North Carolina and the other in South Carolina.

The collection from North Carolina was obtained in 1923, at the new Rocky Point quarries, a mile northeast of Rocky Point station, Pender County, by Dr. L. B. Kellum, who was then engaged in a field study of the Eocene and Miocene fossil faunas of the eastern part of the State, and by me in 1926. This quarry is not identical with French Brothers' quarry at old Rocky Point, on Northeast Cape Fear River, 3 miles east of Rocky Point station, where the earlier Rocky Point collections were made.

Kellum did not furnish a detailed description of the section in which these fossils were found, but he reported that they were contained in a loose sandy matrix in the uppermost layer of the Peedee formation. The Peedee formation (Upper Cretaceous) of this general area, as shown by the quarries at Castle Hayne and at old Rocky Point, is unconformably overlain by the Castle Hayne marl, a formation of Jackson Eocene age. When I visited the new quarries in May, 1926, they were not in operation and the pits were filled with water so that the section could not be examined. Both the Peedee

[1] The Cretaceous formations of North Carolina: North Carolina Geol. and Econ. Survey, vol. 5, 1923; Stephenson, L. W., Invertebrate fossils of the Upper Cretaceous formations, pp. 1–402, 409–592, pls. 1–100; and Rathbun, Mary J., Decapod crustaceans from the Upper Cretaceous of North Carolina, pp. 403–408, 593–596, pls. 101 and 102.

formation and the Castle Hayne marl were, however, abundantly represented on the dump heaps by easily identifiable materials.

The most abundant material was gray, calcareous sandstone of the Peedee formation, containing many fossils preserved in part as the original shell material, such as the oyster, in part in the form of finely granular dolomitic calcite, of which some of the specimens of *Cardium*, *Crassatellites*, and *Veniella* are examples, and in part as interior casts and exterior molds. Fragments of coarse conglomerate consisting chiefly of phosphatic pebbles in a glauconitic sand matrix were common and these were obviously taken from the basal conglomeratic layer of the Castle Hayne formation. On several of the dumps were fragments of hard white limestone and masses of loose crumbly marl containing bryozoa, echinoids, and pectens, and these materials were derived from the Castle Hayne marl above the basal conglomerate. The collection includes two heretofore undescribed echinoids, seven new pelecypods, two new gastropods, and more perfectly preserved specimens of one pelecypod, *Cardium* (*Trachycardium*) *penderense* Stephenson, described in the volume to which reference has already been made. There are also pelecypods and gastropods too imperfectly preserved for specific identification, some of which probably belong to undescribed species.

The following is a list of the species identified:

Cretaceous species from the new Rocky Point quarries, a mile northeast of Rocky Point station, Pender County, N. C. Collected by L. B. Kellum and L. W. Stephenson. U. S. G. S. colls, 12262 and 13585

Echinodermata:
- *Cassidulus kellumi* Stephenson.
- *Cassidulus emmonsi* Stephenson.

Vermes:
- *Serpula cretacea* (Conrad).

Pelecypoda:
- *Glycymeris subgyrata* Stephenson.
- *Ostrea subspatulata* Forbes.
- *Exogyra costata* Say.
- *Trigonia haynensis* Stephenson.
- *Lima insolita* Stephenson.
- *Anomia major* Stephenson.
- *Anomia penderana* Stephenson.
- *Pholadomya littlei* Gabb.
- *Pholadomya sublevis* Stephenson.
- *Veniella* (*Etea*) *grandis* Stephenson.
- *Crassatellites carolinana* Stephenson.
- *Cardium* (*Trachycardium*) *penderense* Stephenson.

Gastropoda:
- *Turritella subtilis* Stephenson.
- *Pugnellus levis* Stephenson.

In addition to the new material from North Carolina, one lot of old material which had been previously overlooked, from Hilton

Park, Wilmington, N. C., found among the Geological Survey collections, contained six specimens of the echinoid, *Linthia variabilis* Slocum, described on a following page.

The South Carolina locality is Mars Bluff on the right side of Peedee River, 3 miles below Peedee village (Atlantic Coast Line R. R. bridge), Florence County. The section is as follows:

Section at Mars Bluff, Peedee River, S. C.

	Feet
Pleistocene terrace deposits:	
Yellowish sandy loam, grading downward into mottled red and red sandy clay, passing into coarse red sand at base	10
Light drab clay, with a reddish sand lens reaching a maximum thickness of 4 feet, at one place near the base	8
Gravel band with pebbles less than an inch in diameter	0.5–1
Unconformity.	
Black Creek formation (Snow Hill marl member):	
Fine light yellowish stratified sand	8
Dark drab to black finely laminated clay and sand	3–5
Light yellow, fine-grained, thinly stratified, micaceous sand, mottled with pink and red	10–15
Dark drab laminated slightly lignitic clay, with partings of fine micaceous sand and some sand lenses; contains some comminuted plant fragments	2.5–4
Light gray friable sandstone with silicified shells, and some lignite (see list of fossil organisms below)	0.5–1
Yellow and orange sand, interbedded with dark drab clay	2
Fine yellow micaceous stratified sand	2.5
Fine compact white and yellow sand	9
Black shale interstratified with blue sand	10

The fossiliferous layer indicated in the section was discovered prior to 1908 by the late Dr. Earle Sloan,[2] then State geologist, who correlated this part of the section with the Eocene. Several collections were subsequently made at the locality at different times, the last by Dr. Wythe Cooke and me in 1922. The original shell material has been completely replaced by silica in all the specimens. The following list was prepared from all the available collections:

Fossils from Mars Bluff, Peedee River, S. C. Collected by Earle Sloan, Wythe Cooke, and L. W. Stephenson. U. S. G. S. coll. Nos. 3551, 4141, 11459–11462, and 11543.

Coelenterata:
- Sponge borings in shell of Tellina.
- One unidentified coral.

Molluscoidea:
- Bryozoa.

Pelecypoda:
- *Leda* species.
- *Striarca poguei* Stephenson.

[2] Sloan, Earle, Catalogue of the mineral localities of South Carolina, p. 358, 1908.

Pelecypoda—Continued.
- *Glycymeris* (?) *greenensis* Stephenson (numerous).
- *Arca* (*Barbatia*) *bladenensis* Stephenson.
- *Arca* (*Barbatia*) *lintea* (Conrad).
- *Ostrea sloani* Stephenson.
- *Anomia olmstedi* Stephenson.
- *Veniella mullinensis* Stephenson.
- *Crassatellites* species.
- *Lucina* species.
- *Cardium donohuense* Stephenson.
- *Cardium* aff. *C. vaughani* Stephenson.
- *Cardium marsense* Stephenson.
- *Cyprimeria* species.
- *Tellina simplex* Stephenson.
- *Tellina elliptica* Conrad ?.
- *Tellina* species.
- *Linearia carolinensis* Conrad?.
- *Cymbophora trigonalis* Stephenson.
- *Cymbophora* species (large).
- *Corbula oxynema* Conrad.
- *Corbula subgibbosa* Conrad.
- *Corbula* species.
- Unidentified pelecypods (several species).

Scaphopoda:
- *Dentalium leve* Stephenson.

Gastropoda:
- *Nerita* species.
- *Epitonium* species.
- *Lunatia carolinensis* Conrad.
- *Lunatia* species.
- *Gyrodes* ?.
- *Turritella* species.
- *Pugnellus* species.
- *Odontobasis* (?) *greenensis* Stephenson.
- *Unidentified gastopods* (several species).

Vertebrata:
- One fish vertebra.

With the exception of the new species, *Cardium* (*Trachycardium*) *marsense*, all of the specifically identified forms in the list occur in the Snow Hill marl member of the Black Creek formation of the Carolinas, and even the new species may be represented there by imperfectly preserved molds and casts. The containing bed is therefore referred to that member, as is also the entire Cretaceous portion of the section, embracing 50 or 55 feet of strata. The beds in their present condition lack the calcareous character of the typical beds of the member, but the fossil-bearing bed was originally calcareous, the shells and other calcareous material having been subsequently replaced by silica.

The photographic illustrations used in this paper were made in the photographic laboratory of the U. S. Geological Survey by W. O. Hazard, and the photographs were retouched by Miss Frances

Wieser, chief scientific illustrator of the Geological Survey, who also made the several drawings.

DESCRIPTION OF SPECIES

CASSIDULUS KELLUMI, new species

Plates 1, 2; plate 3, figs. 1, 2

Description.—Test broadly ovate in basal outline, rather high and dome-shaped; base slightly concave, with two broadly expanding concave areas extending from the peristome to the ambitus, one on either side of the posterior center; these concave areas are separated from each other by a broad, low, rounded posterior ridge which ends at the ambitus in a slight protuberance or angulation below the periproct; a slight protuberance on the ambitus also marks the outer corners of each of the two concave areas at equal distances from the separating ridge and each protuberance is continued as a faint ridge up over the test; the protuberances and concave areas produce a slightly truncated effect on the ambitus at either side of the posterior center. The upper surface is not smoothly domed, for each ambulacral area is distinctly raised between the pore bands, and each interambulacral area is divided into three flattened or slightly concave bands, widest at the ambitus, narrowing upward toward the apex, and the test is slightly humped above the periproct. Dimensions of the holotype: Length, 58 mm.; width, 53 mm., height, 31 mm.

The ambulacra are moderately broad in the petaloidal portions, become narrow at the lower ends of the petals, broaden out toward the ambitus, narrow down again on the base as they approach the peristome, near which they again broaden out sharply to form the floscelles. In the petals the pores are small, and the pairs are connected by very narrow furrows, much narrower than the intervening ridges; the inner pore is slightly elongated, but in deeply weathered specimens is seen to be not quite so long as the outer one; the pairs of pores are very closely spaced and trend obliquely downward away from the center of the petals, and the petals are almost closed at their lower ends; below the petals very small pores can be discerned on the ambulacral plates all the way to the floscelles. The floscelles broaden out sharply and are composed of long narrow more or less irregular plates each with a pore near its outer end; seven or eight pores on either side of each floscelle form an arch broken above by a group of six or seven pores on irregular plates, which form a small imperfect minor arch sunken considerably below the crest of the main arch. Pores occur on the inner ends of some of the plates of the floscelles, and form an irregular double line of five or six pores.

The ambulacral areas between the pore bands are distinctly elevated. The ambulacral plates in the petals are long horizontally and very narrow, and consequently very numerous. The interambulacral plates are much larger, the largest ones being three or four times as long horizontally as they are wide. The whole upper surface is densely packed with tiny primary and secondary tubercles; even the ridges between the pore slits support each a row of tubercles; each primary is surrounded by a distinct areola and on some of the primaries a minute mamelon can be detected. The base is covered with similar larger and more widely spaced primary tubercles with distinct mamelons, some of which can be seen to be perforated, and each primary is surrounded by a relatively broad areola; the secondaries are tiny and relatively few.

The apical system is situated 0.46 the length of the test from the anterior end; as seen in a slightly worn specimen, the madreporite is subcircular and relatively very large, the three other genital plates are small and perforated, and the ocular plates are minute, with no sign of perforations; as seen in a more deeply worn specimen, the madreporite is relatively smaller, the other genitals are larger, the oculars are larger and perforated. The raised apical system on the specimen shown in Plate 3, Figures 1, 2, is apparently an abnormal feature, as none of the other specimens possess it. The significance of this peculiar feature is not known, but Austin H. Clark has called my attention to a similar raised apical system on one specimen of the Recent *Stereocidaris leucacantha* A. Agassiz and H. L. Clark.

The peristome is situated centrally in a slight concavity of the base, is large, and includes five prominent oral lobes whose tips closely approach each other and are separated by deep, narrow ambulacral furrows. The outer surface of each oral lobe is covered with tubercles and is bordered by a slightly raised rim; the walls of the ambulacral furrows are densely packed with very small tubercles of regular size, arranged in rows parallel to the sloping outer surface of the lobe. These features are beautifully preserved on the type, the peristome of which is nearly perfect in all its details.

The periproct is high on the test, is small, and is situated in a deep, narrow sulcus which flares out and becomes shallow toward the ambitus.

Remarks.—Perhaps the most closely related American species is *Cassidulus porrectus* Clark,[3] from the Ripley formation, *Exogyra costata* zone, in the vicinity of Eufaula, Ala. In form, and in the

[3] Clark, William Bullock, The Mesozoic Echinodermata [of the United States]: U. S. Geol. Survey Mon. 54, p. 76, pl. 31, figs. 1*a–i*, 1915.

details of the peristome, apical system, and periproct, the two species are similar, though not identical, but Clark's species attains a size fully twice as great as the Rocky Point species. There is, however, a striking difference in the pore pairs of the ambulacral areas in the two species, the two pores in each pair in the Rocky Point species being approximately equal, while in the Eufaula species the inner pore is small and round, while the outer one is long and narrow. The periproct of *Cassidulus porrectus* occupies a deeper and narrower sulcus than is represented in Clark's illustrations.

Another related species is *Cassidulus micrococcus* Gabb [4] also from the Ripley formation, near Eufaula, Ala. I have compared the types and find that the Eufaula species is smaller, slightly more elongated, markedly flatter, and a little narrower anteriorly; the periproct is situated higher on the test, in a slightly wider sulcus, the pore pairs are unequal and are less definitely connected by furrows, and the madreporite is a little longer and more angular. The type material of *C. micrococcus* is in certain respects not very well preserved and it is difficult to see how Clark [5] was able to describe and figure the apical system and peristome in as great detail as he did. No other material was available for study so far as the record shows.

Locality.—From the new Rocky Point quarries, a mile northeast of Rocky Point station, Pender County, N. C. Collected by L. B. Kellum in 1923, and by L. W. Stephenson in 1926.

Geologic position.—Upper Cretaceous, upper part of Peedee formation, upper part of *Exogyra costata* zone. European equivalent, upper Senonian (Maestrichtian).

Type material.—The type material is in the United States National Museum. Holotype, catalogue No. 73420; 3 paratypes figured or used in the drawing of figures, catalogue No. 73421; 11 additional specimens, some of which are in good state of preservation.

CASSIDULUS EMMONSI, new species

Plate 3, figs. 3–8; plate 4

Description.—Test broadly subovate in basal outline, only moderately high and broadly domed; the slightly conical shape of the type is due to slight crushing on the sides; other specimens are broadly and evenly rounded. Base moderately concave with two pronounced broad radiating depressions extending from the peristome to the ambitus, one on either side of the posterior center; these depressions are separated from each other by a broad ridge and they produce

[4] Gabb, W. M., Description of a new species of *Cassidulus*, from the Cretaceous formation of Alabama: Proc. Acad. Nat. Sci., Phila., vol. 12, p. 519, 1860.

[5] U. S. Geol. Survey Mon. 54, p. 78, pl. 32, figs. 2 *a–b*; pl. 33, figs. 1 *a–f*., 1915.

slight truncations on the margin; a marked angulation on the ambitus marks the outer corners of each of the depressions at equal distances from the posterior center, and each angulation is continued in a very faint ridge up over the test. Dimensions of the holotype: Length, 41 mm. (?); width, 38 mm.; height, 20 mm. Dimensions of the paratype shown in figure 6: Length, 39 mm.; width, 37 mm.; height, 18 mm.

The petaloid portions of the ambulacra are rather narrow and the areas between the pore bands are slightly upraised; the petals are broadest apically and become narrow lanceolate toward the lower extremity where the pore bands almost touch; below the ends of the petals the ambulacra are very narrow, but they broaden out gradually to the ambitus, beyond which on the base they gradually narrow down again to the floscelles which broaden out conspicuously. In the petals the pores are small, and the pairs are connected by very narrow furrows, narrower than the intervening ridges; the outer pore of each pair is only slightly more elongated than the inner one; the furrows are very closely spaced and trend obliquely downward away from the centers of the petals. Below the petals a single row of pores can be faintly seen on each side of the ambulacral areas near the outer borders, these pores being situated on or near the sutures separating the plates, and the pores can be traced all the way to the floscelles. Each floscelle consists of a pair of large triangular plates next to the oral opening, followed outwardly by two series of five to nine narrow plates, one series on either side of the median line, followed by several broader plates of irregular shape and size, which form the transition into the plates of the narrow ambulacral area. As in other nearly related species all the plates of the floscelles above the triangular plates bear pores at their outer ends which are arranged roughly in the form of an arch convex outward; on the two postero-lateral and the anterior floscelles the arched arrangement includes 6 to 8 pores on each side of each floscelle with a group of 3 to 5 pores somewhat sunken below the crest of the arch; the two antero-lateral floscelles are narrower and include 10 or 11 pores on each side of the arch, with no central group of pores above, leaving the arch open and slightly flaring at the top. Some of the long narrow plates bear pores near their inner ends, and a pair of pores occurs one pore on each of the large triangular plates next to the oral opening.

The ambulacral plates in the petals are long horizontally, very narrow and numerous. Below the petals the ambulacral plates are broader and vary in shape and size on different parts of the area. The interambulacral plates are much larger, the largest ones being about two and one-half times as long horizontally as they are wide. The whole upper surface with the exception of the madreporite is densely packed with small tubercles set in deep small areolas; a tiny mamelon can be detected on some of the tubercles; the base is covered with larger tubercles which vary considerably in size on different parts of the surface.

The apical system is situated slightly forward from the center; the madreporite is large and somewhat elongated; the other genital plates are small and close to the madreporite and bear pores. The ocular plates are minute and can not be clearly seen.

The peristome is situated slightly in front of the center of the broadly concave base, and includes five prominent, rather narrow oral lobes whose tips do not approach so close to the center as in the preceding species and whose separating ambulacral furrows are not so narrow; the mouth is therefore somewhat more open. Tiny tubercles can be detected on the walls of the ambulacral furrows of the better preserved specimens.

The periproct is circular, moderately large, and is situated well above the base at the anterior end of a broad shallow sulcus which extends downward without change of width to the ambitus.

Remarks.—This species may be the same as the one described by Emmons[6] under the name *Gonioclypeus subangulatus*, but the type of that species is probably lost, and the description and figures are inadequate for identification. Clark[7] referred Emmons's species questionably to *Cassidulus* and expressed the opinion that it was a Cretaceous species. The type was obtained by Emmons from a sample of marl from Craven County, N. C., sent to him by W. B. Wadsworth, whose address was Core Creek post office (now abandoned). This marl was regarded as of Eocene age. Core Creek is a small tributary of Neuse River in the northwestern part of Craven County, in an area now mapped as Eocene, but the marl pit from which the sample was taken may have been sunk deep enough to cut through the Eocene into the upper part of the underlying Peedee formation of the Cretaceous.

This species is closely allied to *Cassidulus subquadratus* Conrad, the type of which was found by Dr. W. Spillman in the Ripley formation, *Exogyra costata* zone (Upper Cretaceous), in Tippah County, Miss., and is now in the Academy of Natural Sciences of Philadelphia. Compared with Conrad's species, the North Carolina species is smaller, flatter, and less broadly domed, the pore pairs are a little more closely spaced, and the madreporite is more elongated.

The specimen figured by Clark[8] as typical of *C. subquadratus* Gabb, compared with the type, is not a strictly typical specimen;

[6] Emmons, Ebenezer, "Agriculture of the eastern counties; together with descriptions of the fossils of the marl beds." Report of the North Carolina Geol. Survey, p. 309, figs. 242, 243, 1858.

[7] Clark, W. B., The Mesozoic Echinodermata [of the United States]: U. S. Geol. Survey Mon. 54, p. 81, 1915.

[8] Idem, pl. 31, figs. 2*a–g*, 1915.

the periproct is a little smaller and is situated in a shallower, narrower sulcus, and the apical system is markedly smaller. However, it is very closely related and might appropriately be regarded as a varietal form. Clark's specimen, according to the record, was found by W J McGee near Holly Springs, Miss., but this is obviously an error, as this town is located on the outcrop of nonmarine Wilcox Eocene strata, at least 25 miles west of the nearest surface occurrence of the marine Ripley formation.

Locality.—From the new Rocky Point quarries, a mile northeast of Rocky Point station, Pender County, N. C. Collected by L. B. Kellum in 1923 and by L. W. Stephenson in 1926.

Geologic position.—Upper Cretaceous, upper part of Peedee formation, upper part of *Exogyra costata* zone. European equivalent, upper Senonian (Maestrichtian).

Type material.—The material from the new Rocky Point quarries in the National Museum collections includes seven specimens, none of which is perfectly preserved. The specimen shown in Plate 3, Figures 3–5, is named the type (Cat. No. 73423), but this specimen needs to be supplemented by some of the other material (Cat. No. 73424). There is also one specimen of this species in the National Museum collections (Cat. No. 28930) from the Cretaceous in a well at the waterworks at Wilmington, which is incorrectly labeled *Cassidulus aequoreus* Morton. The depth at which the specimen was taken is not indicated on the label, but the upper part of the Peedee formation crops out in the bank of Northeast Cape Fear River, a short distance below the waterworks where the well is located, and the specimen probably came from a very shallow depth.

LINTHIA VARIABILIS Slocum

Plate 5, figs. 1–7

1909. *Linthia variabilis* Slocum, Field Mus. Nat. Hist. Pub. 134, Geol. ser. vol. 4, No. 1, pp. 12–14, pl. 3, figs. 1–11.

1915. *Linthia variabilis* Clark, U. S. Geol. Survey Mon. 54, pp. 99–100, pl. 54, figs. 1*a*–*l*.

Among the collections of the Geological Survey is a tray containing six echinoids from near Wilmington, N. C., identified and labeled by Dr. W. B. Clark as *Hemiaster ungula* (Morton). After the matrix which concealed most of the surface characters had been removed it was found that these specimens did not belong to the genus *Hemiaster* but to the genus *Linthia*, as shown by the presence of both peripetalous and lateral fascioles. A comparison of these specimens with the types of *Linthia variabilis* Slocum and with specimens of that species in the Geological Survey collections from the vicinity of Pontotoc, Miss., shows that they are very close to and are probably identical with Slocum's species. About the only difference observed is a slightly denser crowding of the tubercles on the surface of the Mississippi specimens, and this difference is so slight as to be scarcely varietal. All of the specimens in both the Mississippi and North Carolina collections are more or less deformed by crushing and I am inclined to think that mechanical crushing caused most of the so-called individual variations noted by Slocum in his Mississippi specimens.

Locality.—From the bank of Northeast Cape Fear River on the west side of Hilton Park, Wilmington, just below the pump station of the Clarendon Waterworks Co., New Hanover County, N. C. Collected by L. W. Stephenson in 1906. U. S. G. S. coll. No. 4143.

Geologic position.—Upper Cretaceous, upper part of Peedee formation, upper part of *Exogyra costata* zone. European equivalent, upper Senonian (Maestrichtian).

Type material.—Part of Slocum's types in the Field Museum of Natural History, Chicago, were kindly lent to me for comparison with the North Carolina material, and consisted of the following nine specimens which I am informed include all of Slocum's material representing this species now in the museum.

Catalogue No. P 10457 A.
Catalogue No. P 10457 D.
Catalogue No. P 10457 E.
Catalogue No. P 10457 H (?).
Catalogue No. P 10457 K (?).
Catalogue No. P 10458 L. (Slocum's pl. 3, figs. 5–8.)
Catalogue No. P 10458 M.
Catalogue No. P 10458 N.
Catalogue No. P 10458 (?letter).

The specimen figured by Slocum in Plate 3, Figures 1–4, Cat. No. P 10457 B, was not included among the specimens sent to me. Slocum evidently had more than the nine specimens before him for on page 13 of his text is a table of 20 measured specimens including catalogue numbers P 10457 A, B, D, E, F, G, H, J, K, and P 10458 L, M, N, O, P, S, T, U, V, W, X, and these lettered specimens probably did not include all the material in his possession.

Slocum describes the occurrence of the Mississippi specimens near Pontotoc, Pontotoc County, in the following words: "This species is from the Ripley group and is quite abundant both on the bluffs of One Mile Run and near the southern edge of the village of Pontotoc, Miss. Two casts which evidently belong to this species were collected by the writer in the Owl Creek marls in Tippah County, Miss."

He does not indicate at which of the two Pontotoc localities the different lettered specimens were obtained. The locality on One Mile Run is about a mile south of Pontotoc.

Two of the specimens from the North Carolina locality are figured in the present paper, Cat. No. 73426, U.S.N.M. The other four specimens have the catalogue number 73427. Two typical specimens from Mississippi have been placed with those from North Carolina, Cat. Nos. 73448, 73449.

GLYCYMERIS SUBGYRATA, new species

Plate 5, figs. 8, 8*a*, 9

Description.—Shell broadly ovate-oblong in outline, a little longer than high, moderately convex. Beaks protruding slightly above the hinge line, incurved, faintly prosogyrate, situated centrally, but slightly in advance of the center of the area. Dimensions of the holotype: Length, 31 mm.; height, 28 mm.; convexity, 9 mm. Dimensions of the best preserved paratype: Length, 26 mm.; height, 22 mm.; convexity, 7 mm.

Hinge plate arched and truncated above by the straight lower margin of the area. Several of the central teeth are small, short, and transverse to the hinge line; in front of the central teeth are 10 or 11 larger somewhat oblique teeth, and back of them 9 or 10 similar larger, oblique teeth.

Cardinal area amphidetic, straight on the lower margin, and arched above; the straight margin is about 11 mm. long on the holotype; the area is covered with about 5 narrow chevron-shaped ligamental grooves, the posterior limbs of which are a little longer than the anterior.

On the interior of the shell the adductor scars are strong, of moderate size, and are distinctly raised above the main inner surface, the lower margin of each scar being slightly overhanging. The inner margin of the shell is rather finely crenulated.

The margins of the shell form a broad oval, longer than high, the posterior end being a little more sharply rounded than the anterior.

The outer surface is nearly smooth, with the exception of fine concentric growth lines, and widely spaced stronger lines indicating vigorous growth followed by resting stages. There is no indication of radiating lines such as are usually present on the species of this genus.

Remarks.—The slight, though distinct forward curvature of the beak is a feature that has not been observed on previously described species of this genus from the Upper Cretaceous of North America. *Glycymeris hamula* (Morton) from the uppermost part of the Upper Cretaceous at Prairie Bluff, Alabama River, Ala., is apparently smooth, but it has a direct beak, is more convex, and has a higher area with more numerous ligamental grooves.

Localities.—From the new Rocky Point quarries, a mile northeast of Rocky Point station, Pender County, N. C.; one specimen collected by L. B. Kellum in 1923 and one by L. W. Stephenson in 1926. Two casts from the old Rocky Point quarries at Lanes Ferry, 3 miles east of Rocky Point station, collected by W. B. Clark in 1889.

Geologic position.—Upper Cretaceous, upper part of Peedee formation, upper part of *Exogyra costata* zone. European equivalent upper Senonian (Maestrichtian).

Type material.—The material studied is in the United States National Museum and includes one left valve, the holotype, Cat. No. 73428, another smaller and better preserved left valve, Cat. No. 73429, and two internal casts, Cat. No. 73430.

LIMA INSOLITA, new species

Plate 5, fig. 10

Description.—Shell very large, subovate in outline, inequilateral, oblique. Beak and ears not preserved. Approximate dimensions of the type, a right valve: Length, 57 mm.; height, 60 mm.; convexity, 10+ mm. (?). The specimen appears to have been somewhat flattened by mechanical crushing.

Hinge and internal features not preserved.

Anterior margin broadly rounded, passing into the more sharply rounded ventral margin; posterior margin sharply rounded below, becoming nearly straight and sloping forward above, probably making an angle with the hinge line of about 140°.

The surface of the type is marked with more than 25 radiating ribs, which are narrow and low, and are separated by much wider interspaces, some of which show faint indications of very fine interlining; the broadest interspaces between the ribs along the ventral margin of the type are about 3 mm. wide; on the anterior and posterior slopes the ribs become very faint.

Remarks.—This is the largest species of *Lima* yet found in the Upper Cretaceous of the Atlantic and Gulf Coastal Plain.

Locality.—From the New Rocky Point quarries, a mile northeast of Rocky Point station, Pender County, N. C. Collected by L. W. Stephenson in May, 1926.

Geologic position.—Upper Cretaceous, upper part of Peedee formation, upper part of *Exogyra costata* zone. European equivalent, upper Senonian (Maestrichtian).

Type material.—The holotype is in the United States National Museum, Cat. No. 73431.

ANOMIA MAJOR, new species

Plate 5, fig. 11

Description.—Shell large, moderately thick, subcircular to broadly subovate in outline, ranging in different individuals from flat to strongly convex. Beak small, depressed to moderately prominent, situated 1 to 2 millimeters away from the dorsal margin. Dimensions of the type, a left valve: Length, 50 mm.; height, 40+ mm. (the specimen is somewhat deformed and crushed). Hinge and internal features not uncovered.

Surface marked by fine concentric growth lines and by radiating sculpture which varies greatly in strength of development on different individuals. On the type the surface is nearly smooth around the beak; away from the beak the smooth surface passes into a surface marked by fine radiating lines to a distance of 18 or 20 mm., and this in turn passes into the more coarsely ribbed portion of the shell; the main ribs are faint to moderately strong, subangular to rounded, and some of them show faint irregularly spaced nodes; the spaces between the ribs differ markedly in width but in general are wider than the ribs.

Remarks.—The species is related to *Anomia ornata* Gabb from the upper part of the Ripley formation in the Chattahoochee region, Georgia, but its main ribs are less strongly developed and it lacks the numerous small, sharply defined subordinate ribs of the Georgia species. The species is also related to *Anomia forteplicata* Gardner, of Maryland, a form that is also closely related to *Anomia ornata* Gabb. The form identified by Gardner as *Anomia ornata* Gabb, from near Friendly, Prince Georges County, Md., may be only an individual variant of *Anomia forteplicata* Gardner, but a full suite of specimens would be necessary to determine this relationship. Apparently both the Maryland species recognized by Gardner average much smaller in size than the typical *Anomia ornata* Gabb, some specimens of which are more than 40 mm. in length.

Locality.—From the new Rocky Point quarries, a mile northeast of Rocky Point station, Pender County, N. C. Collected by L. W. Stephenson, May, 1926.

Geologic position.—Upper Cretaceous, upper part of Peedee formation, upper part of *Exogyra costata* zone. European equivalent, upper Senonian (Maestrichtian).

Type material.—Includes the holotype, United States National Museum Cat. No. 73432, and three smaller, younger specimens Cat. No. 73433.

ANOMIA PENDERANA, new species

Plate 5, fig. 12

Description.—Shell of moderate thickness, subcircular in outline, strongly convex in the umbonal portion, flattening out toward the margin. Beak broken but probably of moderate size and situated more than a millimeter away from the margin. Dimensions of the type, a left valve: Length, 33 mm.; height, 32 mm.; convexity, about 8 mm.

The surface has been smoothed off somewhat by corrosion, but the ribs are apparently not very prominent, are rounded, differ considerably in strength, are in general much narrower than the interspaces, and bear faint irregularly spaced nodes; there is evidence of numerous faint lines between the ribs.

Remarks.—The ribs of this species are much finer and more regularly spaced than in *Anomia major* Stephenson, and it seems unlikely that it can be an individual variant of that species. The species does not appear to be very closely related to any described Coastal Plain species.

Locality.—From the new Rocky Point quarries, a mile northeast of Rocky Point station, Pender County, N. C. Collected by L. W. Stephenson, May, 1926.

Geologic position.—Upper Cretaceous, upper part of Peedee formation, upper part of *Exogyra costata* zone. European equivalent, upper Senonian (Maestrichtian).

Type material.—The species is based on one specimen, United States National Museum Cat. No. 73434.

PHOLADOMYA SUBLEVIS, new species

Plate 6, figs. 1, 2

1923. *Pholadomya littlei* STEPHENSON (in part), North Carolina Geol. and Econ. Survey, vol. 5, pp. 247–249, pl. 63, figs. 3, 4 (only).

Description.—Shell relatively small, equivalve, inequilateral, elongated, subelliptical in outline, moderately convex, broad in the umbonal region. The shell has a slightly swollen appearance toward the lower anterior extremity. The two valves gap slightly anteriorly, but are almost closed posteriorly. Beaks, incurved, approximate, situated about 0.3 the length of the shell from the anterior extremity. Dimensions of the type: Length, 61 mm.; height, 36 mm.; convexity, 25 mm.

Hinge long, straight, anterior margin rather sharply rounded below; ventral margin very broadly rounded, becoming almost straight; posterior margin sharply rounded at the extremity which is about the midheight.

Surface marked by 13 or 14 radiating costae which, as shown by the external mold of the paratype, are weak and narrow, becoming obscure on the antero- and postero-dorsal slopes; the costae are somewhat irregularly spaced, the widest spacing being back of the midlength of the shell.

Remarks.—The species is based on two specimens, the larger of which is named the holotype. The paratype was figured in the paper cited in the synonymy, and was questionably regarded as a young individual of *Pholadomya littlei* Gabb; the holotype shows that the ribs remain finer with increase in size than they do on Gabb's species, and the finding of two relatively small specimens suggests that the species does not attain large proportions.

Locality.—The holotype is from the new Rocky Point quarries a mile northeast of Rocky Point station, Pender County, N. C. The paratype was found in French Brothers' quarry at old Rocky Point (now Lanes Ferry), 3 miles east of Rocky Point station.

Geologic position.—Upper Cretaceous, upper part of Peedee formation, upper part of *Exogyra costata* zone. European equivalent, upper Senonian (Maestrichtian).

Type material.—The material is in the United States National Museum and includes the holotype, Cat. No. 73435, and one paratype Cat. No. 31719.

VENIELLA (ETEA) GRANDIS, new species

Plate 6, figs. 3, 3*a*, 4

Description.—Shell large and thick in comparison with other species of the subgenus, elongate subovate in outline, inequilateral, moderately convex. Beaks prominent, incurved, prosogyrate, approximate, situated about one-third the length of the shell from the anterior extremity. Umbonal ridge distinct, extending from the beak to the lower posterior extremity, curved, convex upward, bounded above by a pronounced radiating depression extending from the beak to the posterior truncation. Dimensions of the holotype a right valve: Length, 58 mm.; height, 42 mm.; convexity, 14 mm.

Hinge of right valve with two cardinal teeth separated by a deep triangular socket; the anterior cardinal is short and thin and is directed downward and slightly backward; the posterior cardinal is long, thick, oblique, and strongly bifid. The inner anterior lateral tooth is short, thick, and prominent, and is situated close to the anterior cardinal from which it is separated by a deep narrow cleft; the inner lateral is separated from the weak outer lateral by a deep socket. The inner posterior lateral is partly broken but as shown by a cast, it is rather thick, strong, and relatively long; the outer lateral is weak and is separated from the inner one by a pronounced socket deepest toward its forward end.

Ligament opisthodetic, set in a narrow deep groove extending in an upbent curve from the beak to the forward end of the lateral socket, a distance of 18 mm.

Anterior adductor scar broadly subovate, deeply impressed; posterior adductor scar obliquely elongate, not so deeply impressed, and a little larger than the anterior. Pallial line simple. Inner surface, as shown on a cast, with two or three broad, rather weak, radiating undulations.

Dorsal margin long and slightly arched behind the beak, short and concave in front of the beak; anterior margin sharply rounded; ventral margin broadly and regularly rounded; posterior margin subangular below, truncated, slightly concave, sloping obliquely forward and rounding into the dorsal margin above.

Surface marked by concentric growth lines which become rather coarse back of the umbonal ridge, and by several stronger concentric channels which mark resting stages in growth.

Remarks.—This species differs from its nearest known relative *Veniella* (*Etea*) *carolinensis* (Conrad), in its markedly greater size and relatively greater height, and in the pronounced arching of the umbonal ridge.

Locality.—From the new Rocky Point quarries, a mile northeast of Rocky Point station, Pender County, N. C. Collected by L. B. Kellum in 1923.

Geologic position.—Upper Cretaceous, upper part of Peedee formation, upper part of *Exogyra costata* zone. European equivalent, upper Senonian (Maestrichtian).

Type material.—The material is in the United States National Museum and includes the holotype, a right valve, Cat. No. 73436, and three internal calcareous sandstone casts, Cat. No. 73437, one of which has clearly impressed upon it the concentric markings of the outer surface of the shell.

CRASSATELLITES CAROLINANA, new species

Plate 7, figs. 1, 1*a*, 2; plate 8

Description.—Shell large, elongate, inequilateral, moderately convex. Beaks prominent, incurved, slightly prosogyrate, situated about 0.37 the length of the shell from the anterior end. Umbonal ridge nonprominent. Dimensions of the holotype, a left valve: Length, 64 mm.; height, 48 mm.; convexity, 15 mm. Dimensions of a well-preserved right valve: Length, 66 mm.; height, 52 mm.; convexity, 16 mm.

Hinge of left valve with two cardinal teeth, the anterior one strong and trending obliquely forward, the posterior one nearly vertical in trend, thin above, becoming stronger and more prominent below, the two cardinals separated by a deep somewhat expanding socket lined on the sides with fine transverse striations. Hinge of right valve with one strong prominent cardinal tooth sloping a little forward in front of the resilifer, and a very weak anterior cardinal sloping strongly forward in front of a socket of only moderate depth. No true laterals are present, but the margins of the shell under the lunule and under the escutcheon are slightly raised, forming a sort of pseudo-laterals. The anterior raised margins are separated from the anterior cardinals by pronounced channels. The resilifer is broad and subtrigonal, and at its lower margin just back of the posterior cardinal on each valve is a small pit. On the left valve on the posterior side of the resilifer close to the margin, is a narrow ridge or pseudo-cardinal. Some distance back of the resilifer near the inner margin is a very low broad hump suggesting a rudimentary lateral, and between this and the slightly raised outer margin above is a shallow channel. A similar hump occurs near the inner margin a short distance in front of the socket on the right valve. Lunule distinct and deep, most sharply outlined on the left valve. Escutcheon distinct, but shallow, sharply defined on the right valve, less so on the left valve.

Adductor scars subequal strongly impressed; back of the upper end of the anterior scar is a small deeply impressed retractor scar. Pallial line simple. Most of the internal casts show a depression, corresponding to an internal ridge, beginning just in front of the beak, extending in a broad regular curve downward and backward, and dying out before reaching the pallial line. Inner margin of the shell finely crenulated.

The dorsal margins of the shell slope from the beak at an angle of about 130°; the antero-dorsal margin rounds down into the regularly but rather sharply rounded anterior margin, and this in turn into the broadly and regularly rounded ventral margin; posterior margin subangular below, slightly truncated above.

Surface marked by rather coarse growth lines of irregular strength.

Remarks.—Internal casts of this species were figured without specific name in North Carolina Geological and Economic Survey.[9] The new material includes one nearly perfect left and one nearly perfect right valve, several imperfect right and left valves, and several internal calcareous sandstone casts, one of which is nearly perfect on the right side.

The specimens figured by Weller[10] in his Plate 41, figures 1 and 2, under the name *Crassatellites subplanus* (Conrad), appear to be very close to this species, but they are relatively shorter. The specimens are, however, relatively longer than Conrad's type of *C. subplanus* and I question the correctness of their identification.

The species *Crassatellites vadosus* (Morton) which is very common in the upper part of the Ripley formation of the Gulf Coastal Plain in beds which are of about the same age as the Cretaceous stratum uncovered in the Rocky Point quarries, is more convex and more

[9] Vol. 5, p. 277, pl. 68, figs. 5–7, 1923.

[10] Weller, Stuart, A report on the Cretaceous Paleontology of New Jersey, Geol. Survey New Jersey, Paleontology, vol. 4, p. 553, pl. 41, figs. 1, 2, 1907.

sharply pointed posteriorly, and has a more sharply defined umbonal ridge than *C. carolinana.* The hinge characters of the two species also differ in detail.

Localities.—From Pender County at the new Rocky Point quarries, a mile northeast of Rocky Point station, and at French Brothers' quarry at old Rocky Point, 3 miles east of Rocky Point station; from the Castle Hayne quarries in New Hanover County, N. C. The type was collected by L. B. Kellum in 1923.

Geologic position.—Upper Cretaceous, upper part of Peedee formation, upper part of *Exogyra costata* zone. European equivalent, upper Senonian (Maestrichtian).

Type material.—The type material is in the United States National Museum. Holotype, Cat. No. 73438. Paratypes Cat. Nos. 31750–31752, 73439.

CARDIUM (TRACHYCARDIUM) PENDERENSE Stephenson

Plate 6, figs. 5–8, 8*a*

1923. *Cardium* (*Trachycardium*) *penderense* Stephenson, North Carolina Geol. and Econ. Survey, vol. 5, pp. 291–292, pl. 71, figs. 1–3.

Description.—The type of this species is an imperfect external mold from French Brothers' quarry at Old Rocky Point on Northeast Cape Fear River, now known as Lanes Ferry, 3 miles east of Rocky Point station, Pender County, N. C. The additional material now available for study includes numerous internal casts and some imperfect external molds, collected by W. B. Clark at the old quarry in 1888, and not previously examined by me, and a collection made by L. B. Kellum in 1923 at the new quarries a mile northeast of Rocky Point station, including 7 left and 9 right valves, some of which are nearly complete, and 3 internal casts. The original description should be consulted before reading the following supplemental description.

The more complete new material shows the number of ribs to be 48 or 49 instead of 45. The individuals show considerable variation, ranging in outline from a little longer than high to considerably higher than long. These differences may be due in part to mechanical deformation in the sediments, but I am inclined to regard them as chiefly original individual variations, or perhaps in part as sex differences. The ribs appear to be identical in the different forms, and there is no suggestion that more than one species or even variety is represented. The ribs on the anterior slope near the margin exhibit rather coarse transverse rugosities. Some of the specimens show marked resting stages in growth at wide intervals, while others, even large ones, exhibit continuous even growth. The beaks are almost direct or very slightly prosogyrate, instead of opisthogyrate as suggested in the original description. The hinge is normal for the subgenus *Trachycardium*, as this group is developed in the Upper Cretaceous deposits of the Atlantic Coastal Plain.

Geologic position.—Upper Cretaceous, upper part of the Peedee formation, upper part of *Exogyra costata* zone. European equivalent, upper Senonian (Maestrichtian).

Figured specimens.—The new material figured is from the collection made by Kellum in 1923, at the new quarries, a mile northeast of Rocky Point station, Pender County, N. C., Cat. No. 73442; seven additional specimens are in the collection.

CARDIUM (TRACHYCARDIUM) MARSENSE, new species

Plate 7, figs. 3, 3*a*, and 4

Description.—Shell large, subcircular to broadly subovate in outline, a little longer than high, slightly oblique. Beaks moderately prominent, incurved, approximate, nearly direct, situated slightly in advance of the midlength. Umbonal ridge moderately prominent, shell most inflated centrally, postero-dorsal slope steep, antero-dorsal slope rounded, becoming steep above. Dimensions of the holotype: Length, 49 (?) mm.; height, 46 mm.; convexity, 16 mm.

Hinge normal for the subgenus *Trachycardium*. Ligamental groove short and deep. Inner surface smooth as preserved, adductor scars faintly impressed, inner margin strongly crenulated.

Dorsal margin broadly arcuate, anterior and ventral margins regularly rounded, posterior margin subangular below, truncated above, trending obliquely forward and rounding rather sharply into the postero-dorsal margin.

Surface ornamented with 33 or 34 strongly developed ribs, 25 of which are in front of the umbonal ridge. The ribs are sub-V-shaped in cross section, subangular to rounded on the crests, and each rib is scored on each side with a faint, narrow, longitudinal channel. At the bottom of the depression between each rib is a closely appressed slit. On the anterior slope the crest of each rib is set with irregularly spaced distinct nodes 2 to 4 mm. apart. The ribs on the posterior slope grade from broadly V-shaped near the umbonal ridge to almost flat near the postero-dorsal margin.

Remarks.—This species has fewer and coarser ribs than either *C. donohuense* Stephenson or *C. longstreeti* Weller, both of which are closely related species occurring in the same faunal zone in North Carolina. The material consists of silicified shells, including a large right valve, the holotype, broken and partly wanting in the postero-ventral portion, a smaller more perfect right valve and several more or less fragmentary right and left valves.

Locality.—From Mars Bluff on Peedee River, 3 miles below the Atlantic Coast Line Railway bridge, Florence County, S. C. Collected by C. W. Cooke and L. W. Stephenson in 1922.

Geologic position.—Upper Cretaceous, Snow Hill marl member of Black Creek formation, upper part of *Exogyra ponderosa* zone. European equivalent, upper Senonian (Campanian).

Type material.—The type material is in the United States National Museum. Holotype, Cat. No. 73440; paratype, Cat. No. 73441.

TURRITELLA SUBTILIS, new species

Plate 9, figs. 6, 7

Description.—Spire high with probably not less than 20 whorls, apical angle apparently about 20°. The diameter of the largest whorl preserved is approximately 21 mm. Sides of whorls very slightly convex, practically flat on one well preserved specimen, ornamented with 28 or 30 fine revolving threads of irregular strength, strongest on the middle and anterior parts of the whorls; in places the threads are faintly nodose. Suture sharply, but not deeply impressed. There is a faint indication of growth lines which appear to be strongly convex backward on the whorls. The other features of the shell are not preserved.

Remarks.—This species is larger and is much more finely ornamented than *Turritella pointensis* Stephenson, from the old French Brothers' quarries, 3 miles east of Rocky Point station. *Turritella lorillardensis* Weller from the stratigraphically lower Woodbury clay of New Jersey appears to be a rather closely related species, but its ornamentation is coarser, the sutural depression is deeper, and the whorls are a little more convex.

Locality.—From the New Rocky Point quarries, a mile northeast of Rocky Point station, Pender County, N. C. Collected by L. B. Kellum in 1923.

Also from the old Rocky Point quarries at Lanes Ferry, 3 miles east of Rocky Point station, collected by W. B. Clark in 1889.

Geologic position.—Upper Cretaceous, upper part of Peedee formation, upper part of *Exogyra costata* zone. European equivalent, upper Senonian (Maestrichtian).

Type material.—The type material is in the United States National Museum, and includes the holotype, Cat. No. 73443, and several paratypes, Cat. Nos. 73444, 73445.

PUGNELLUS LEVIS, new species

Plate 9, figs. 1–5

1923. *Pugnellus* species, North Carolina Geol. and Econ. Survey, vol. 5, p. 374, pl. 93, fig. 12 (probably not fig. 13).

Description.—Shell large and roughly fusiform; spire of moderate height, body whorl large; number of whorls 5 or 6. Side of whorls of spire plump but slightly flattened, as shown by the internal cast, and the flattened band becomes more pronounced as it continues around onto the upper part of the body whorl. The spire and a considerable part of the body whorl are callused over, concealing the surface features, and a heavy rounded irregular ridge of callus extends from near the beak well down over the shell, distant about one-third the circumference of the shell in front of the aperture. The surface of the body whorl in front of this ridge of callus is smooth as far as it is preserved. The forward part of the body whorl is wanting in the type, so that the nature of the outer lip is not known.

Canal deep and narrow, probably moderately long, but length not determined. Dimensions of the type: Altitude, 60+ mm.; diameter, 42+ mm.

Remarks.—The internal cast shown in Figure 12, cited above in the synonymy, probably belongs to this species, but the specimen shown in Figure 13 appears to be a more slender form and may be an undescribed species.

Wade[11] has described a large smooth species, *Pugnellus abnormalis*, from Coon Creek in the lower part of the Ripley formation in Tennessee, but his species has a higher spire, and the shell as a whole is more elongated than the Rocky Point species. A large undescribed species in the upper part of the Navarro formation of Kaufman County, Tex., approaches this one in smoothness, but faintly developed longitudinal plications are present on the body whorl of the Texas species. *Pugnellus goldmani* Gardner is a nearly smooth species from the Monmouth formation of Maryland. *Pugnellus densatus* Conrad from the Ripley formation of the eastern Gulf region and from the Navarro formation of Texas, and *Pugnellus pauciplicatus* Stephenson from the Snow Hill member of the Black Creek formation of North Carolina are forms with longitudinal plications well developed on the forward half of the body whorl.

Locality.—From the new Rocky Point quarries a mile northeast of Rocky Point station, Pender County, N. C.

Geologic position.—Upper Cretaceous, upper part of Peedee formation, upper part of *Exogyra costata* zone. European equivalent, upper Senonian (Maestrichtian).

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[11] Wade, Bruce, Fauna of the Ripley formation, Tennessee: U. S. Geol. Survey Prof. Paper 137, p. 149, pl. 52, figs. 6, 7, 1926.

Type material.—The type material is in the United States National Museum and includes the holotype, Cat. No. 73446, and three paratypes, Cat. No. 73447.

EXPLANATION OF PLATES

(The specimens figured in Plates 1 to 9 are from the new Rocky Point quarries, a mile northeast of Rocky Point station, Pender County, N. C., except as otherwise indicated.)

PLATE 1

Cassidulus kellumi Stephenson (p. 5)

FIG. 1. Upper surface of the test of the type. U. S. Nat. Mus. Cat. No. 73420.
2. Lower surface of the test of the type.
3. Posterior surface of the test of the type.
4. The apical system of the type, ×4.
5. Diagrammatic view of the apical system, ×5, based on one of the paratypes.
6. The peristomal area of the type, ×2+.

PLATE 2

Cassidulus kellumi Stephenson (p. 5)

FIG. 1. Anterior surface of the test of one of the paratypes. U. S. Nat. Mus. Cat. No. 73421.
2. Drawing of the surface of the right side of one of the paratypes.
3. Lower surface of a typical specimen showing the form and arrangement of the plates. U. S. Nat. Mus. Cat. No. 73421.
4. Diagrammatic representation of the right postero-lateral ambulacrum of the specimen shown in Figure 3, ×2⅔.

PLATE 3

Cassidulus kellumi Stephenson (p. 5)

FIG. 1. Upper surface of the test of a specimen having an apparently abnormal growth covering the apical system. U. S. Nat. Mus. Cat. No. 73421.
2. The peculiar growth covering the apical system of the specimen shown in Figure 1, ×4.

Cassidulus emmonsi Stephenson (p. 7)

FIG. 3. Upper surface of the test of the type. U. S. Nat. Mus. Cat. No. 73423.
4. Lower surface of the test of the type.
5. Posterior surface of the test of the type; the apparent subconical profile is due to slight crushing from above.
6. Upper surface of a typical specimen which has not been distorted by crushing. U. S. Nat. Mus. Cat. No. 73424.
7. Posterior surface of the specimen shown in Figure 6; note the even doming of this uncrushed specimen.
8. Outline profile of the specimen shown in Figure 6, as viewed from the right side.

PLATE 4

Cassidulus emmonsi Stephenson (p. 7)

FIG. 1. Upper surface of the test of a typical specimen from a well at the waterworks at Wilmington, depth not stated. U. S. Nat. Mus. Cat. No. 28930.

2. Lower surface of the test of the specimen shown in Figure 1.
3. Part of the upper surface of the same specimen, ×3.
4. The peristomal area of the same specimen, ×3.
5. Diagrammatic representation of part of the left antero-lateral ambulacrum of a typical specimen, ×4. U. S. Nat. Mus. Cat. No. 73424.

PLATE 5

Linthia variabilis Slocum (p. 10)

FIG. 1. Upper surface of a specimen from Hilton Park, Wilmington, N. C. U. S. Nat. Mus. Cat. No. 73426; the test has been slightly flattened by crushing from above.

2. Lower surface of the specimen shown in Figure 1.
3. Right lateral surface of the same specimen.
4. Upper surface of a smaller specimen from Hilton Park which has been crushed laterally, and made to appear narrower than normal. U. S. Nat. Mus. Cat. No. 73426.
5. Lower surface of the specimen shown in Figure 4.
6. Right lateral surface of the same specimen.
7. The same enlarged, ×2.

Glycymeris subgyrata Stephenson (p. 12)

FIGS. 8, 9. The type, a left valve. U. S. Nat. Mus. Cat. No. 73428.
8*a*. Profile showing the convexity of the type.

Lima insolita Stephenson (p. 13)

FIG. 10. The type, a right valve. U. S. Nat. Mus. Cat. No. 73431.

Anomia major Stephenson (p. 13)

FIG. 11. The type, a left valve. U. S. Nat Mus. Cat. No. 73432.

Anomia penderana Stephenson (p. 14)

FIG. 12. The type, a left valve. U. S. Nat. Mus. Cat. No. 73434.

PLATE 6

Pholadomya sublevis Stephenson (p. 15)

FIG. 1. Left side of the type, an internal cast on which the external markings of the shell have been impressed by pressure after the removal of the shell by solution. U. S. Nat. Mus. Cat. No. 73435.

2. View of the upper surface of the type, showing also the convexity of the shell.

Veniella (*Etea*) *grandis* Stephenson (p. 16)

FIGS. 3, 4. The type, a right valve. U. S. Nat. Mus. Cat. No. 73436.
3*a*. Profile showing the convexity of the type.

Cardium (Trachycardium) penderense Stephenson (p. 19)

FIGS. 5, 6. A typical left valve. U. S. Nat. Mus. Cat. No. 73442.
7. Internal view of a typical right valve.
8. A large typical left valve.
8*a*. Profile showing the convexity of the preceding specimen.

PLATE 7

Crassatellites carolinana Stephenson (p. 17)

FIGS. 1, 2. The type a left valve. U. S. Nat. Mus. Cat. No. 73438.
1*a*. Profile showing the convexity of the type.

Cardium (Trachycardium) marsense Stephenson (p. 20)

FIGS. 3, 4. The type, a large left valve, from Mars Bluff, Peedee River, Florence County, S. C. U. S. Nat. Mus. Cat. No. 73440.
3*a*. Profile showing the convexity of the type.

PLATE 8

Crassatellites carolinana Stephenson (p. 17)

FIG. 1. View of the right side of an internal cast. U. S. Nat. Mus. Cat. No. 73439.
2, 3. A typical right valve. U. S. Nat. Mus. Cat. No. 73439.

PLATE 9

Pugnellus levis Stephenson (p. 22)

FIGS. 1, 2, 3. Views of the type. U. S. Nat. Mus. Cat. No. 73446.
4, 5. Views of an internal cast probably belonging to this species. U. S. Nat. Mus. Cat. No. 73447.

Turritella subtilis Stephenson (p. 21)

FIG. 6. The type. U. S. Nat. Mus. Cat. No. 73443.
7. Gutta-percha squeeze from the mold of the apical portion of a typical specimen. U. S. Nat. Mus. Cat. No. 73445.

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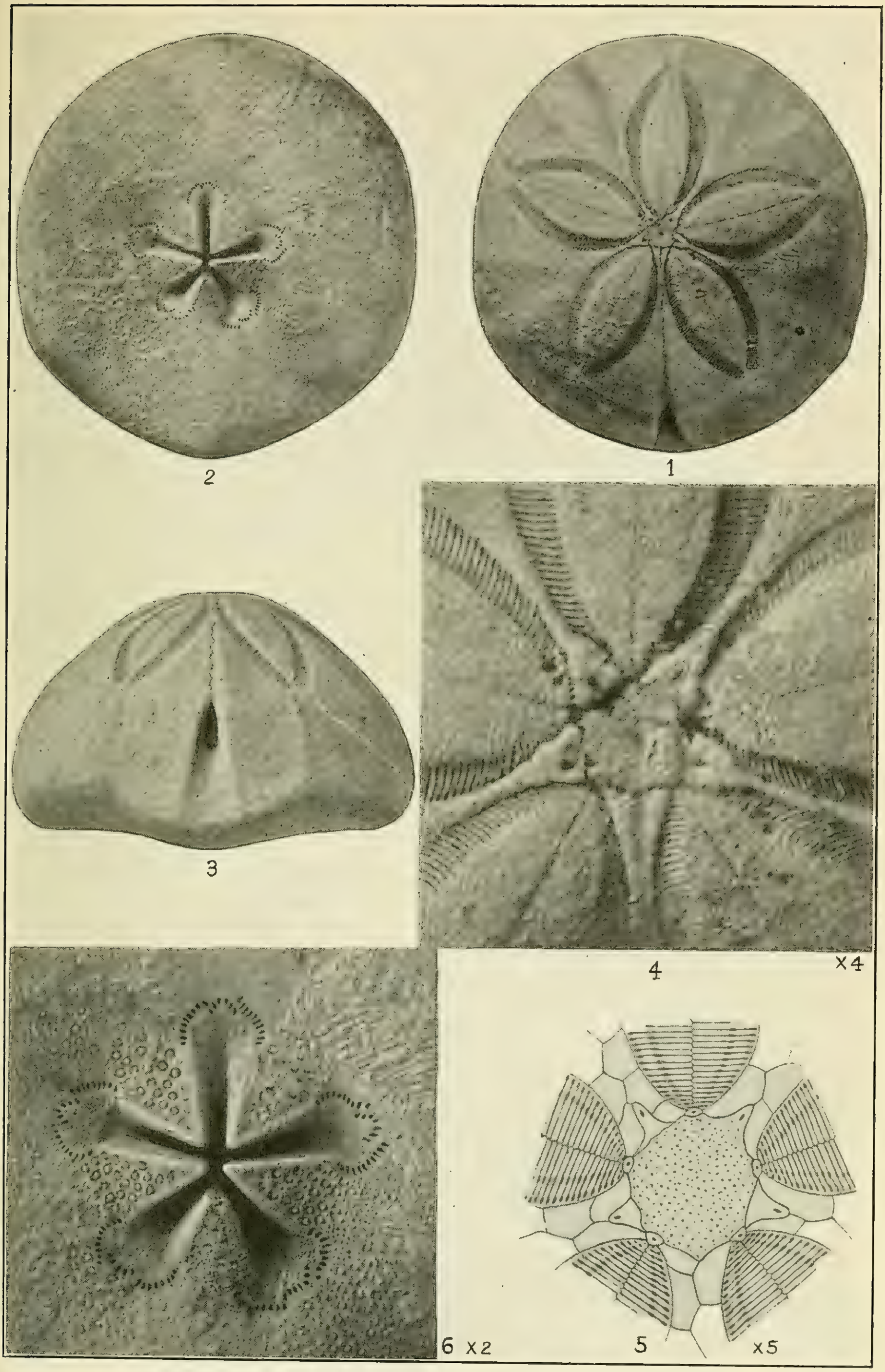
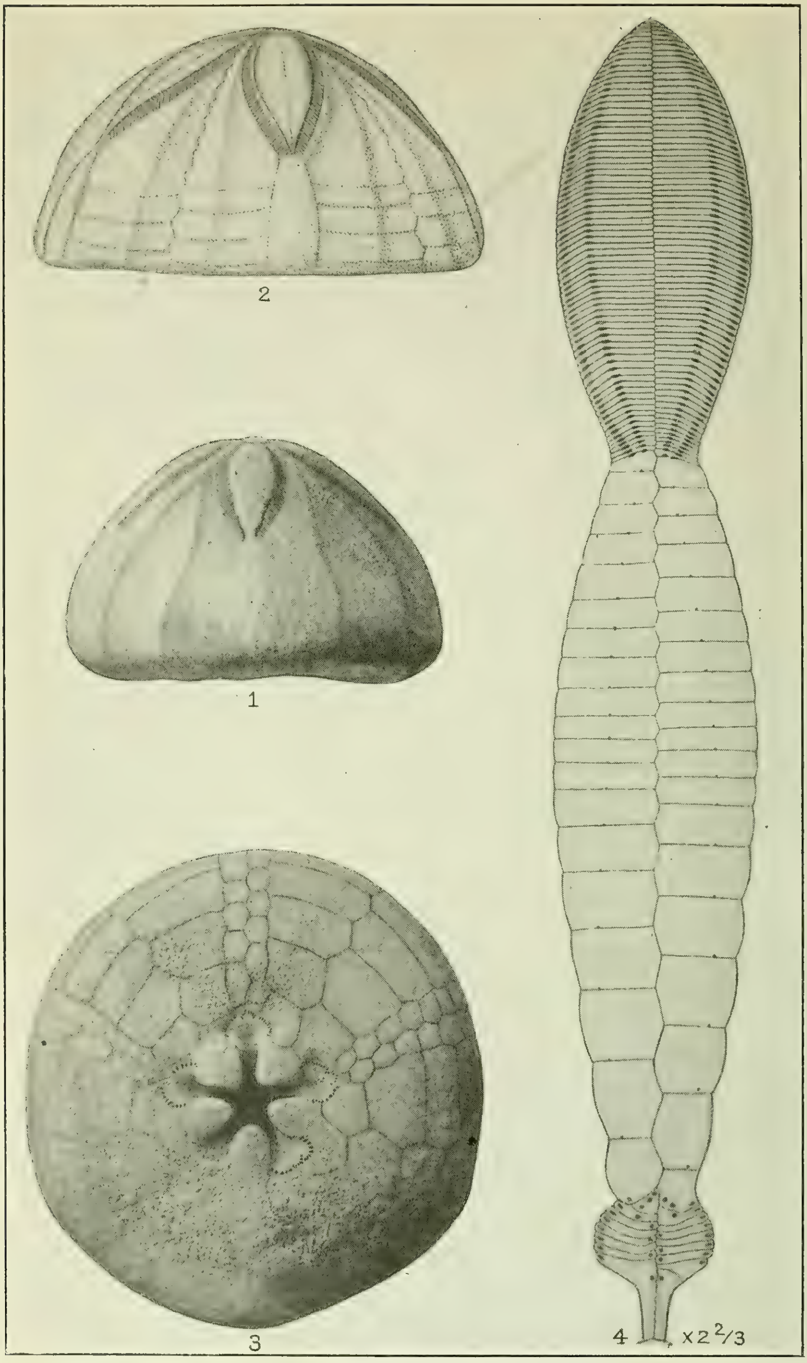


UPPER CRETACEOUS ECHINOID FOSSILS FROM NORTH CAROLINA

FOR EXPLANATION OF PLATE SEE PAGE 23



UPPER CRETACEOUS ECHINOID FOSSILS FROM NORTH CAROLINA

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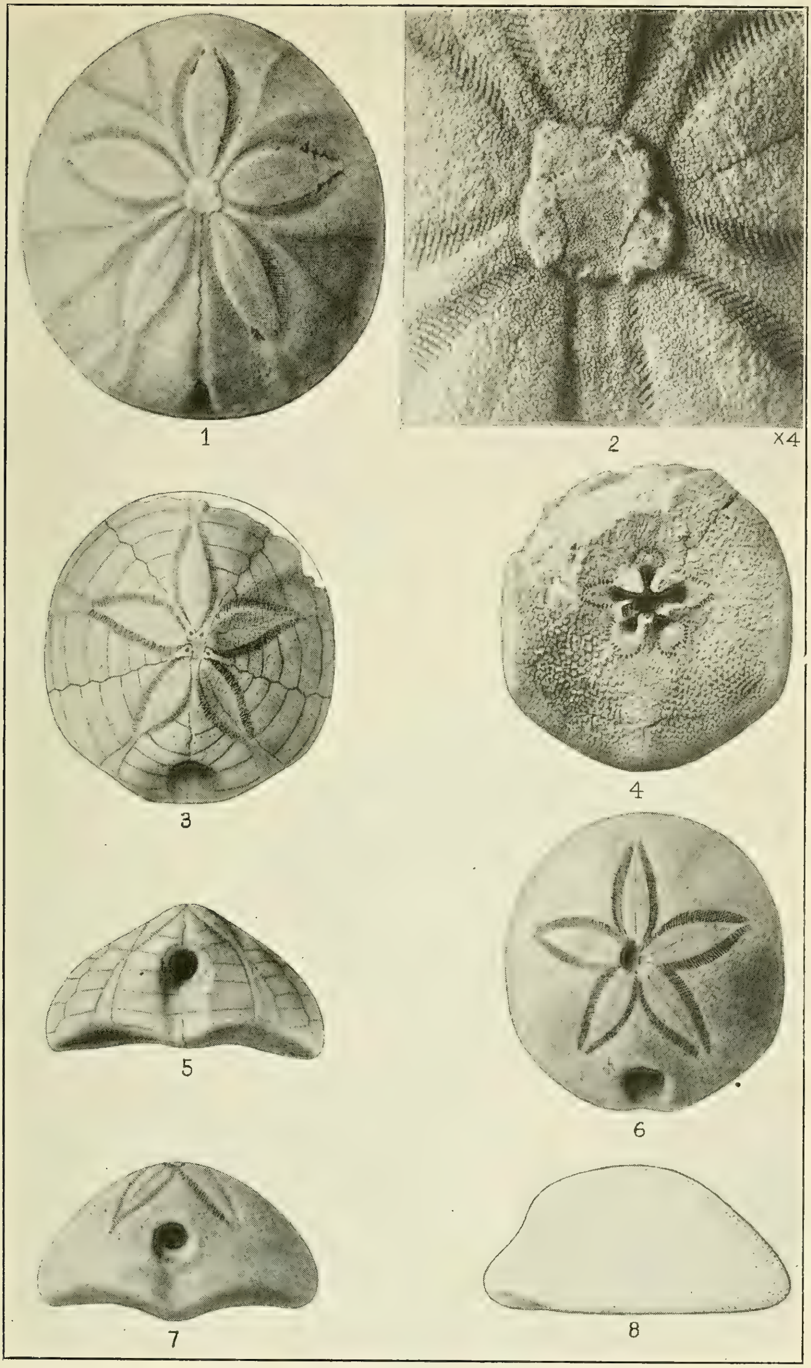

UPPER CRETACEOUS ECHINOID FOSSILS FROM NORTH CAROLINA

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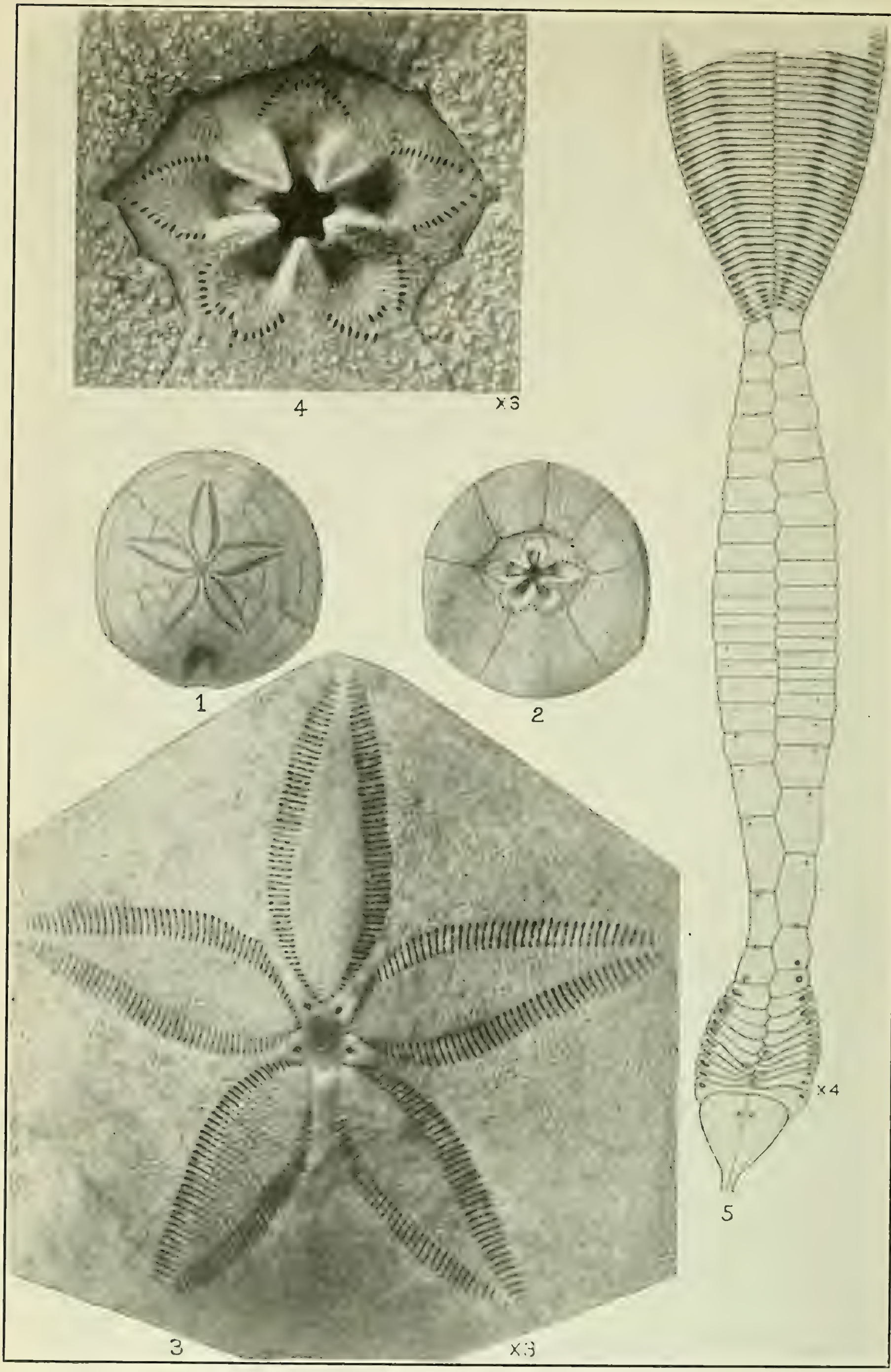
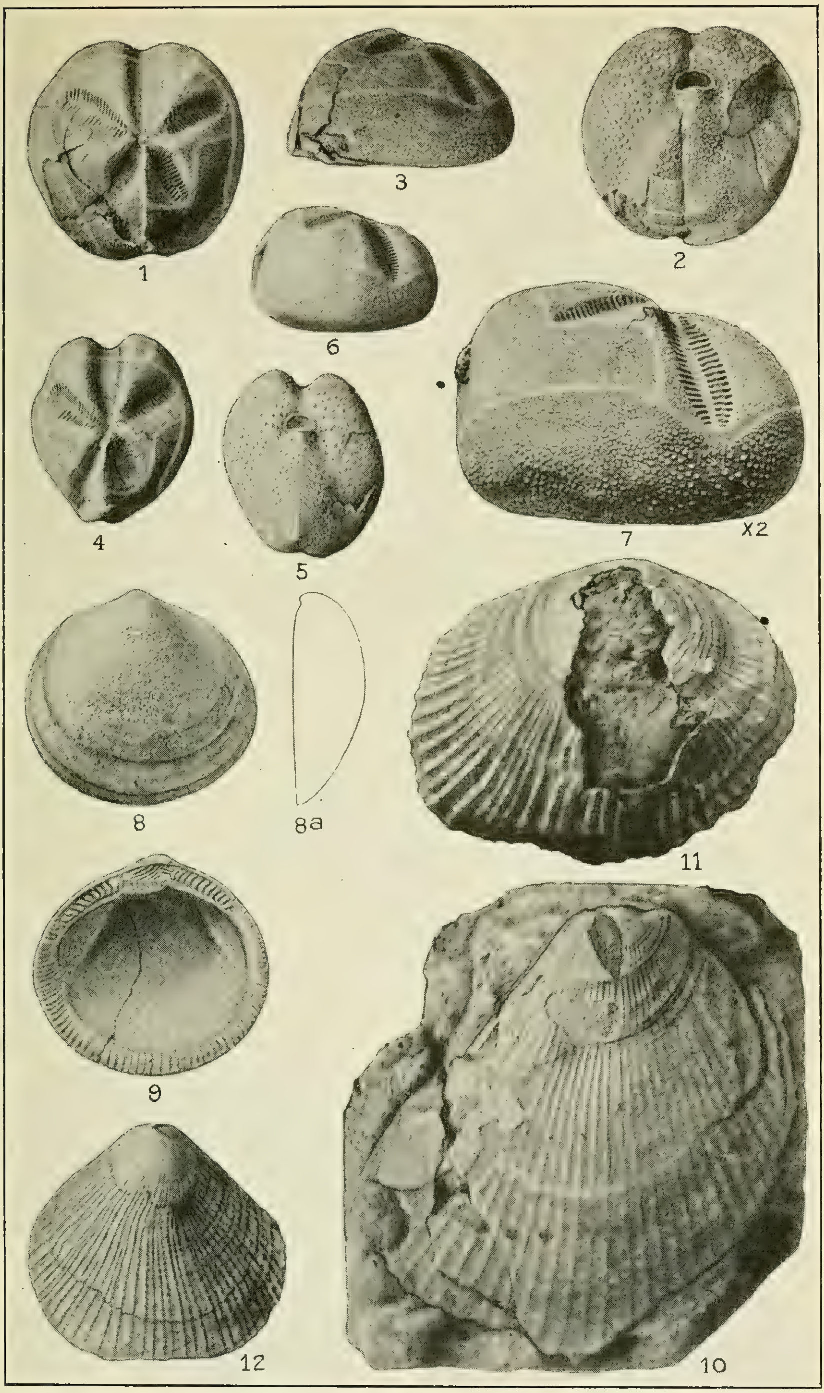


UPPER CRETACEOUS ECHINOID FOSSILS FROM NORTH CAROLINA

FOR EXPLANATION OF PLATE SEE PAGE 24



UPPER CRETACEOUS ECHINOID AND MOLLUSCAN FOSSILS FROM NORTH CAROLINA

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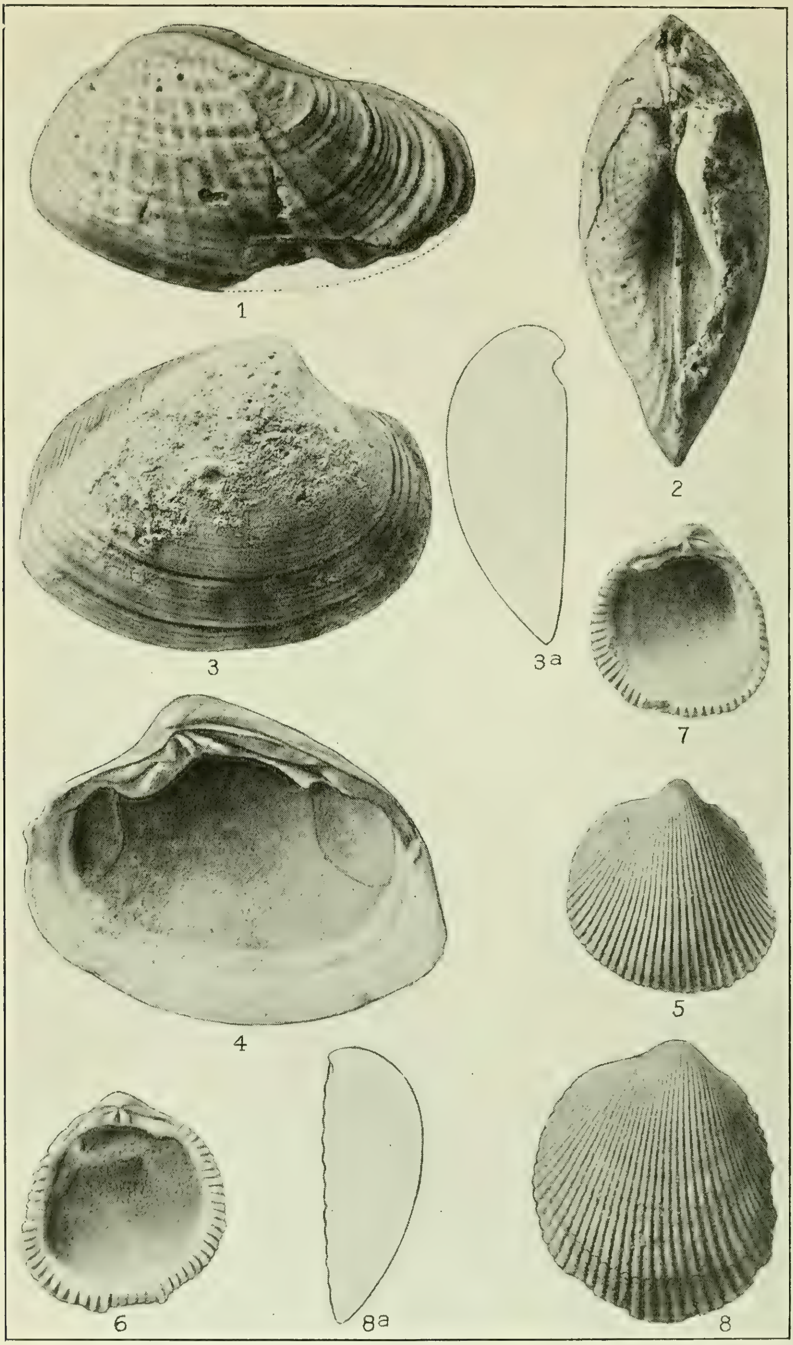
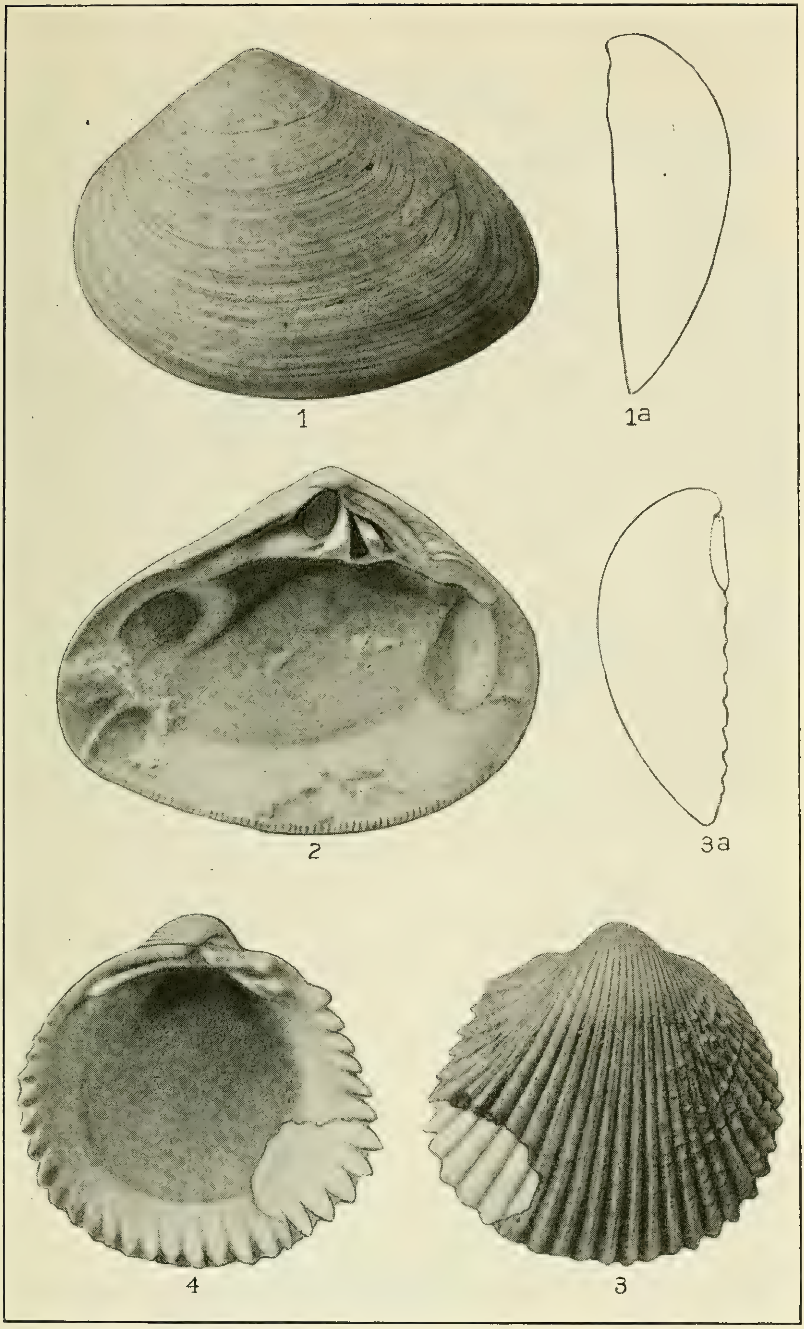


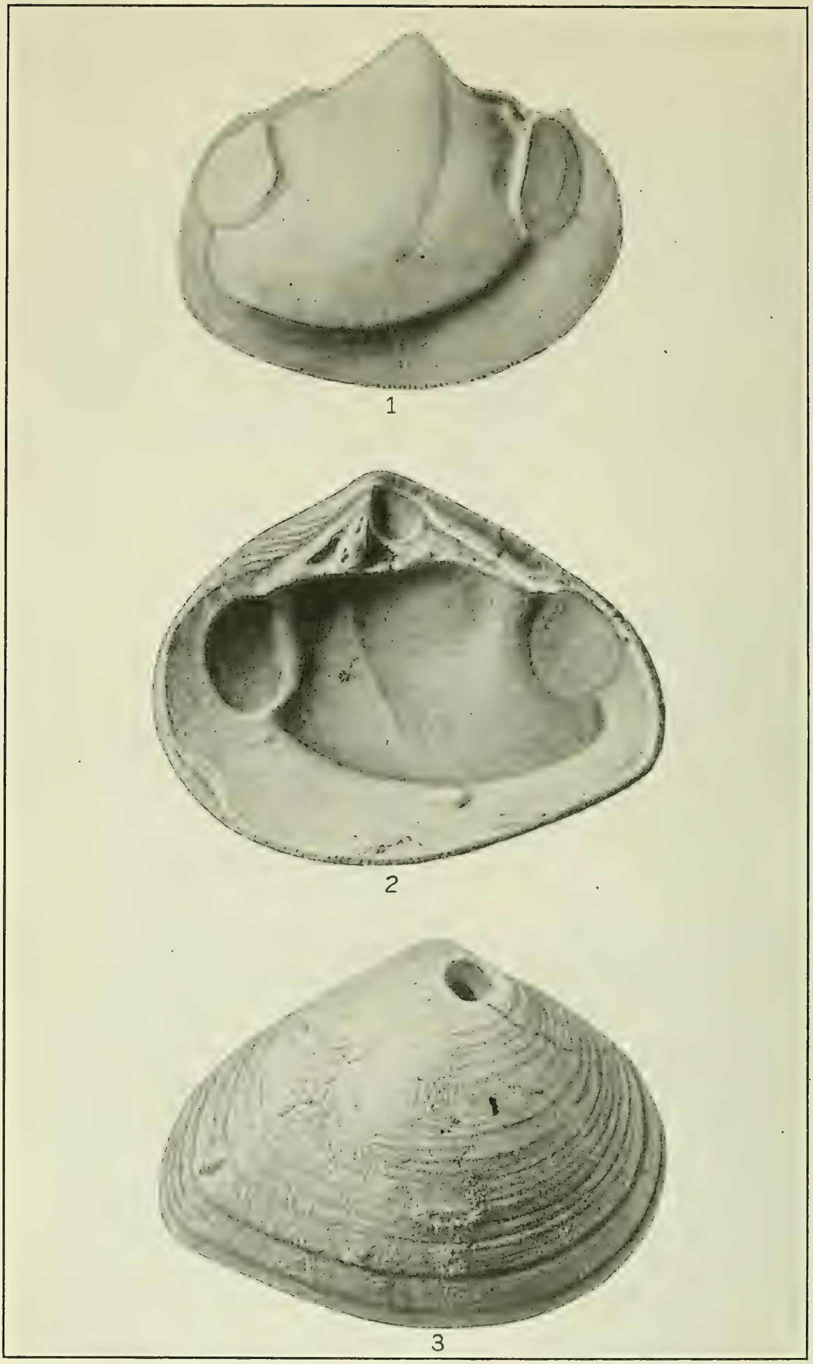
UPPER CRETACEOUS MOLLUSCAN FOSSILS FROM NORTH CAROLINA

FOR EXPLANATION OF PLATE SEE PAGES 24 AND 25



UPPER CRETACEOUS MOLLUSCAN FOSSILS FROM NORTH AND SOUTH CAROLINA

FOR EXPLANATION OF PLATE SEE PAGE 25



UPPER CRETACEOUS MOLLUSCAN FOSSILS FROM NORTH CAROLINA

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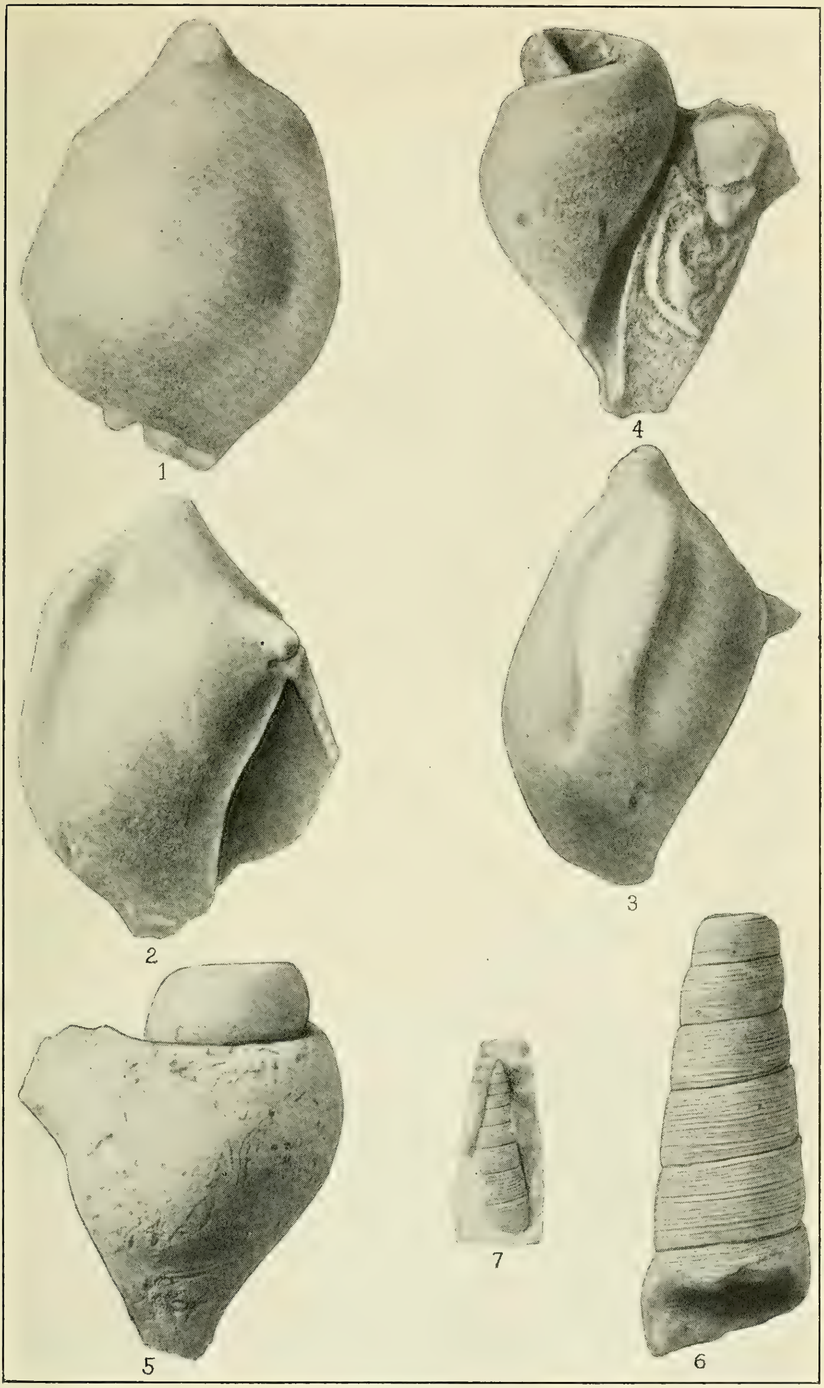

UPPER CRETACEOUS MOLLUSCAN FOSSILS FROM NORTH CAROLINA

FOR EXPLANATION OF PLATE SEE PAGE 24

ROSSITE AND METAROSSITE; TWO NEW VANADATES FROM COLORADO

By William F. Foshag
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AND

Frank L. Hess
United States Bureau of Mines

OCCURRENCE

Contributed by Frank L. Hess

The mineral described in this paper was found in veinlets cutting McElmo sandstone in Bull Pen Canyon, San Miguel County, Colo., 5 miles southeast of Summit Point post office, Utah near the point where the 38th parallel cuts the boundary line between Colorado and Utah, and is on the western edge of the known carnotite-bearing sandstones of the area. The deposit from which it came is on a claim belonging to M. E. O'Neil, and to Mr. O'Neil I am indebted for his courtesy in allowing me to examine the deposit, to collect specimens, and for other specimens which he sent me later. At the left of the entrance to one of his prospect tunnels known as the Arrowhead was a considerable amount of soft, dull brownish-red sandstone which owed its color to a mixture which seems to be made up of hewettite, vanoxite, and roscoelite, though when mixed, as in this deposit, these minerals are very difficult to identify. Wherever I have seen sandstone with similar aggregates of minerals, it has been soft and friable, so that cracks in which minerals may form are easily developed. In certain parts of the sandstone are the usual carbonized plant remains that characterize the carnotite deposits in sandstones of McElmo age in the plateau region. Here and there were rich spots and streaks of carnotite. Veinlets of a pale yellow, flaky mineral ranging from the thickness of cardboard to one-half inch and several feet long cut the sandstone at various angles. Gypsum is so common in the sandstones that I at first supposed that it formed the veinlets, but closer examination showed that the mineral had only one prominent cleavage and so could not be gypsum. Excellent material was available and was collected, but all was milky. Later I received from Mr. O'Neil further specimens which had glassy centers and milky rims which were apparently the effect of dehydration. The mineral was later than the carnotite and other uranium and vanadium minerals in the deposit.

Although fairly plentiful at the point of discovery, this is the only deposit in which I have found the mineral after an examination of hundreds of carnotite deposits. It is entirely possible, however, that some veinlets in other deposits thought at the time to be gypsum may be this mineral.

We have named the clear, glassy mineral *rossite* in honor of Dr. Clarence S. Ross, of the United States Geological Survey. Since it was found that the lighter yellow, flaky mineral differed from the clear material in degree of hydration as well as in its optical properties, it was deemed advisable to distinguish them in mineralogical nomenclature. We therefore propose to call the naturally dehydrated form *metarossite*, a name that refers to its relation to rossite as well as to its probable mode of genesis.

ROSSITE

INTRODUCTION

Rossite was found sparingly in the second lot of material obtained, only as small lumps in the flaky mineral. When either rossite or metarossite is dissolved in hot water and allowed to crystallize the crystals have a composition corresponding to the natural rossite. A chemical analysis was made on the natural mineral as well as one on the recrystallized product. Inasmuch as no natural crystals of rossite were found the crystallography is based entirely upon the recrystallized compound. The optical properties were also determined upon the recrystallized mineral.

CHEMICAL PROPERTIES

Contributed by William F. Foshag

PYROGNOSTICS

Rossite when heated before the blowpipe fuses easily to a black bead without imparting any color to the flame. Heated in a closed tube it fuses easily and gives off water. The mineral is slowly but completely soluble in water from which it can be recrystallized. Moistened with concentrated hydrochloric acid the mineral turns mahogany red (vanadic acid). When an acid solution of the mineral is reduced with hydrogen sulphide or sulphur dioxide it becomes blue in color.

ANALYSES

Sufficient material in the form of hard, glassy cores of rossite could be selected from the more flaky mineral and cleaned by rubbing the soft metarossite off. The rossite could not be completely purified by this means, but the sample analyzed carried only a small percentage of the metarossite and a few per cents of sand grains from the inclosing sandstone. For a second analysis a quantity of the metarossite was recrystallized and the clear, glassy crystals so obtained used.

Water was determined as loss on heating. Since the mineral fused easily, a low temperature was sufficient to accomplish the complete expulsion of the water. Actually most of the water was driven off at a temperature of 120° C. As the dehydrated mineral is very slowly soluble in water, another portion was taken for the other constituents. The mineral was dissolved in hot water, the insoluble matter filtered off, and the vanadium precipitated as mercuric vanadate and ignited to the oxide. Lime and magnesia were determined in the usual manner. Constituents precipitated by hydrogen sulphide in acid solution (Pb, Cu, Mo, etc.) were found to be absent. Iron and phosphorus could not be detected. The results follow:

TABLE 1.—*Analysis of rossite*

Constituent	Natural glassy	Recrystallized	Ratios		Theoretical $CaO.V_2O_5.4H_2O$
Water (H_2O)	22. 90	22. 59	1, 255	4×0.963	23. 22
Lime (CaO)	18. 00	18. 48	330	1×1.012	18. 07
Magnesia (MgO)	0. 14	----------			
Vanadic oxide (V_2O_5)	58. 00	58. 92	323	1×0.990	58. 71
Insoluble	1. 60	----------			
	100. 64	99. 99			

Rossite is therefore a simple hydrous calcium vanadate. Its composition is expressed by the formula $CaO.\ V_2O_5.\ 4H_2O$. In the last column of Table 1 the theoretical composition for this compound is given.

CRYSTALLOGRAPHY

Contributed by William F. Foshag

GENERAL

None of the specimens of rossite show any crystallographic forms. The mineral, however, is soluble in water, and material suitable for goniometric measurements can easily be obtained by recrystallization. The habits of crystals obtained in this manner were all very similar, and repeated recrystallizations under various conditions failed to vary the habit greatly. The crystals best suited for measurement were about a millimeter or less in length; the faces of the larger crystals were too curved while the largest were an aggregate of a number of individuals apparently complexly twinned. Except for one lot that was tabular in habit all crystals obtained were prismatic. More than 50 crystals were mounted on the goniometer and provisionally examined, but only 15 were found to be entirely suitable and completely measured. The measurements showed rossite to be triclinic with the forms *c* (001), *b* (010), *a* (100), *m* (110), and *y* (101). Because of the absence of pyramids on all of the crystals the axial ratios and the numerical value of *q* were not calculated. The polar elements were determined to be as follows: $x_0=.4969$, $y_0=.1624$, $p_0=.8295$, $\lambda=80°\ 39'$, $\mu=59°\ 31'$, $\nu=85°\ 38'$. The axial angles are $\alpha=98°\ 18'$, $\beta=97°\ 24'$, $\gamma=89°\ 34'$.

CALCULATION OF THE ELEMENTS

The crystals were measured on the two-circle goniometer, the prismatic habit rendering it easy to adjust them in polar position. The prominence of the brachypinacoid and the good brachypinacoidal cleavage gave satisfactory results for v.° The forms whose measurements could be used in the calculation of the elements were the following: *a* (100), *m* (110), *b* (010), and *c* (001). No pyramids could be found on any of the crystals, and repeated recrystallizations under various conditions failed to produce any habit with the slightest pyramidal development. The axial ratios and the numerical value for *q* were therefore not determined. All measurements were made upon the artificially recrystallized mineral. The suitable measurements of the four forms upon which the elements are based are given below:

TABLE 2.—*Measurement of a (100) rossite*

Crystal No.	Reflection	Size of face	ϕ °	ϕ ′
2	Excellent	Medium	86	22
3	do	do	86	49
3	Good	do	87	8
4	do	Narrow	86	10
4	do	do	87	4
5	Excellent	Medium	84	33
6	Good	do	86	53
6	do	do	86	58
8	do	Broad	85	40
8	do	Medium	86	15
10	do	do	85	46
10	do	do	85	49
12	do	do	85	10
13	Excellent	do	83	3
Average			85	38

TABLE 3.—*Measurement of m (110) rossite*

Crystal No.	Reflection	Size of face	ϕ
			° ′
2	Excellent	Broad	54 47
3	do	do	53 55
3	do	do	53 31
4	Good	do	53 28
4	do	Medium	53 3
6	do	do	53 5
8	do	Broad	52 45
10	Excellent	do	54 43
10	Good	Medium	52 57
12	Excellent	Broad	52 2
	do	do	52 27
Average			53 48

TABLE 4.—*Measurement of c (001), rossite*

Crystal No.	Reflection	Size of face	ϕ	ρ
			° ′	° ′
2	Excellent	Large	73 39	31 34
3	do	do		31 24
4	do	do	73 11	31 27
7	do	do	72 29	31 26
11	do	do	72 18	31 43
Average			72 54	31 31

TABLE 5.—*Measurement of y (101) rossite*

Crystal No.	Reflection	Size of face	ϕ	ρ
			° ′	° ′
	Good	Medium	44 20	−87 22
	do	do	44 30	86 27
15	do	do	43 47	86 5
1	Twin, excellent	do	44 6	-- --
1	do	do	44 24	-- --
Average			44 13	−86 38

In this compilation the angles are listed as "excellent" when the readings between two faces were designated "excellent" during measurement; and listed as "good" when the readings for the faces were between "excellent" and "good" or between "good" and "good." It will be noted that even in the cases where the faces are all designated as "excellent" the measurements range from 83° 38′ to 84° 49′, a difference of over 3° for ϕ for (100); and from 52° 2′ to 54° 47′, a difference of almost 3° for ϕ for (001). This variation is large for crystals so well suited for crystallographic measurement and the cause is not entirely clear. The average values for ϕ and ρ of the forms of rossite are given in the following table:

TABLE 6.—*Averages of measured angles of rossite*

Form	Number of measurements	ϕ		ρ	
		°	′	°	′
a (100)	14	85	38	90	0
m (110)	11	53	48	90	0
c (001)	5	72	54	31	31
y ($\bar{1}01$)	5	−86	38	44	13

The value of the elements based on these measurements are as follows:

TABLE 7.—*Axial elements of rossite*

Projection elements	Polar elements	Linear elements
$x_0'=0.5829$	$x_0=0.4969$	
$y_0'=.1906$	$y_0=.1624$	
$p_0'=.9730$	$p_0=.8295$	
$q_0'=$	$q_0=$	
$v=85°\ 38'$	$r=1$	
$h=$	$\lambda=80°\ 39'$	$\alpha=98°\ 18'$
	$\mu=59\ 31$	$\beta=97\ 24$
	$\nu=85\ 38$	$\gamma=89\ 34$

FORMS AND ANGLES

Except for the forms *b* (010), *a* (100), *m* (110), *c* (001), and *y* ($\bar{1}01$) no others were found except a few doubtful ones. These doubtful forms were observed only once each and may represent, in part at least, nothing more than the smooth surfaces by which the crystals were attached to the walls of the crystallizing dish. All the forms noted with the average angle of each are given in the table below:

TABLE 8.—*Measured forms of rossite*

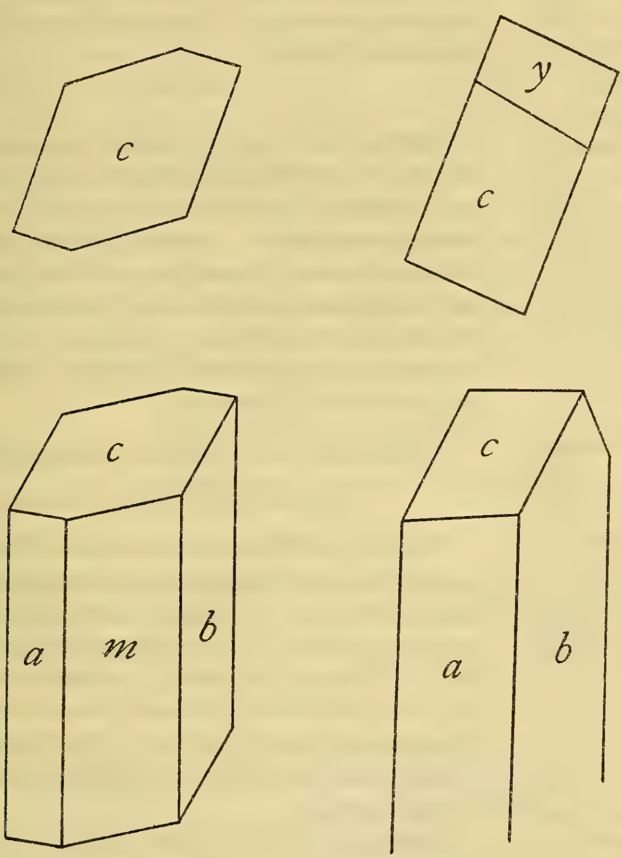
Number	Letter	Number of crystals	Number of measurements	Symbol	ϕ		ρ	
					°	′	°	′
1	*c*	15	15	001	72	54	31	31
2	*b*	15	30	010	0	00	90	00
3	*a*	15	30	100	85	38	90	00
4	*m*	15	30	110	53	48	90	00
5	*y*	5	5	$\bar{1}01$	−86	38	44	13
6		1			96	21	64	00
7		1			61	10	44	00
8		1			35	24	88	23

c (001). The basal pinacoid was found on all of the crystals measured and is usually the only terminal face present. Very often it is smoothly curved.

b (010). The brachypinacoid is always the most prominent face in the prism zone and is always bright and smooth.

a (100). The macropinacoid is always present, but is variable in size, ranging from broad to narrow. Its relative size is dependent upon the size of the unit prism.

m (110). The unit prism is usually present as a medium to broad face, but may be absent. Next to the clinopinacoid it is the most prominent face on the crystals.



A *B*

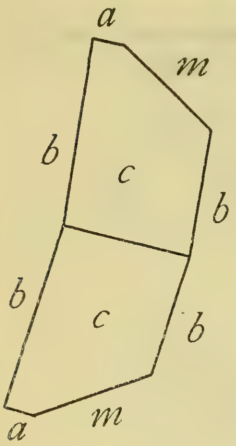
FIG. 1.—A AND B, CRYSTAL HABIT OF ROSSITE

There are no other faces present in the prism zone. Those present are always sharp, without striations, but some are slightly curved.

y ($\bar{1}01$). The face of the macrodome is present on some crystals but is usually smoothly curved so that accurate measurement was impossible. It is often present as a small triangular terminal face, but sometimes becomes as prominent as the base.

HABITS

The crystals of rossite are commonly of a prismatic habit (fig. 1), but a habit tabular to the base was found in one lot of crystals. The prismatic habit varies somewhat, due to the relative size of the macropinacoid and the unit prism. When the orthopinacoid is large the crystals have an almost equal horizontal thickness. When the prism is prominent and the macropinacoid small or lacking the crystals are almost lathlike. The length of the crystals also varies. Many crystals showing a combination of the three pinacoids are stumpy and even almost equidimensional; in the latter case they appear as rhombs. The crystals rarely are long needlelike blades.



TWINNING

Among the larger crystals twins are the rule but are so intricately intergrown that it is difficult to know just what relations the individuals have to each other. Among the smaller crystals twins are rare. In one lot, however, twins having the general appearance of the butterfly twins of gypsum were found. In these the twinning plane is the macropinacoid (100). These twins are similar to Figure 2.

PHYSICAL AND OPTICAL PROPERTIES

Contributed by William F. Foshag

The color of rossite varies from Martius yellow in the small crystals to pinard yellow in the larger crystals. The luster varies from vitreous pearly to glassy. The hardness lies between 2 and 3. The specific gravity, determined by floating clear crystals in a suitable bromoform-carbon tetrachloride mixture is 2.45. The fresh mineral is brittle and has a good cleavage parallel to the clinopinacoid.

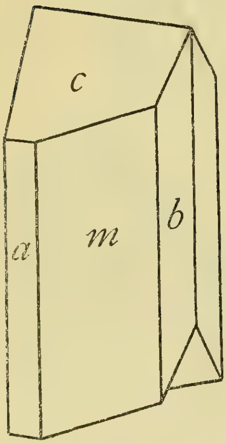


Fig. 2.—Twin crystal of rossite

Rossite is a biaxial with a large axial angle. The plane of the optic axes is essentially parallel to the axis c with $Z=c$ and roughly bisects the angle between a (100) and b (010). The base and the brachypinacoid show the emergence of an optic axis near the edge of the field. The extinction direction measured on the basal plane and from the edge 001–010 was found to be 16° ±3. The indices of refraction measured on the recrystalized mineral by the immersion method are as follows:

$$\alpha=1.710,\ \beta=1.770,\ \gamma=1.840$$

The dispersion is very strong; the emergence of an optic axis appears as a broad band of colors. The high dispersion manifests itself in bright-colored flashes when the crystal is mounted and revolved on the goniometer.

METAROSSITE

GENERAL

The mineral that occurred most abundantly in the material received is what we here call metarossite. It forms small yellow veins in a light gray and friable sandstone, is coarse, platy in habit, but is soft and friable. Occasionally within the center of masses of metarossite one can find small glassy kernels of rossite. The relation of the metarossite to the rossite suggests that it is a dehydration product of that mineral. As will be evident from the analyses given further on, the mineral is a distant hydrate and not a partially altered rossite. Two analyses made on different lots agree very well with each other and with the theoretical values for the formula assigned to it: $CaO.V_2O_5.2H_2O$. We feel justified, therefore, in assigning a distinct name to this compound.

CHEMICAL PROPERTIES

Contributed by William F. Foshag

PYROGNOSTICS

The behavior of metarossite before the blowpipe is entirely similar to the rossite. It is, however, somewhat more slowly soluble in water. Its chemical reactions are identical with those of rossite.

ANALYSIS

Abundant material was available for analysis. (No. 95331, U. S. N. M.) Two different samples were submitted to chemical analysis, one from the first lot received and another from the second lot. The samples were carefully chosen, only the larger and purer cleavage fragments being selected. Upon examination under the petrographic microscope the large majority of the flakes were clear and transparent, but the very large grains had a somewhat muddied appearance, due to included air. There were occasional grains of sand from the inclosing sandstone, estimated to amount to about 2 per cent. The analysis was carried out according to the scheme outlined under rossite, with the following results:

Table 9.—*Analysis of metarossite*

	Natural	Pearly	Ratios		Theoretical $CaO.V_2O_5.2H_2O$
Water (H_2O)	13.56	14.08	786	2×1.088	13.14
Lime (CaO)	20.04	19.60	362	1×1.003	20.44
Magnesia (MgO)	0.10	0.13			
Vanadic oxide (V_2O_5)	64.08	64.20	360	1×0.997	66.42
Insoluble	2.72	2.48			
	100.50	100.49			

Metarossite is a hydrous calcium vanadate of the formula $CaO.V_2O_5.2H_2O$. It differs from rossite in its lesser hydration, that mineral being the similar compound with four molecules of water. If rossite is left exposed to the air it gradually becomes lighter in color, loses its vitreous luster, and passes over into metarossite, still, however, retaining its platy structure. If metarossite is dissolved in water and allowed to crystallize, rossite separates out, but the glassy crystals so obtained gradually pass over into the metarossite again. It was at first thought that this change of the higher hydrate to the lower one was continuous, similar to the changes in hydration in other platy minerals, notably carnotite, autunite, etc. There are several facts, however, that point to the existence of two distinct hydrates. First, there is the occurrence of rossite as sharp residual kernels in the metarossite without any suggestion of gradation; and, secondly, the two analyses made upon separate lots of material agree satisfactorily with each other and very well with the theoretical values for the dehydrate.

CRYSTALLOGRAPHY

Contributed by William F. Foshag

No measurable crystals of metarossite were found, although on one specimen a crust of the vanadate showed projections resembling crystals. They were too imperfect, however, to be measured or to even suggest the symmetry of the crystals.

PHYSICAL AND OPTICAL PROPERTIES

Contributed by William F. Foshag

Metarossite is light yellow in color (Martius yellow, Ridgway) and has a dull pearly luster. It is soft and friable and can be easily crushed between the fingers. Due to its decided platy cleavage (probably inherited from the rossite) it breaks easily into flat, flaky grains. These under the microscope are clear and homogeneous. This platy cleavage makes it difficult to obtain good quantitative measurements of its optical properties. Like the rossite the cleavage flakes show the emergence of an optic axis with a very high dispersion. The indices of refraction are considerably higher than those of rossite. Only α was within the range of the oils available and was found to be 1.840, β and γ were both somewhat higher than 1.85 but could not be measured directly because the ease with which the mineral dehydrated and melted prevented the use of piperine-iodide melts. The birefringence is high and so far as could be determined the minerals showed no pleochroism.

RELATION OF ROSSITE AND METAROSSITE TO OTHER MINERALS

There are no known vanadates having the composition of these two minerals nor any arsenates or phosphates similar to them. They are, however, members of a series with the other known calcium vandates found in nature, hewettite, and pascoite. Tripling the formulæ of rossite and metarossite brings out the following interesting relation:

Hewettite	1 CaO. 3 V_2O_5. 9 H_2O.
Pascoite	2 CaO. 3 V_2O_5. 11 H_2O.
Rossite	3 CaO. 3 V_2O_5. 12 H_2O.
Metarossite	3 CaO. 3 V_2O_5. 6 H_2O.

The relation of metarossite to rossite is not entirely clear. It is possible that in common with many other minerals with a decided platy cleavage the water content is variable and that the compound can lose water without any great change in its molecular structure. The ratios for the two hydrates show, upon analysis, such good agreement with the theoretically required amounts without any evidence for any intermediate steps that it seems possible that we are dealing here with two distinct hydrates and not with a continuous series. Even were this not the case it is deemed advisable to separate the two compounds in mineral nomenclature in order to avoid confusion, the properties of the two substances being so greatly different.

SYNTHESIS

Both pascoite and rossite have been synthesized by Waldemar T. Schaller [1] by heating hewettite suspended in water with precipitated calcium carbonate on the steam bath and allowing the clear solution

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[1] Unpublished data.

to crystallize at room temperature. Rossite was formed when the calcium carbonate was present in excess. The crystals formed in this way are similar in every respect with those obtained by recrystallizing the natural rossite or metarossite. If the synthetic mineral is left exposed to the air it eventually loses water and passes over into metarossite.

SUMMARY

ROSSITE

Name.—In honor of Dr. C. S. Ross, of the United States Geological Survey.

Chemical properties.—A hydrous calcium vanadate, $CaO. V_2O_5. 4H_2O$. Analysis: CaO 18, MgO 0.14, V_2O_5 58, H_2O 22.90. Sum 100.64. Soluble in water.

Crystallographical properties.—Triclinic. $x_0=0.4969$, $y_0=0.1624$, $p_o=0.8295$, $\lambda=80° 39'$, $\mu=59° 31'$, $\nu=85° 38'$, $\alpha=98° 18'$, $\beta=97° 24'$, $\gamma=89° 34'$. Habit prismatic. Forms: *c* (001), *b* (010), *a* (100), *m* (110), *y* ($\bar{1}01$).

Physical and optical properties.—Color yellow. Luster pearly to vitreous. Biaxial. 2V large. Plane of the optic axes parallel to the axis *c* with $Z=c$.

$\alpha=1.710$, $\beta=1.770$, $\gamma=1.840$. Dispersion strong. Hardness: 2–3; specific gravity 2.45.

Occurrence.—Found as small glassy kernels embedded in flaky metarossite at Bull Pen Canyon, San Miguel County, Colo.

METAROSSITE

Name.—In allusion to its relation to rossite, a partially dehydrated rossite.

Chemical properties.—A hydrous calcium vanadate, $CaO. V_2O_5. 2H_2O$. Analyses CaO 20.04; 19.60, MgO 0.10; 0.13, V_2O_5 64.08; 64.20, H_2O 13.56; 14.08, Insoluble 2.72; 2.48. Sums 100.50; 100.49. Soluble in water.

Physical and optical properties.—Color yellow. Luster pearly to dull. Biaxial. 2V large. Dispersion strong.

$\alpha=1.840$, β and γ higher than 1.85. Soft and friable.

Occurrence.—Found as small veinlets in sandstone at Bull Pen Canyon, San Miguel Canyon, Colo., as a dehydration product of rossite.

O

CRYSTALLINE CARNOTITE FROM UTAH

By Frank L. Hess
Of the United States Bureau of Mines

and

William F. Foshag
Assistant Curator, United States National Museum

OCCURRENCE

Contributed by Frank L. Hess.

The carnotite deposits of Colorado, Utah, and Arizona have been watched carefully since they first became known, in the hope of finding the mineral in visible crystals. Many specimens of a crystalline yellow uranium mineral have been collected, but when tested they invariably proved to be the calcium mineral, tyuyamunite, so that crystal form or waxy body was and may yet be taken as almost surely indicating the mineral with the name of Siberian ancestry. The carnotite fields have yielded a number of new minerals, vanoxite, pintadoite, uvanite, rauvite, and rossite, and when in examining a carnotite deposit on a little flat known as Bridger Jack, on the west side of Cane Springs Pass which leads over a low shoulder of the La Sal Mountains 16 miles southeast of Moab, I discovered veinlets of a golden yellow mineral beautifully crystallized in plates, the broadest of which were between one and two millimeters across, I did not know whether the mineral was a new one or an old one in a new guise.

The mineral formed compact crusts one or two millimeters thick and 15 or 20 centimeters broad on the walls of narrow cracks. Where the crusts did not entirely fill the cracks the exposed surface had a dull greenish color and showed indistinct crystal terminations.

The veinlets were in a buff porous sandstone of the McElmo formation, presumably of either Lower Cretaceous or Upper Jurassic age. The rocks are here in the drainage basin of Grand River (now by congressional enactment the upper part of the Colorado) and erosion has entirely removed the rocks above the McElmo.

Dutton[1] concluded that the erosion of the Grand Canyon began in Eocene time. Situated as it is on a small tributary near the upper end of the Grand Canyon, erosion probably exposed the Bridger Jack area to oxidation and the action of meteoric water at a considerably later period in the Tertiary.

The veins are later than the usual carnotite deposits of the plateau region, for the ordinary deposits are impregnations of sandstone in connection with leaves or fillings of cavities in old tree trunks (*auracarioxylon*) some of which were hollow and all were partly decayed before petrifaction. What the form of the minerals may have been when deposited is uncertain, but carnotite and other minerals now present were not formed until the rocks were eroded and exposed to the percolation of meteoric waters. Generally carnotite and related minerals have moved out far enough to make an aureole around the vegetal masses, but after the soft sandstones were brought near enough to the surface to allow the formation of open cracks, the carnotite at this place was moved from the aureole and deposited in the cracks.

PHYSICAL AND OPTICAL PROPERTIES

Contributed by William F. Foshag

The carnotite (U.S.N.M. 95332) forms crusts from 1–2 millimeters in thickness and with rough botyroidal surface on calcareous sandstone. The outer surface is colored greenish to brownish yellow and shows only faint suggestions of crystal faces. The inner portion is made up of coarse plates in parallel position or roughly radiated. These plates are of a deep lemon yellow color with a decided tinge of green and have a pearly silky luster. The powdered mineral is of a strontian yellow color.

Under the microscope the mineral is seen to be made up of clear yellow plates showing a perfect platy cleavage. There appears however, to be no other cleavage. These plates show no pleochroism but grains oriented normal to the cleavage are strongly pleochroic. The scheme is: X grayish yellow with strong absorption, Y lemon yellow, Z lemon yellow. As far as could be determined the plates show parallel extinction. The cleavage flakes show a biaxial interference figure and a medium dispersion of the optic axes. The axial angle (2 V) on material containing 1.32 per cent of water was measured with the aid of a micrometer ocular and found to be $50° \pm 2°$. The indices of refraction of the mineral were found to be somewhat higher than amorphous sulphur. Material dried over concentrated sulphuric

[1] Dutton, Clarence E. The physical geology of the Canon district. U. S. Geol. Survey, Second Ann. Rep., p. 119, 1882.

acid (H_2O=1.32 per cent) showed, with sulphur-selenium melts, the following indices of refraction: β=2.06 and γ=2.08 for Na light. The mineral left over sulphuric acid of a water vapor pressure of 19 mm. (H_2O=1.72 per cent) was somewhat lower, β=2.04, γ=2.06.

CHEMICAL PROPERTIES

Contributed by William F. Foshag

For analysis there were selected the thicker crusts that were easily detached from the rock. These had a maximum thickness of 2 mm. and were entirely made up of coarse, clean plates. The lower surface of the crusts was pared with a knife to remove any adhering sand grains or calcite from the sandstone cement. The mineral was then crushed to pass 100 mesh and the material thus prepared was examined under the petrographic microscope for impurities. The sample consisted almost wholly of clear, coarse, transparent plates of carnotite of a bright yellow color. Some of the larger grains had a clouded appearance but reflected light showed this effect to be due to included air spaces. A careful search revealed no visible grains of calcite.

The analysis of the carnotite was accomplished as follows: Water was determined both directly and as loss on ignition. As these two determinations gave essentially the same amounts of water later determinations were made wholly as ignition loss. The vanadium was separated from the other constituents by volatilization as vanadium chloride in a stream of dry hydrochloric acid gas. The distillate was examined for molybdenum, phosphorus, iron, arsenic, and lead and found to be essentially free of these elements. The vanadium was then reduced with sulphur dioxide and titrated with potassium permanganate solution after removal of the SO_2 by boiling in a stream of carbon dioxide. The residue in the boat, left from the distillation of the vanadium was entirely soluble in water except for a small amount of gangue. Hydrogen sulphide passed into this acidified solution gave only traces of lead and copper. The uranium, iron, and alumina after oxidation of the iron were separated from the lime and magnesia by three precipitations with carbonate free ammonia. The separations of these constituents were made by the usual methods. Alkalis were determined in a separate portion after the vanadium was separated by distillation, uranium, iron, and alumina by freshly prepared ammonium sulphide and lime and magnesia by ammonium carbonate and ammonium oxalate. The results of the analysis together with the calculated ratios and the theoretical composition for the compound K_2O. $2UO_3$. V_2O_5. $2/3H_2O$. is given in the table below.

Analysis, ratios, and theoretical composition of carnotite from Moab, Utah

Analysis		Ratios		Theoretical composition
H_2O	1. 35	0. 075	2/3	1. 4
CuO, PbO	Tr.			
MgO	. 22			
BaO	None.			
CaO	. 64	. 011		
K_2O	9. 58	. 101	1 × 1. 008	10. 9
Na_2O	. 35	. 005		
Fe_2O_3	. 04			
Al_2O_3	. 16			
UO_3	65. 62	. 229	2 × 0. 996	66. 6
V_2O_4	None.			
V_2O_5	21. 12	. 116	1 × 1. 000	21. 1
P_2O_5	Tr.			
As_2O_5	None.			
MoO_3	None.			
Insol	. 32			
	99. 40			

From these results it is readily seen that the mineral from Cane Springs Pass is an unusually pure carnotite. It is interesting to note the absence of barium and copper, elements reported by Hillebrand in the finer grained carnotites, as well as of phosphorus, arsenic, and molybdenum. The lime content is appreciable, and since no calcite could be detected in the analyzed sample it probably belongs to the mineral where it replaces potash. If the lime is calculated with the alkalies, the ratios come out very close to the theoretical values. The soda content is so small as to be of doubtful significance.

It will be noted that the water content is much lower than that ordinarily given for carnotite. The air-dried material carried a water content of 1.36 per cent, while material kept over sulphuric acid having a water vapor pressure of 19 mm. had a water content of 1.72 per cent. The water content is therefore quite variable, a characteristic common to the members of the uranite groups. The water content is not only determined by the vapor pressure of the water but probably by the size of the grains as well.

RADIUM—URANIUM RATIO

Contributed by Frank L. Hess

It is not surprising, considering the geology of the veins, that lead could not be determined chemically. Sufficient time had not elapsed since the solution and redeposition of the carnotite for the disintegration of the uranium to form lead in chemically measurable quantity unless much more carnotite than was available could be used. However, that some lead is present was shown spectroscopically by E. G. Zies, who was kind enough to test the mineral for us. He found also copper and tin, together with gold and silver, the amount of the last two being very small.

The problem of the age of the mineral had therefore to be attacked through the proportional equilibrium of the radium present. Rutherford[2] estimated that equilibrium of radioactivity—that is, the maximum possible quantity of radium present with its ancestral uranium—was reached after a period of 10,000,000 years. Mr. C. W. Davis, of the Reno station of the Bureau of Mines, was therefore asked to make a determination of the proportional radioactivity, which he kindly did, using a part of the analyzed material. Concerning the determination Mr. Davis wrote:

The carnotite from Foshag's analysis contains 65.6 per cent UO_3, which, using the atomic weight of uranium as given in the international table of atomic weights for 1925,[3] gives the uranium content of 54.60 per cent.

Standard pitchblende, part of the sample used by Lind and Roberts in their determination of the absolute value of the radium : uranium ratio,[4] containing 66.12 per cent U, was used to standardize the instruments and the Ra/U ratio found by them (3.40 by 10^{-7}) was used in my calculations.

Four samples of the carnotite of about 60 milligrams each and four samples of the standard pitchblende of about 50 milligrams each were accurately weighed into thin glass bulbs on an assay balance, and the bulbs, which were provided with a neck, were sealed off by drawing out the neck. After from 35 to 38 days (it took 4 days to make the final determinations) these samples were analyzed for radium.

The method described by Lind and Whittemore[5] as the "solution emanation method in a single operation" was chosen as the most satisfactory for the purpose. This prevents any loss of radium that might occur from the long standing of solutions and eliminates errors that might occur in determining the "emanating power" of the minerals used. It also makes the use of equilibrium tables unnecessary. The details of boiling off, collection, and measuring of the radon are given by Lind.[6]

The electroscope chambers were treated so that the natural leak was satisfactory (0.033 divisions per second), and a blank test on the reagents and apparatus gave precisely the same rate of leaf fall. This natural leak remained constant during the four days on which the tests were made.

Fifteen electroscopic readings were made for each determination, the pressure in the chambers being kept at less than atmospheric until about 30 minutes before readings.

At the times during which readings were taken the barometric pressure was within the limits 644 mm. and 642.9 mm., and the temperature was within the limits 20° C. and 18.5° C., so that no correction is necessary for these factors.

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[2] Rutherford, E. Radioactive substances and their radiations. Cambridge, p. 431, 1913.
[3] Journ. Amer. Chem. Soc., vol. 47, p. 600, 1925.
[4] Idem, vol. 42, p. 1170, 1920.
[5] Bureau of Mines Technical Paper 88, pp. 12–13, 1915.
[6] Journ. Industrial & Engineering Chemistry, vol. 7, p. 1024, 1915.

The results are given in tabular form below:

Chamber No.	D. P. S. per g.		Ra per g.×10⁷			
	Standard pitchblende	Carnotite	Standard	Carnotite	Upper g carnotite	$\frac{R}{U}\times10^{-7}$
1	30. 579	17. 152				
	30. 148	17. 132				
Average	30. 364	17. 140	2. 248	1. 269	0. 5460	2. 32
2	32. 027	17. 522				
	31. 720	17. 774				
Average	31. 873	17. 648	2. 248	1. 244	0. 5460	2. 28 2. 30

You will notice that the Ra: U ratio (2.30×10^{-7}) is only about 68 per cent of the normal ratio (3.40×10^{-7}) determined by Lind and Roberts.

From Mr. Davis's determination that the radioactivity is about 68 per cent of that present when radium is in equilibrium, it follows that the mineral is about 6,800,000 years old—say 7,000,000 years, and such a figure accords well with the geology of the deposit.

The ordinary carnotites of the region show as much as 0.80 per cent PbO, indicating an age of about 42,000,000 years.[7] Owing to the movement of the mineral the lead here too is probably lower than it would be if the mineral occupied exactly its original position.

The Grand Canyon of the Colorado, although much deeper and more imposing farther down the river, nevertheless has a very considerable development at Moab, where the drainage from Bridger Jack joins the main stream. Concerning the age of the Grand Canyon in years, Dutton[8] said:

> No doubt the question will often be asked, how long has been the time occupied in the excavation of the Grand Canyon? Unfortunately there is no mystery more inscrutable than the duration of geological time. On this point geologists have obtained no satisfactory results in any part of the world. Whatever periods may have been assigned to the antiquity of past events have been assigned provisionally only, and the inferences are almost purely hypothetical. In the Plateau country, Nature, has, in some respects, been far more communicative than in other regions, and has answered many questions far more fully and graciously. But here, as elsewhere, whenever we interrogate her about time other than relative, her lips are sternly closed, and her face becomes as the face of the Sphinx.

Through the crystallized carnotite just described Nature partly answers the question of age. Possibly other discoveries of radioactive minerals will allow a still further determination of the age of the Colorado Canyon as they do of many other earth features.

[7] Hess, Frank L. New and known minerals from the Utah-Colorado carnotite region. U. S. Geol. Survey Bull. 750, p. 78, 1924.

[8] Dutton, C. E., U. S. Geol. Survey, Second Ann. Rep., p. 166.

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MISCELLANEOUS NOTES AND DESCRIPTIONS OF ICHNEUMON-FLIES

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This paper consists of the descriptions of one new genus and thirteen new species of North American Ichneumonidae, four new species from the Neotropical Region, short revisions of the North American species of several genera, several generic transfers, and the synonymizing of two European species.

Genus ISCHNOPSIDEA Viereck

Ischnus Authors, not Gravenhorst.
Rhexidermus (Foerster) Ashmead, Proc. U. S. Nat. Mus., vol. 30, 1906, p. 171, pl. 12, fig. 2.

Two specimens of a species referable to this genus have recently come to hand. They are specifically distinct from *coloradensis* Cushman as well as from the unnamed species referred to in the description of *coloradensis*.

ISCHNOPSIDEA ALBERTA, new species

Distinguishable at once from *coloradensis* Cushman by the larger eyes and consequently shorter malar space, the entirely black antennae, and the relatively longer tergites, as well as by many of the following characters:

Female.—Length 7.5 mm.; antennae (tips broken but in the paratype about two-thirds as long as body).

Head large; temples nearly as broad as eyes, slightly sloping, convex; eyes large, parallel within, their long diameter about four times the length of malar space; face densely, transversely striato-punctate, head otherwise, including clypeus, sparsely punctate and polished. Thorax shining, punctate, metapleurum densely so; scutellum polished, almost impunctate, margined to beyond middle; propodeum with basal areas punctate, middle areas polished, apical areas transversely striate, and pleural areas rugulose opaque; areola pentagonal, less than twice as long as basal area. Abdomen slender, third tergite fully as long as broad; postpetiole longitudinally rugulose; gastrocoeli nearly confluent medially, abdomen densely, opaquely punctate; ovipositor sheath about half as long as first segment.

Black; antennae entirely black; mandibles, palpi, tegulae, humeral and subapical lines whitish or pale stramineous; legs testaceous, the distal joints of trochanters paler, hind tibia and tarsus infuscate, the tibia not paler at base.

Type locality.—Edmonton, Alberta.

Type.—Cat. No. 40432, U.S.N.M.

Two females collected by George Salt, the type on October 21, 1923, and the paratype on March 25, 1924.

The paratype is slightly smaller than the type and has the legs somewhat more contrastingly colored.

CRYPTUS CALIGATUS, new species

Apparently closely related to *luctuosus* Cresson, but differing at least in its black front tarsi and medially interrupted apical propodeal carina.

Female.—Length 9 mm.; antenna 8 mm.; ovipositor 2.5 mm.

Temples sharply convexly sloping, sparsely punctate, subpolished; vertex more densely punctate, subopaque; frons concave but hardly excavated, opaque reticulate rugose, without median carina, scrobes subpolished and transversely wrinkled; eyes large and bulging; diameter of lateral ocellus very slightly shorter than ocell-ocular line; face opaquely finely punctate; clypeus polished, sparsely punctate, in profile nasutiform; cheeks in front view slightly convex, their extended angle acute; malar space slightly longer than basal width of mandible, opaque shagreened with sparse, weak punctures; first joint of flagellum distinctly longer than second. Thorax dorsally and ventrally polished and slightly punctate, laterally opaque and rugoso-punctate, the speculum polished; propodeum reticulate rugose, basal lateral areas more finely so; basal carina weak, apical carina broadly obsolete medially, the angles prominent, spiracles very broadly oval; legs rather stout, the hind femur about five times as long as deep; tarsi slender, only the fourth joint narrowly cordate; abdomen finely, granularly opaque throughout except petiole which is polished dorsally and transversely rugose laterally, petiole somewhat depressed, postpetiole broad, spiracles about as close to each other as to apex; second tergite distinctly longer than broad at base; ovipositor sheath nearly as long as first two tergites.

Black; short lines on posterior and facial orbits and dot at top of eye yellow; wings uniformily, dilutely impunctate, tegulae black;

all femora and front and middle tibiae ferruginous, joints 2–5 of hind tarsus brown, legs otherwise black.

Type locality.—Calgary, Alberta.

Type.—Cat. No. 40433, U.S.N.M.

Two females colected by George Salt, the type on August 5, and the paratype on July 19, 1924.

Genus AGROTHEREUTES Foerster

Probably not generically distinct from *Spilocryptus* Thomson, of which it is sometimes treated as a subgenus. Viereck[1] uses it to replace *Cryptus* Fabricius, which he considers to be preoccupied by *Cryptus* Jurine. It is here used, in its original restricted sense, as including subapterous forms of the tribe Cryptini related to *Spilocryptus*.

No North American species referable to the genus in this restricted sense appears to have been described. The following three new species are typical, agreeing with all characters assigned to *Spilocryptus* in Schmiedeknecht's keys[2] except those of wing venation. Schmiedeknecht considers *Agrothereutes* a subgenus of *Spilocryptus*.

All three species have the following characters in common: Head black, granularly opaque, clypeus polished and sparsely punctate; temples strongly sloping, weakly convex; eyes large, bulging, very slightly divergent below; lower margin of antennal foramen at about lower fourth of eye; flagellum slightly thicker at apex than at base, blackish with the basal joints reddish and an incomplete annulus spanning joints 5–8 white. Thorax, except mesoscutum, scutellum, postscutellum, and mesosternum, which are shining, subopaquely roughened; propodeum with basal carina medially and pleural carinae obsolete and apical carina defined only at angles, where it is prominent; legs testaceous, hind femur at apex, and hind tibia except at extreme base fuscous, basally whitish, the same pattern but paler on middle and front tibiae. Abdomen granularly subopaque, the first tergite polished; first three tergites reddish, others black, the seventh with a median apical white spot.

KEY TO NORTH AMERICAN SPECIES

1. Thorax largely red………………**rufopectus**, new species.
   Thorax black………………2
2. First tergite fully two-thirds as broad as long; abdomen basally rufous, third tergite more or less black apically………………**slossonae**, new species.
   First tergite less than two-thirds as broad as long; abdomen basally testaceous, third tergite not at all black………………**microlatus**, new species.

[1] Hym. Conn. [2] Opusc. Ichn.

AGROTHEREUTES RUFOPECTUS, new species

Distinct from the other two species in its largely red thorax.

Female.—Length 6.5 mm.; antennae 4.5 mm.; ovipositor 2 mm.

Diameter of lateral ocellus nearly as long as ocell-ocular line; malar space equal to basal width of mandible; penultimate joint of flagellum nearly as thick as long; second joint of maxillary palpus half as thick as long; front wings not reaching propodeal tubercles; first tergite fully two-thirds as broad at apex as long.

Head black with facial orbits narrowly reddish; thorax dark rufous, sutures, prothorax laterally, prepectus, metapleurum below, metasternum, and basal areas of propodeum black; abdomen basally rufous, third tergite apically blackish.

Type locality.—Bilby, Alberta.

Type.—Cat. No. 40434, U.S.N.M.

One specimen collected by George Salt on June 28, 1924.

AGROTHEREUTES SLOSSONAE, new species

Female.—Length 6.5 mm.; antennae 5 mm.; ovipositor 2 mm.

Diameter of lateral ocellus about two-thirds as long as ocell-ocular line; malar space slightly longer than basal width of mandible; penultimate joint of flagellum distinctly longer than thick; second joint of maxillary palpus hardly half as thick as long; front wings fully reaching propodeal tubercles; first tergite fully two-thirds as broad at apex as long.

Head black; maxillary palpi pale testaceous; thorax entirely black; abdomen basally rufous, third tergite more or less blackish apically.

Type locality.—Franconia, New Hampshire.

Type.—Cat. No. 40435, U.S.N.M.

Two specimens probably collected by Mrs. Annie T. Slosson.

AGROTHEREUTES MICROALATUS, new species

Differs from *slossonae* in its smaller size, more slender form and shorter wings.

Female.—Length 5.5 mm.; antennae 3.5 mm.; ovipositor 1.5 mm.

Diameter of lateral ocellus little more than half as long as ocell-ocular line; malar space slightly longer than basal width of mandible; penultimate joint of flagellum distinctly longer than thick; second joint of maxillary palpus nearly three times as long as thick; front wings not reaching propodeal tubercles; first tergite less than two-thirds as broad at apex as long.

Head black; maxillary palpi pale testaceous, thorax entirely black; abdomen basally testaceous, third tergite entirely so.

Type locality.—New England.

Type.—Cat. No. 40436, U.S.N.M.

One specimen taken from the stomach of a ruffed grouse and received from the Biological Survey, United States Department of Agriculture.

ISCHNUS DODDI, new species

In Schmiedeknecht's key to genera of Cryptini this species runs with no difficulty to (*Habrocryptus* Thomson) = *Ischnus* Gravenhorst; and, except for its rather large oval propodeal spiracle, relatively shorter first flagellar joint, and narrower abdomen with relatively long apical tergites, differs structurally in no significant way from the genotype, *Ischnus porrectorius* (Fabricius).

Female.—Length 11 mm.; antennae 8 mm.; ovipositor 6 mm.

Head transverse; eyes large and slightly bulging; temples sharply receding and rather weakly convex; vertex and frons densely, finely punctate, temples sparsely punctate; eyes slightly longer than width of face, parallel within; face densely punctate, medially elevated, with a longitudinal impression on each side of the elevation; clypeus in profile nasutiform; cheeks convex; malar space two-thirds as long as basal width of mandible; antennae slender, basal joint of flagellum only slightly longer than second joint. Thorax opaque, finely confluently punctate; pronotum laterally rugulose, epomia strong; notauli long, foveolate; scutellum polished, very weakly punctate; sternauli weak, speculum small, shining, obliquely roughened; mesopleural furrow foveolate; propodeum rather coarsely reticulate rugose behind the basal carina, more finely so in front, the sculpture merging laterally into that of the metapleurum; basal carina strong, apical carina developed only laterally; all longitudinal carinae, including the pleural, wanting; spiracle rather large, oval; legs and wings normal for the genus. Abdomen elongate lanceolate, first three tergites granularly opaque; first tergite more than twice as long as broad at apex, second much longer than broad at base, postpetiole broader than long; ovipositor nearly as long as abdomen; apex elongate sagittate.

Head and thorax black with the following whitish markings; orbits, broadly on cheeks and narrowly interrupted on malar space, small spots on clypeus and at base of mandible, incomplete annulus on flagellar joints 6–9, anterior and humeral margins of pronotum, tegula at base and apex, subalar tubercle, and scutellum except at apex; wings hyaline with blackish venation, the stigma pale at base; legs ferruginous, the front coxa behind and trochanter piceous, front and middle coxae pale below. Abdomen with first two tergites entirely and third except at sides ferruginous, rest black except a broad white band at apex of fourth tergite and pale membraneous margins of apical tergites.

Host.—*Cactoblastis cactorum.*

Type locality.—Piriapolis, Uraguay.

Type.—Cat. No. 40437, U.S.N.M.

Two females reared in January, 1925, by Alan P. Dodd under his No. 105.

Genus TRICHOCRYPTUS Thomson

Sobas FOERSTER, Verh. Nat. Ver. Preuss. Rheinl., vol. 25, 1868, p. 187—SCHMIEDEKNECHT, Ent. Nachr., vol. 16, 1890, p. 113. Type.—*Ichneumon cinctorius* Fabricius.

Trichocryptus THOMSON, Opusc. Ent., fasc. 5, 1873, pp. 520, 521; vol. 6, 1874, p. 609. Type.—*Ichneumon cinctorius* Fabricius.

Apsilops ASHMEAD, Trans. Amer. Ent. Soc., vol. 23, 1896, p. 207 (not Foerster). Type.—*Cryptus hirtifrons* Ashmead.

Dapanus ASHMEAD, Proc. U. S. Nat. Mus., vol. 23, 1900, p. 29 (not Foerster). Type.—*Ichneumon cinctorius* Fabricius.

In an earlier paper [3] I argued that *Ichneumon cinctorius* Fabricius could not function as the genotype of *Sobas* Foerster on the ground that it would not agree with the characters ascribed by Foerster to his Family Cryptoidae, in which he placed the genus *Sobas*. Upon examination of Foerster's manuscript, however, I find that he actually founded his genus on *cinctorius;* and it must, I therefore think, be accepted as the type of *Sobas* in spite of its disagreement with the generic description.

Sobas Foerster is preoccupied by *Sobas* Pascoe, 1863.

As pointed out by Thomson (p. 612), the genotype will run in Foerster's key to the Phygadeuontoidae to either *Apsilops* or *Heterotypus*, depending upon whether the basal flagellar joints are considered short or long as stated in couplet 7 of the key. It will certainly not run to *Dapanus*, in which genus Ashmead placed it and of which it was considered as type by Viereck, for by the same character by which it agrees with *Heterotypus* it differs from *Dapanus*.

All published notes on the biology of species of *Trichocryptus* associate it with water. As early as 1785 Fourcroy [4] records (*Ichneumon scirpi* Fourcroy) = *Trichocryptus cinctorius* (Fabricius) as living in its larval stage in *Scirpus*, while Henriksen [5] records the other European species, *Trichocryptus aquaticus* Thomson as parasitic on *Hydrocampa nympheata* feeding on *Potamogeton natans*. Hart [6] records having observed (*Cryptus cyaneiventris* Riley MS) = *Trichocryptus hirtifrons* (Ashmead) walking on the leaves of water plants both above and below the surface of the water in search for its host (*Hydrocampa*) *Nymphula obliteralis* (Walker). The dense fine pubescence of the body is apparently associated with the habit of entering water.

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[3] Proc. U. S. Nat. Mus., vol. 58, 1920, p. 258.

[4] Entomologia Parisiensis, pt. 1, p. 413.

[5] Ent. Meddel., vol. 12, Heft 2, 1918, p. 218.

[6] Bull. Ill. State Lab. Nat. Hist., vol. 4, 1895, pp. 178 and 270.

Head and thorax opaque, finely confluently punctate and entirely covered with a very fine, short, velvety, more or less glittering pubescence; abdomen somewhat less densely punctate, the pubescence correspondingly sparser. Head transverse with temples convexly sloping, in front view subtriangular with malar space longer than basal width of mandibles and mouth rather narrow; clypeus inflexed and truncate at apex, exposing the labrum; pubescence of clypeus and mandibles longer than that on rest of head; antennae of female rather short and strongly thickened toward apex, first flagellar joint shorter than second. Notauli strong, complete; scutellum weakly convex, not margined laterally; sternauli short; propodeum long, completely areolated, areola broadly hexagonal, costulae before middle, apical carina mucronate on each side, spiracles small, short oval; alar areolet large, the intercubiti nearly parallel; radial cell short; nervulus antefurcal; postnervulus broken below middle; nervellus reclivous, strongly broken either above or below middle; apical tarsal joints in female long, that of hind tarsus nearly or quite as long as second joint, claws large, strongly curved, simple. Abdomen in female rather broadly ovate, and apical segments short; first tergite with lateral carinae extending to apex, dorsal carinae nearly to apex.

Only one described North American species is referable to this genus: (*Cryptus*) *Trichocryptus hirtifrons* (Ashmead). To this may now be added the very distinct new species described below.

TRICHOCRYPTUS HIRTIFRONS (Ashmead)

Cryptus hirtifrons ASHMEAD, Proc. U. S. Nat. Mus., vol. 12, 1890, p. 411, male.

Cryptus cyaneiventris RILEY MS., Insect Life, vol. 3, 1890, p. 154.—HART, Bull. Ill. State Lab. Nat. Hist., vol. 4, 1895, pp. 178, 270. New synonyms.)

Apsilops hirtifrons ASHMEAD, Trans. Amer. Ent. Soc., vol. 23, 1896, p. 207.—DALLA TORRE, Cat. Hym., 1901–1902, p. 715, female.

Agrothereutes (*Apsilops*) *hirtifrons* VIERECK, Hym. Conn., (1916), 1917, pp. 330, 333.

(*Trichocryptus*) *hirtifrons* CUSHMAN, Proc. U. S. Nat. Mus., vol. 58, 1920, p. 259.

Originally described from a single Texan male; the female was described six years later from specimens from Illinois collected by C. A. Hart in association with (*Hydrocampa*) *Nymphula obliteralis* (Walker).

Type.—Cat. No. 2028, U.S.N.M.

In addition to the unique type male there are in the National collection 11 females from Columbus, Ohio; one from Havana, Illinois (ex *Hydrocampa*), one of the specimens taken by Hart; and one from Florida, reared March 26, 1888, from Pyralid on water lily, under Bureau of Entomology No. 4261°. The last mentioned is the specimen recorded in Insect Life under "*Cryptus cyaneiventris* Riley MS." Three females and one male reared by Hart and loaned me by the Illinois State Natural History Survey have also been examined. The Illinois male has the red of the legs much paler than in the type and also has a small white spot on the scutellum, but seems not to differ otherwise.

The following characters of the female are given for comparison with the corresponding characters of the new species.

Scutellum and spot at apex of abdomen white; abdomen black with faint purplish reflection, apex of second tergite narrowly reddish; tibiae and tarsi black or blackish. Eyes longer than width of face, very slightly convergent below; temples strongly receding; their anteroposterior length much less than that of eye. Thorax much less than twice as long as deep (measured from middle of mesosternum to middle of scutellum); petiolar area longer than combined areola and basal area; legs slender, apical joint of hind tarsus slightly shorter than second joint; first tergite much less than half as broad at apex as long, petiole slender, dorsal carinae weak, spiracle at apical third; second tergite nearly as long as broad at apex; ovipositor slender, apex elongate sagittate.

TRICHOCRYPTUS BICOLOR, new species

Immediately distinguishable from *hirtifrons* (Ashmead) by its red abdomen.

Female.—Length 5.5 mm.; antennae 3 mm.; ovipositor 1 mm.

Head rather thick, temples rather broad, their antero-posterior length nearly equal to that of eye; eyes as long as width of face, distinctly convergent below. Thorax fully twice as long as deep; propodeum in profile straight above, precipitate behind, petiolar area shorter than combined areola and basal area; legs rather stout, apical joint of hind tarsus as long as second joint; wings long; areolet slightly convergent above; nervellus broken below middle. First tergite stout, barely twice as long as broad at apex, dorsal carinae strong, spiracles at about middle, petiole thick, flattened above and broader than deep; second tergite much broader at apex than long; ovipositor stout, sword-shaped, not apically sagittate.

Head and thorax entirely black, with blackish pubescence, antennae and palpi dark brown; wings faintly smoky; legs ferruginous with only the trochanters blackish; abdomen, except petiole, pale ferruginous, apex immaculate.

Type locality.—Sprague, Washington.

Type.—Cat. No. 40438, U.S.N.M.

One female taken July 16, 1922, by M. C. Lane.

TRICHESTEMA, new genus

Agrees with the above description of *Trichocryptus* Thomson except as follows: Malar space shorter than basal width of mandible; antennae in female only slightly thickened toward apex, first and second flagellar joints equal in length; propodeal spiracle long, slit-like; areolet with intercubiti strongly convergent above, radial cell long; abdomen in female lanceolate, the apical segments long.

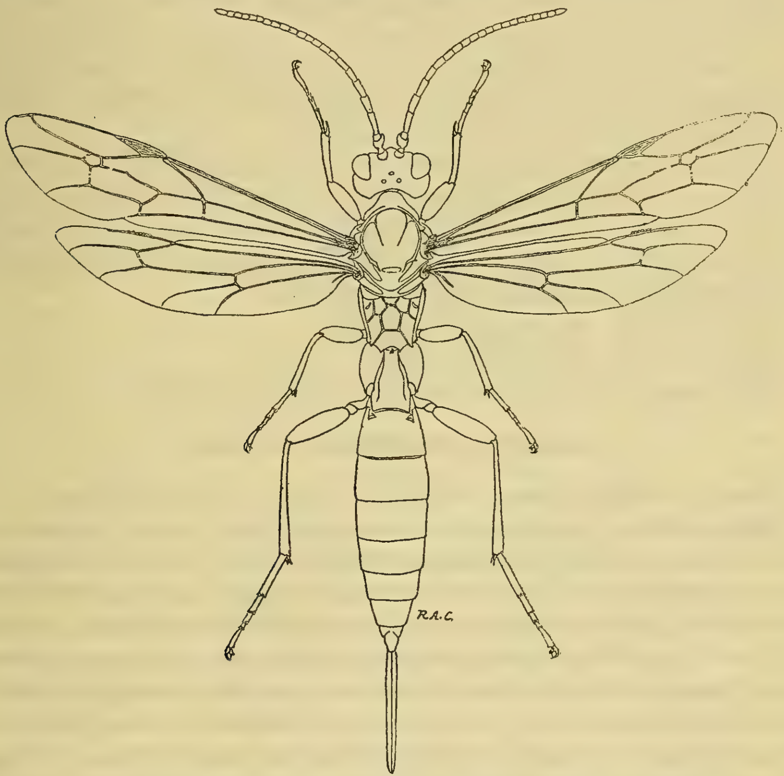

FIG. 1.—TRICHESTEMA HELCOSTIZOIDES CUSHMAN. DRAWN FROM TYPE

The long apical abdominal segments, and short, thick first tergite give this genus a habitus strongly reminiscent of *Helcostizus* Foerster.

The velvety pubescence probably indicates an association with water.

Genotype.—*Trichestema helcostizoides* Cushman, new species.

TRICHESTEMA HELCOSTIZOIDES, new species

Female.—Length 11 mm.; antennae 4.5 mm.; ovipositor 3 mm.

Head transverse, temples sloping, their antero-posterior length slightly less than that of eye; eyes about as long as their distance apart, parallel within; malar space slightly shorter than basal width of mandible; clypeus less than half as long as broad. Thorax flattened dorsally, more than twice as long as deep; propodeum straight above, precipitate and concave behind, upper hind angles very prominent, but angulate rather than mucronate, areola and petiolar area confluent and together longer than petiolar area; legs, especially femora, stout; apical joint of hind tarsus as long as second joint; nervellus broken slightly above middle. Abdomen shining, finely and rather densely punctate; first tergite less than twice as long as broad at apex with very strong carinae, spiracle at apical third, petiole very broad, flat above; last three tergites about equal in length and only slightly shorter than fifth; ovipositor stout, sword-like, not apically sagittate.

Head and thorax black, pubescence silvery, palpi brown, scutellum white; legs ferruginous, trochanters and tarsi black, middle tibia at base and hind tibia throughout fuscous; wings grayish because of dense pubescence, veins black, stigma testaceous; abdomen black; second and third tergites somewhat reddish.

Type locality.—Bruce, South Dakota.

Type.—Cat. No. 40439, U.S.N.M.

One female taken August 24, 1923, by H. C. Severin.

EPHIALTES NIGROAENEUS, new species

Female.—Length 7 mm.; antennae 7 mm.; ovipositor 2 mm.

Head polished, unsculptured, and with only sparse pubescence; eyes sinuate within; face broader than vertex, its sides divergent below; clypeus small, separated at base, truncate at apex, weakly impressed and narrowly reflexed at apex; malar space as long as basal width of mandible; vertex narrow, ocell-ocular line much shorter than diameter of ocellus; temples narrow, and very sharply receding; antennae as long as body; flagellum very slender, its basal joint half as long again as second and fully ten times as long as thick. Thorax polished, without sculpture and almost without pubescence; notauli deep anteriorly; propodeum dorsally finely transversely aciculate, laterally very finely granularly opaque, posteriorly polished without carinae, but with prominent ridges on each side of petiolar area; tibiae and tarsi opaque and densely pubescent, legs otherwise polished and without vestiture; abdomen finely coriaceous, subopaque; tergites 1–5 with subapical transverse impressions, deep at sides and obsolescent in middle; first tergite without carinae and with the basal impression short.

Black; propodeum and abdomen aeneous; wings deeply infumate; legs black with purple reflections, extreme base of front and middle femora, hind femur except apex and apical joint of its trochanter ferruginous.

Type locality.—Cinchona, Jamacia.

Type.—Cat. No. 40440, U.S.N.M.

One female taken by C. C. Gowdey, August 5, 1926, and bearing his No. 1675.

EPHIALTES POLYCHROMUS, new species

Female.—Length 14 mm.; antennae 13 mm.; ovipositor 4 mm.

Head smooth, without sculpture except a few coarse subobsolete punctures on upper part of face; frons deeply concave; face hardly as broad as vertex, somewhat elevated medially and laterally, the elevations separated by rather deep longitudinal impressions; clypeus twice as broad as long, distinctly discreted, apically inflexed with a narrow reflexed margin, broadly, slightly concavely truncate; malar space little more than half as long as basal width of mandible; ocell-ocular line slightly shorter than diameter of ocellus; temples narrow and very sharply receding; eyes strongly sinuate within; antennae very nearly as long as body, flagellum very slender, slightly tapering toward apex, its basal joint more than a half longer than second. Thorax smooth; mesoscutum with rather dense suberased punctures, scutellum more sparsely and less distinctly punctured, mesopleurum and metapleurum with a few coarse subobsolete punctures; notauli distinct for only a short distance; propodeum coarsely transversely striate, the stria at top of apical slope very strong and setting off a rather distinct petiolar area which is less distinctly defined laterally, spiracles large ovate. Abdomen very finely coriaceous, coarsely, sparsely, and subobsoletely punctate on first five tergites; transverse impressions of tergites 2–5 distinct laterally, obsolete medially; first tergite without dorsal carinae, basal impression occupying about half its median length.

Head and thorax yellow with the following brownish markings: A transverse fascia on vertex including the posterior ocelli, a frontal mark inclosing the anterior ocellus, three stripes on mesoscutum, apex of scutellum, anterior and posterior margins of mesopleurum, a transverse fascia at base of propodeum extending entirely across and surrounding the spiracles, and the apical middle of propodeum; antennae fusco-ferruginous; front and middle legs yellow; the femora inside and the tibiae apically more reddish, the tarsi apically brown; hind coxae brown, yellow below and above except at apex, trochanters pale testaceous and yellow, femur bright ferruginous, tibia yellow with base narrowly and apex broadly fusco-ferruginous; tarsus with first joint yellow, rest fuscous; wings bright yellow, veins blackish, stigma testaceous; basal five tergites brown at base and apex, transversely yellow in middle; apical tergites ferruginous; sheath blackish.

Type-locality.—Santiago de Cuba.

Type.—Cat. No. 40441, U.S.N.M.

One female.

HEMITELES (APTESIS) HEMIPTERUS (Fabricius)

Synonym.—*Hemiteles insignipennis* SCHMIEDEKNECHT. (New synonymy.)

There are before me three females reared from cocoons of *Phytonomus posticus* and four females reared as secondary parasites of *Pyrausta nubilalis*, two of the latter through *Microgaster tibialis* Nees and two through *Eulimneria crassifemur* (Thomson).

One of the three from *Phytonomus* is fully winged and the two from *Eulimneria* are only slightly brachypterous, but are clearly not specifically different from the short-winged specimens. These three run to, and the fully winged one agrees perfectly with, *Hemiteles insignipennis* Schmiedeknecht.

SYRPHOCTONUS FOUTSI, new species

An anomalous species, perhaps generically distinct from *Syrphoctonus*, chiefly remarkable for its somewhat elevated clypeus, which is apically entire and not medially sulcate, and, in the female, for its apically attenuate abdomen. The nearest approach in the tribe to this form of clypeus is found in *Syrphoctonus vertebratus* Cushman, in which the clypeus, though of about the same form otherwise, has a fairly distinct median sulcus. The female of the latter species is unknown.

Female.—Length 6 mm.; antennae 4 mm.

Head shining with only the face and cheeks opaque; temples convexly narrowed; frons medially concave; ocell-ocular line a half longer than diameter of an ocellus; vertex medially elevated, slightly impressed next to eyes; face about twice as broad as long, convex, with rather dense very short pubescence; clypeus twice as broad as long, straight from base to apex, convex from side to side, the apex elevated, subtruncate and without a median sulcus; malar space slightly shorter than basal width of mandible; flagellum filiform, all joints distinctly longer than thick, first a half longer than second. Thorax hardly twice as long as deep, polished, sparsely and weakly punctate; propodeum rather coarsely rugoso-punctate, opaque; apical slope weakly impressed on either side of middle; second abscissa of cubitus twice as long as intercubitus; first brachial cell as broad as long, subdiscoideus below middle of postnervulus; nervellus strongly broken below middle; legs slender, hind tarsus much longer than tibia. Abdomen twice as long as head and thorax, attenuate beyond middle, first two tergites and base of third opaque, rest polished; first slightly longer than broad, broadest at spiracles; second distinctly longer than broad, longitudinally striate in basal middle, widening slightly toward apex; third to seventh deeply emarginate at apex, each successively smaller; eighth and genitalia very small.

Black, with the following markings white: Face with short orbital extensions above (in paratype the middle of face nearly to clypeus is black), malar space and cheeks, clypeus, mandibles, palpi, propleura, lower and posterior margins and humeral angle of pronotum, cuneiform spots on sides of mesocutum, scutellum, and postscutellum, mesopleurum and sternum, except broad mark on upper pleurum and smaller one in position of sternauli, suture between meso- and metapleurum, and spot on metapleurum, antennae black, apical margin of scape and lower side of pedicel and of flagellum for two-thirds of its length white, all coxae and trochanters white, front and middle femora and tibiae pale stramineous, hind femur pale testaceous, its tibia white with extreme apex black; tarsi white, apical joints and small apices of basal joints of hind tarsi fuscous; wings hyaline, veins and stigma brownish, tegulae and radices white; abdomen immaculate above, sternites black, membrane white.

Male.—Antennae white beneath throughout; legs paler; abdomen not attenuate apically, more or less sculptured throughout, tergites not emarginate, second to sixth white at apex; otherwise like female.

Type locality.—Glen Echo, Maryland.

Type.—Cat. No. 40442, U.S.N.M.

Two females and one male, all taken by Robert M. Fouts, the allotype at Washington, District of Columbia.

Genus HIMERTUS Thomson

? *Himerta* Foerster, Verh. nat. Ver. preuss. Rheinland, vol. 25, 1868, p. 200.

Himertus Thomson, Opusc. Ent., fasc. 9, 1883, p. 926. Genotype.—(*Himertus bisannulatus* Thomson) =*Mesoleptus defectivus* Gravenhorst.

Clepsiporthus Davis, Trans. Amer. Ent. Soc., vol. 24, 1897, p. 325 (not Foerster). (New synonymy.) Genotype.—*Mesoleptus? rubiginosus* Cresson.

Neoprotarchus Cushman, Proc. U. S. Nat. Mus., vol. 64, art. 20, 1924, p. 10. (New synonymy.) Genotype.—*Neoprotarchus ater* Cushman.

Since the publication of *Neoprotarchus* the National Museum has acquired a specimen of the genotype of *Himertus* as well as specimens of another North American species. Comparison of these specimens as well as specimens of *Clepsiporthus rubiginosus* (Cresson) shows no real generic differences. Even the clypeal tooth, characteristic of *Neoprotarchus ater*, can be considered of no more than specific significance.

Clepsiporthus of Davis is not the same as Foerster's *Clepsiporthus*. The genotype will not run in Foerster's key to that genus, differing in the key characters under couplets 31 and 33, since the clypeus is distinctly transversely impressed at apex and the alar areolet is lacking. In addition to the genotype, *Clepsiporthus flavidus* Davis seems also to belong to *Himertus*.

I believe that Schmiedeknecht has erred in placing *Himertus* in the Euryproctina, for the petiolar foveae (glymmae) are quite as distinct in *defectivus* as in *Genarches* (as represented by *facialis* [Gravenhorst]), which he placed in the Mesoleiina. In fact, *Himertus* and *Genarches* are very doubtfully distinct generically, the presence of the alar areolet in *Genarches* and its absence in *Himertus* being the only apparent character for separating them. I fail to find on the only specimen of *Genarches* available to me the tooth described by Foerster as being located near the apex of the third joint of the maxillary palpus. Both *Himertus* and *Genarches* belong, in my opinion, in the Mesoleiina where they are closely related to *Protarchoides* Cushman.

The following key will separate the four North American species here referred to *Himertus*.

1. Black species — 2
   Rufous or ferruginous species — **rubiginousus** (Cresson).
2. Clypeus with a sharp tooth at junction of basal and apical areas — **ater** (Cushman).
   Clypeus without such a tooth — 3
3. Front and middle tarsi "reddish brown" — **flavidus** (Davis).
   Front and middle tarsi yellow — **dakota**, new species.

HIMERTUS ATER (Cushman) (new combination)

Neoprotarchus ater Cushman, Proc. U. S. Nat. Mus., vol. 64, art. 20, 1924, p. 10, fig. 4.

The type is female, not male as stated in the original description.

HIMERTUS FLAVIDUS (Davis) (new combination)

Clepsiporthus flavidus Davis, Trans. Amer. Ent. Soc., vol. 24, 1897, p. 326.

Apparently very closely allied to *dakota* and perhaps identical with it.

HIMERTUS DAKOTA, new species

Female.—Length 12 mm.; antennae 10 mm.

Structurally practically identical with *ater* (Cushman) except that the clypeal tooth is lacking, the malar space is slightly longer, the longitudinal groove of propodeum and first tergite are much less distinct, the inner hind calcarium is barely half as long as basitarsus, and the postnervulus is broken distinctly above the middle.

In color the same as *ater* except as follows: Facial spot divided medially and flanked on either side by a reddish spot; all tarsal joints except apical, front tibia entirely, middle tibia except reddish apex, and somewhat more than basal half of hind tibia pale yellow; hind tarsus somewhat fuscous at base.

Type locality.—Spearfish, South Dakota.

Type.—Cat. No. 40443, U.S.N.M.

One female taken July 26, 1924.

A male from Harney Peak, South Dakota (July 22, 1924), which, because of its darker legs, I doubtfully refer to this species, has the face, lower cheeks, clypeus, mandibles, maxillary palpi, tegulae, humeral, and subalar spots and spots at origins of notauli white. The front and middle tarsi have only the base of the first joint and the third and fourth joints white, while on the hind tarsus only the fourth joint is obscurely pale at base. The white on the tibiae is also less extensive than on the type. If this is really the male of *dakota*, the color antigeny is very unusual.

HIMERTUS RUBIGINOSUS (Cresson) (new combination)

Mesoleptus? rubiginosus Cresson, Proc. Acad. Nat. Sci. Phila., 1878, p. 372.
Clepsiporthus rubiginosus Davis, Trans. Amer. Ent. Soc., vol. 24, 1897, p. 326.

Genus PROTARCHOIDES Cushman

In the following new species the hind tarsi are only slightly compressed and the ocelli are very large, but it agrees in all the other characters by which the present genus is said to differ from *Protarchus* Foerster.

The following key will separate the three North American species:

1. Coxae testaceous; hind tibia and tarsus black, the tarsus strongly compressed ---------- 2
   Coxae black; legs otherwise pale testaceous; hind tarsus weakly compressed **pallipes**, new species.
2. Mandibles and palpi yellow ---------- **mandibularis** Cushman.
   Mandibles black; palpi reddish ---------- **longipes** Cushman.

PROTARCHOIDES PALLIPES, new species

Female.—Length 15 mm.; antennae 16 mm.

Face fully as broad as frons; ocelli very large, diameter of lateral ocellus much longer than ocell-ocular line; propodeal carinae very high and irregular, lateral abscissa of apical carina less strong but distinct; hind tibia and tarsus not conspicuously compressed; first tergite fully twice as long as broad at apex, the median carinae and the space between them strongly elevated above the general surface between the spiracles.

Deep black, this color including the mandibles, clypeus, palpi, tegulae, coxae, and trochanters; pubescence black (in the other two species it is pale); antennae black at base and in apical half, the space between pale testaceous; wings deeply yellow stained, stigma reddish; legs beyond trochanters pale testaceous, base of tibiae and tarsi slightly paler.

Type locality.—Edmonton, Alberta.

Type.—Cat. No. 40444, U.S.N.M.

Two specimens taken August 23, 1926, by George Salt.

Except for slightly larger size the paratype is practically identical with the type.

Genus PHRUDUS Foerster

The name *Phrudus* was first used by Foerster in his Synopsis der Familien und Gattingen der Ichneumonen,[7] but Foerster neither designated a genotype nor included species in the genus, and the only description of the genus consists of the characters leading to it in his key.

In 1886 Bridgman[8] also described a genus *Phrudus* based on the single species, *Phrudus monilicornis* Bridgman.

In 1901 Strobl[9] described his *Ktenostilpnus* with *aequaearticulatus* Strobl as genotype.

In 1914 Roman[10] brought forth his genus *Vendolus*, based on *Vendolus stilpninus* Roman.

Roman[11] later synonymized *Ktenostilpnus* and *Vendolus* with *Phrudus* Bridgman and his own *Vendolus stilpninus* with *monilicornis* Bridgman.

Thomson, Roman, and Morley credit the genus to Bridgman, while Schmiedeknecht, Dalla Torre, and Viereck treat it as Foerster's. That Bridgman's genus is the same as Foerster's there can, I think, be little doubt. In Foerster's key to the Ctenopelmoidae *monilicornis* will certainly run to *Phrudus*. Also, it agrees with Foerster's unpublished description of his genus, which, translated, is as follows:

Antennae 20-jointed, first flagellar joint a little longer than second; clypeus distinctly separated; propodeum distinctly areolated; first tergite narrow, spiracles in middle; radius originating at middle of stigma; areolet irregular, sessile; cubitus obsolete beyond areolet; median vein in hind wing effaced basally; nervellus not broken.

Furthermore, Bridgman apparently permitted Thomson to see his species before its publication, for he credits Thomson with having suggested the name. And Thomson habitually used Foerster's names without crediting them to Foerster, simply using the latter author's work as a convenient source of generic names. The synonymy of the genus is therefore as follows:

Genus PHRUDUS (Foerster) Bridgman

Phrudus FOERSTER, Verh. Nat. Ver. Preuss. Rheinl., vol. 25, 1868, p. 196. No species included.

Phrudus BRIDGMAN, Trans. Ent. Soc. Lond., 1886, p. 360. Type.—*Phrudus monilicornis* Bridgman.

Phrudus (Bridgman) THOMSON, Opusc. Ent., fasc. 12, 1888, p. 1258.

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[7] Verh. Naturh. Ver. Preuss. Rheinland., vol. 25, 1868, p. 148.

[8] Trans. Ent. Soc. London, 1886, p. 361.

[9] Mitt. Nat. Ver. Steier., Jahrgang 1900, Heft. 37, 1901, p. 256.

[10] Arch. Zool., vol. 9, No. 2, 1914, p. 35.

[11] Ark. Zool., vol. 17A, no. 4, 1924, p. 32.

Ktenostilpnus Strobl, Mitth. Nat. Ver. Steiermark, Jahrg. 1900, Heft 37, 1901, p. 256. Type.—*Ktenostilpnus aequaearticulatus* Strobl.
Phrudus (Foerster) Schmiedeknecht, Hym. Mitteleur., 1907, p. 620.
Phrudus (Bridgman) Morley, Brit. Ichn., vol. 4, 1911, p. 258.
Phrudus (Foerster) Schmiedeknecht, Opusc. Ichn., fasc. 32, 1912, p. 2489.
Vendolus Roman, Ark. Zool., vol. 9, No. 2, 1914, p. 35. Type.—*Vendolus stilpninus* Roman.
Phrudus (Foerster) Viereck, Bull. 83, U. S. Nat. Mus., 1914, p. 116.
Phrudus (Bridgman) Roman, Ark. Zool., vol. 17A, No. 4, 1924, p. 32.

There has been wide variance of opinion as to the systematic position of the genus. Foerster originally placed it in his family Ctenopelmoidae (Tribe Ctenopelmini Ashmead), while Thomson considered it related to *Grypocentrus* Ruthe. Bridgman quoted Thomson's opinion and placed his description of the genus among those of other Tryphoninae. Schmiedeknecht leaves it in close proximity to *Grypocentrus*, though commenting on its similarity in habitus to *Stilpnus* and *Atractodes*.

Strobl placed his *Ktenostilpnus* in the Stilpnini, where Morley also considers it to belong with "no shadow of doubt." Roman places *Vendolus* in the Cremastini where he considers it allied to *Demophorus* Thomson. In his later publications he reinterates his belief that this is the proper position for the genus.

Phrudus is more or less anomalous wherever it is placed. It is certainly not Stilpnine for it lacks the principal recognition character of that group, that is the combined areola and petiolar area extending practically to the base of the propodeum. Nor do I believe that the short abscissula is sufficient ground unsupported for relegating it to the Cremastini. In my opinion it is less anomalous in its original placing among the Tryphoninae than elsewhere.

Phrudus has not heretofore been recorded from North Americal. The following two new species from this continent have recently come to hand. One of these lacks the areolet but is, I think, not generically distinct.

PHRUDUS DAKOTA, new species

Female.—Length 2.6 mm.

Slender with thorax compressed; that is, slightly deeper than broad. Head polished, nearly as long as broad and in side view fully as long as deep; temples slightly sloping; vertex elevated; frons strongly convex; face transversely striate-punctuate, prominent above, narrower than frons and fully twice as broad as long; clypeus sculptured as face, separated, three times as broad as long, apex sinuately curved; malar space much narrower than basal width of mandible; cheek fully three times as broad as malar space, strongly sloping; eyes bulging, broadly oval; antennae hardly half as long as body, stout, flagellum with 13 joints, first joint distinctly longer than thick, others to sixth gradually decreasing in length, seventh to twelfth about as broad as long, apical joint elongate-ovate, more than twice as long as thick. Thorax nearly twice as long as deep; mesoscutum longer than broad, polished and sparsely punctate, notauli briefly distinct; scutellum elongate, strongly convex, polished with faint scattered punctures, mesoplurum with a broad band of oblique striation in middle, polished above and below; metapleurum rather densely punctate; propodeum polished, areola, middle lateral areas and margins of petiolar areas irregularly rugose; completely

FIG. 2.—PHRUDUS DAKOTA CUSHMAN. DRAWN FROM TYPE

areolated, petiolar area occupying only about half median length, areola much longer than broad, areolet obliquely pentagonal; legs stout, hind femur hardly three times as long as deep. Abdomen rather narrow, nearly four times as long as broad, polished; first tergite very slender, decurved, longitudinally striate above; second nearly as long as broad at apex.

Black; legs pale testaceous to stramineous, antennae testaceous in basal half, fuscous at apex; wings hyaline, venation brown.

Type locality.—Spearfish, South Dakota.

Type.—Cat. No. 40445, U.S.N.M.

One specimen taken July 26, 1924.

PHRUDUS EXAREALATUS, new species

Distinct from *dakota* in the lack of the areolet and stouter body and legs.

Female.—Length, 2 mm.

Stout, thorax hardly compressed, abdomen barely three times as long as broad. Head much broader and deeper than long; temples strongly rounded; vertex moderately elevated, not narrower than frons, about twice as broad as long, more coarsely sculptured than face, apex rounded; malar space nearly as long as basal width of mandible, and nearly half as long as width of cheek; eyes less bulging and more elongate than in *dakota;* antennae fully half as long as body, subapical joints thicker than long, apical joint less than twice as long as thick. Thorax distinctly more than half as deep as long; mesoscutum as broad as long, polished; scutellum and mesopleurum polished, without sculpture; metapleurum and propodeum indistinctly sculptured; petiolar area occupying more than half median length, areola slightly longer than broad with costulae in middle; legs stout, hind femur hardly three times as long as deep. Abdomen about three times as long as broad; first tergite slender, decurved, longitudinally striate above; second much broader at apex than long.

Black; legs testaceous; antennae fuscous, scape, pedicel, and base of flagellum testaceous; wings hyaline, venation brown.

Type locality.—Cranberry Lake, New York.

Type.—Cat. No. 40446, U.S.N.M.

One female taken by E. A. Hartley on August 7, 1924.

PODOGASTER CACTORUM, new species

In Szepligeti's key to the species of *Podogaster*[12] this species will run to couplet 2, where it agrees with the first alternate in having the discoidal and brachial cells of equal length and with the second in its entirely hyaline wings.

In Morley's key[13] it runs to couplet 2 (5), agreeing with 2 in the first and third items and with 5 in the second.

Female.—Length 12 mm.; antennae 7 mm.; ovipositor 2 mm.

Head from above weakly transverse, the temples extending straight back for most of their length, then curving sharply mesad to join the occiput; occiput deeply concave, the bounding carina developed only at top, where it is almost contiguous with the ocelli; diameter of lateral ocellus equal to ocell-ocular line; eyes convergent below, almost contiguous to clypeal foveae and to mandibles, at their lower extremity less than half as far apart as at vertex, concavely arcuate within; face densely punctate, frons sparsely so; clypeus acutely

[12] Ann. Mus. Nat. Hung., vol. 4, 1906, p. 122.

[13] Rev. Ichn. Brit. Mus., pt. 2, 1913, p. 60.

pointed; antennae slender, tapering slightly toward apex, scape and pedicel of nearly equal length, scape squarely truncate at apex. Thorax largely rugose; pronotum polished above, longitudinally rugose below; mesoscutum irregularly transversely rugose, middles of three lobes granularly opaque to subopaque; scutellum irregularly rugose at sides, the median groove polished, basal fovea coarsely foveolate; postscutellum transversely carinate; mesopleurum above longitudinally striate with a large smooth speculum, below coarsely punctate, sternum more finely and sparsely punctate, sternauli short but deep; combined propodeum and metathorax subhemispherical, coarsely reticulate rugose, the propodeal neck constricted, spiracles elongate oval; wings small, discoideus and subdiscoideus of equal length and continuous, the second discoidal cell therefore pointed at base, postnervulus strongly reclivous; longitudinal veins in hind wing wanting beyond cross veins, intercubitella and cubitella forming an unbroken curve. Abdomen granularly opaque, very slender, first and second tergites equal in length and together comprising more than half total length of abdomen.

Head and thorax yellow with the following black or blackish markings: spot on vertex enclosing the ocelli, occipital spot, longitudinal mark on each lobe of mesoscutum, basal and longitudinal grooves of scutellum, lateral areas of scutellum and postscutellum, a median and two lateral stripes on propodeum joined at base by a transverse band, and a longitudinal spot on mesopleurum; wings hyaline, venation black; front leg yellow, with femur largely stramineous; tibia below and tarsus reddish stramineous; middle legs similarly marked but the stramineous partly replaced by piceous; hind legs largely black, coxa except outer side and trochanter and femur at base below yellow, femur dark reddish below, calcaria yellowish. Abdomen blackish above, ferruginous laterally beyond second tergite.

Male.—Essentially like female, but eyes a little less strongly convergent.

Type locality.—Concordia, Entre Rios, Argentina.

Host.—*Cactoblastis cactorum.*

Type.—Cat. No. 40447, U.S.N.M.

One of each sex reared in February, 1925, by Alan P. Dodd under his No. 106.

CREMASTUS (ZALEPTOPYGUS) MORDELLISTENAE Cushman

A series of specimens has been received from Charles H. Hicks, of the University of Colorado, and reared by him under his numbers 333 and 567 from a species of *Mordellistena.* The females show that the type is not normally colored, apparently stained. In the normal female all the markings of the head, the mandibles, and the tegulae are yellow rather than piceous. The hind coxae vary from entirely black to largely reddish piceous, while the abdomen beyond the second tergite is normally largely and sometimes almost entirely reddish.

Genus CERATOGASTRA Ashmead

Ceratosoma Cresson, Proc. Ent. Soc. Phila., vol. 4, 1865, p. 281.
Ceratogastra Ashmead, Can. Ent., vol. 32, 1900, p. 368.
Ceratogaster Dalla Torre, Cat. Hym., 1901–1902, p. 62.

In addition to the two species originally assigned to *Ceratosoma*, the following species have since been referred to the genus under one or another of the three names:

([*Exetastes*] *Ceratosoma rufa* [Provancher])=*Dyspetes rufus* (Provancher). (New combination.)

A homotype (by Gahan) of this species is in the National Collection and is the basis for its transfer to *Dyspetes*. The occiput is not medially impressed as in the genotype, the impression being represented only by a median angulation of the occipital carina; and the scutellar and propodeal carinae are stronger than in the genotype; but I see no good reason for not referring it to *Dyspetes*.

(*Ceratosoma rubyata* Davis)=*Ceratogastra ornata* (Say).

As pointed out by Cushman and Gahan,[14] the type of *rubyata* is a cyanide-stained specimen of Say's species.

(*Agathis ornata* Say)=*Ceratogastra ornata* (Say).
(*Agathis polita* Say)=*Ceratogastra polita* (Say).

Say's two species were transferred to the present genus by Cushman and Gahan, who also synonymized the genotype *fasciata* (Cresson) with *ornata*.

This leaves three species in the genus: *ornata* (Say), *polita* (Say), and *apicalis* (Cresson), to which is now added the following new species. The four may be distinguished by the following key:

1. Only the basal two tergites yellow at apex……polita (Say).
   At least the first three tergites yellow at apex……2
2. Head behind eyes barely as broad as eyes; wings strongly infumate at apex; only first three tergites yellow at apex……trifasciata, new species.
   Head behind eyes broader than eyes; wings not distinctly infumate at apex; all tergites apically yellow……3
3. Front wings apically hyaline……apicalis (Cresson).
   Front wings uniformly deeply yellowish……ornata (Say).

CERATOGASTRA TRIFASCIATA, new species

Female.—Length 14 mm.; antennae 8 mm.

Temples barely as broad as eyes; face and frons of equal width; eye nearly one-fifth longer than width of face; clypeus coarsely

[14] Proc. Ent. Soc. Wash., vol. 23, 1921, p. 154.

and rather densely punctate; malar space distinctly less than half as long as basal width of mandible; antennae more than half as long as body, subapical joints only very slightly broader than long. Teeth of claws larger than usually, front and middle claws with three, hind claws with two teeth. Abdomen strongly attenuate from apex of third tergite, first three tergites comprising less than half total length of abdomen, tergites 5–7 hardly telescoped; oblique furrows of second tergite reaching base but not meeting, their extended angle acute; first tergite distinctly longer than broad.

Black, with the following markings yellow: Face, clypeus, mandibles, scape below, frontal and posterior orbits (the latter not confluent across vertex but stopping at top of eyes), anterior lateral margins of mesoscutum, scutellum and a small spot on each side in front, postscutellum and a small spot on each side, tegulae, humeral angles of pronotum, subalar tubercle, streak along prepectal carina, a broad band covering apices of propodeum and metapleura, and a broad apical band on each of the first three tergites; flagellum entirely black; coxae black; trochanters yellow, the basal joints more or less testaceous; front and middle femora testaceous, more or less yellow in front toward apex; hind femur nearly black piceous; front and middle tibiae and all tarsi yellow; hind tibia yellow at base, blackish at apex; wings deeply stained with yellowish, broad apices and median cell infumate; median, basal and discoidal veins blackish, other veins paler, stigma pale testaceous.

Type locality.—Forest Hills, Massachusetts.

Type.—Cat. No. 40448, U.S.N.M.

One female captured October 3, 1924, by George Salt.

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FOSSIL AND RECENT BRYOZOA OF THE GULF OF MEXICO REGION

By Ferdinand Canu
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and

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The extensive dredgings of the United States Fish Commission steamer *Albatross* in the Gulf of Mexico and adjoining waters, now preserved in the United States National Museum, were consulted from time to time by the authors of the present work during their investigations of North American Tertiary bryozoa with the result that a considerable number of observations upon the Gulf bryozoa had accumulated at the conclusion of these studies. This fact, in conjunction with the interest in the Gulf of Mexico faunas in general and the comparatively small amount of published work upon their bryozoa, afforded the reasons for the present paper. In addition, a collection of fossil bryozoa from Bocas Island, Panama, submitted to us for report by the United States Geological Survey, contained so many forms identical with recent Gulf species that their study was incorporated.

The classic work of Smitt[1] on Floridan bryozoa collected by Count L. F. de Pourtales during the expeditions of the United States Coast Survey in 1867-1869 in the deeper waters of the Florida region remained practically the only publication until 1914, when Osburn's "Bryozoa of the Tortugas Islands, Florida,"[2] dealing with the shallow water faunas, appeared.

[1] Smitt, A. F., 1872-73. Floridan Bryozoa, collected by Count L. F. de Pourtales. Kongl. Svenska Vetenskaps-Akademiens Handlingar, pt. 1, 1872, in vol. 10, No. 11, pp. 1-20, pls. 1-4; pt. 2, 1873, in vol. 11, No. 4, pp. 1-83, pls. 1-13. Stockholm.

[2] Osburn, R. C., 1914. The Bryozoa of the Tortugas Islands, Florida. Pub. No. 182, Carnegie Institution of Washington, pp. 181-222.

Previous to Smitt's work Pourtales[3] listed and described as new seven species of bryozoa two of which have been found to be synonyms. Levinsen, in his "Morphologic and Systematic Studies on the Cheilostomatous Bryozoa" (1909), records six species from the Florida and West Indian region, two of them new. Since Osburn's paper in 1914 no important work upon the recent bryozoa of the Gulf has been issued, but with the publication of our work[4] on the Early Tertiary and Later Tertiary and Quaternary Bryozoa of the Atlantic and Gulf Coastal Plains of the United States containing numerous fossil faunas of Gulf origin the study of the recent bryozoa from this region assumes new interest.

More than 40 stations of the *Albatross* explorations of 1883–1888 have been found to contain bryozoa, some of them in great richness. Most of these stations are located in the Gulf of Mexico, including the Florida Straits and the Straits of Yucatan, although two (D. 2117, D. 2136) from the Caribbean Sea and two (D. 2672, D. 2415) east of Georgia and Florida have been included. Few species occurred at these four stations so that the larger faunas have all been derived from the Gulf of Mexico. We also have been able to include studies on faunas from the vicinity of Miami, Fla., collected by the late John B. Henderson. For convenience of reference, the Gulf Stations can be classified as follows:

D. 2354, 2362, 2363, 2365, Straits of Yucatan; D. 2152–2343, Gulf of Mexico, north of Habana, Cuba; Fowey Light and D. 2639, 2640, 2647, Straits of Florida; D. 2411, 2413, 2414, 2404, 2405, 2407, 2373, 2387–2392, Cedar Keys, Egmont Key, and Tortugas, Gulf off west coast of Florida.

As in the past, we are under obligations to Mr. F. Julius Fohs, of New York City, who has shown his appreciation of our studies on microorganisms by generous financial assistance in the preparation of this paper.

The bryozoa described by Smitt and by Osburn are cited in the following two lists while those noted in the present paper are given on succeeding pages. Species in the first two lists marked with an asterisk are discussed in this work. The plate and figures cited in the first list refer to Smitt's work while the depth is registered under Osburn's list.

SMITT, FLORIDAN BRYOZOA, 1872

**Crisia denticulata* (pl. 1, figs. 1–5). Figure 5=*C. ramosa* Harmer.
**Diastopora repens* (pl. 1, fig. 6)=Plagioecia.
**Idmonea atlantica* (pl 2, figs. 7, 8).
**Idmonea serpens?* (pl. 2, figs. 9, 10).

[3] Pourtales, L. F. de, 1867. Contributions to the fauna of the Gulf Stream at great depths. Bulletin of the Museum of Comparative Zoology, vol. 1, No. 6. (Bryozoa on pp. 106 and 110.)
[4] Bulletins 106 and 125, United States National Museum.

**Crisia hochstetteriana* (pl. 2, figs. 11–13)=*Crisina canariensis.*
**Idmonea milneana* (pl. 3, figs. 14–19)=*Diaperoecia radicata.*
Filisparsa pourtalesii (pl. 3, figs. 20–22)=Tervia.
**Hornera galeata* (pl. 4, figs. 23–25).
**Entalophora proboscideoides* (pl. 3, figs. 26, 27).
**Entalophora deflexa* (pl. 4, figs. 28–30)=Mecynoecia.
Discoporella clypeiformis (pl. 3, fig. 3)=Lichenopora.
Cellularia pusilla (pl. 4, figs. 32–34)=Scrupocellaria.
Cellularia cornigera (pl. 4, figs. 35–38)=Scrupocellaria.
Cellularia cervicornis (pl. 4, figs. 39–42)=Scrupocellaria.
**Caberea retiformis* (pl. 4, figs. 43–46)=Scrupocellaria.
**Halophila johnstoniae* (pl. 4, fig. 47).
Bugula flabellata Gray (pl. 4, figs. 48–52).

SMITT, FLORIDAN BRYOZOA, 1873

**Nellia oculata* (pl. 1, figs. 53, 54).
Farcimia cereus (pl. 1, figs. 55, 56).
**Cellaria tenuirostris* (pl. 1, figs. 57–59)=*Cellaria nodosa.*
**Vincularia abyssicola* (pl. 1, figs. 60, 61)=*Velumella americana* (fig. 60) and *Rectonychocella abyssicola* (fig. 61).
Membranipora lineata (pl. 2, fig. 62)=Callopora.
**Membranipora irregularis* (pl. 2, fig. 63)=Alderina.
Membranipora sigillata (pl. 2, figs. 64–68).
**Membranipora canariensis* (pl. 2, figs. 69–71)=Cupuladria.
**Mollia patellaria* (pl. 2, fig. 72).
**Mollia antiqua* (pl. 3, fig. 73)=Floridina.
**Micropora coriacea* (pl. 3, fig. 74).
**Cupularia umbellata* (pl. 3, figs. 75–80).
**Cupularia doma* (pl. 3, figs. 81–84).
Biflustra lacroixii (pl. 4, figs. 85–88)=*Callopora filum.*
**Biflustra denticulata* (pl. 4, figs. 89–91)=Hemiseptella.
**Biflustra savartii* (pl. 4, figs. 92–95)=Acanthodesia.
**Steginoporella elegans* (pl. 4, figs. 96–101)=*Steganoporella magnilabris.*
Steginoporella rozierii (pl. 4, fig. 102)=Thalamoporella.
Membraniporella agassizii (pl. 5, figs. 103–106).
**Cribrilina radiata* (pl. 5, figs. 107, 108)=Puellina.
**Cribrilina innominata* (pl. 5, figs. 109, 110)=Puellina.
**Cribrilina figularis* var. *floridana* (pl. 5, figs. 111, 112)=*Puellina floridana.*
Escharipora? mucronata (pl. 5, figs. 113–115)=Tremogasterina.
**Porina serrulata* (pl. 5, figs. 116–125)=Cigclisula.
Porina violacea=Adeona.
**Porina plagiopora* (pl. 6, figs. 134, 135)=Adeona.
**Porellina ciliata* (pl. 6, figs. 126–129)=Microporella.
Escharipora stellata (pl. 6, figs. 130–133)=Triporula.
**Porina subsulcata* (pl. 6, figs. 136–140)=Bracebridgia.
Anarthropora minuscula (pl. 6, fig. 141).
**Hippothoa? fenestrata* (pl. 6, fig. 142)=Stenopsis.
**Tessaradoma boreale* (pl. 6, figs. 143–145).
**Mamillopora cupula* (pl. 7, figs. 146, 147).
Myriozoum ovum (pl. 7, figs. 148–151).
**Gemellipora eburnea* (pl. 7, figs. 152–156=Pasythea.
**Gemellipora lata* (pl. 7, fig. 157)=Tremoschizodina.
**Hippothoa porosa* (pl. 7, fig. 158)=Mastigophora.

**Hippothoa pesanseris* (pl. 7, figs. 159, 160)=Mastigophora.
**Hippothoa spongites* (pl. 8, figs. 161–163)=Stylopoma.
Escharella sanguinea (pl. 8, figs. 164, 165)=Schizobrachiella.
**Hippothoa pertusa isabelleana* (pl. 8, figs. 166–168)=Schizopodrella.
Hippothoa mucronata (pl. 8, fig. 169)=Lacerna.
Cellepora verruculata (pl. 8, figs. 170–172).
Hippothoa biaperta (pl. 8, figs. 173–176)=Schizopodrella (Stephanosella).
**Gemellipora eburnea* (pl. 9, fig. 178)=Hippothoa.
**Hippothoa divergens* (pl. 9, fig. 179)=Buffonellaria.
Hippothoa divergens var. *lata* (pl. 9, fig. 177)=*Buffonellaria lata.*
Cellepora tuberosa (pl. 9, fig. 180).
Cellepora gigas (pl. 9, figs. 181, 183–185).
Discopora pertusa (pl. 9, fig. 182 and pl. 11, figs. 240, 241)=Holoporella.
Cellepora coronata (pl. 9, fig. 186).
Cellepora margaritacea (pl. 9, figs. 187–192).
**Cellepora avicularis* (pl. 9, figs. 193–198)=Schismopora dichotoma.
Escharella jacotini (pl. 10, fig. 199.)=Smittina trispinosa.
**Escharella jacotini* var. *spathulata* (pl. 10, fig. 200)=Smittina.
Escharella landsborovii (pl. 10, figs. 201, 202)=Smittina?
**Escharella (depressa) rostrigera* (pl. 10, figs. 203–205)=*Hippaliosina rostrigera.*
**Escharella (depressa) setigera* (pl. 10, fig. 206)=*Crepidacantha setigera.*
**Gemellipora striatula* (pl. 11, fig. 207)=*Trypostega venusta.*
**Gemellipora glabra* (pl. 11, figs. 208–210).
Escharella audouinii (pl. 11, fig. 211)=Lepralia.
**Gemellipora limbata* (pl. 11, figs. 212–214).
Lepralia inornata (pl. 11, figs. 215, 216)=Trypostega.
**Lepralia cleidostoma* (pl. 11, figs. 217–219)=Hippoporina.
**Lepralia edax* (forma *typica* and *calcarea*) (pl. 11, figs. 220–223)=*Hippoporidra edax* and *H. calcarea.*
**Lepralia edax janthina* (pl. 11, figs. 224–225)=Hippotrema.
**Lepralia turrita* (pl. 11, figs. 226–228)=Holoporella.
**Escharella bisinuata* (pl. 12, fig. 229)=Petraliella.
Eschara cervicornis (pl. 12, figs. 230–231)=Marguetta or Bryocryptella.
Discopora advena (pl. 12, fig. 232)=Cellepora.
**Discopora albirostris* (pl. 12, figs. 334–339)=Holoporella.
Discopora albirostris pusilla (pl. 12, fig. 233)= *Holoporella pusilla.*
**Retepora (beaniana) reticulata* (pl. 13, figs. 242–244) see Bryocryptella.
**Retepora (cellulosa) marsupiata* (pl. 13, figs. 245–254).

OSBURN, TORTUGAS ISLANDS, 1914

Pedicellina cernua Pallas (10 fms.).
Barentsia discreta Busk, 1886 (18 fms.).
**Crisia denticulata* Lamarck, 1816 (10–15 fms.).
Lichenopora hispida Fleming, 1829 (2 fms.).
**Aetea truncata* Landsborough, 1852 (5 fms.).
**Aetea sica* Couch, 1844 (10 fms.).
Bugula neritina Linnaeus, 1758 (shallow water).
Bugula neritina minima Waters, 1909 (8 fms.).
Bugula flabellata Gray, 1847 (12 fms.).
Bugula microoecia Osburn, 1914 (18 fms.).
**Bugula caraibica* Levinsen, 1909 (shallow water).
Bugula armata Verrill, 1900 (8–10 fms.).

Beania mirabilis Johnston, 1847 (18 fms.).
Beania intermedia Hincks, 1881 (5–15 fms.).
Beania cupulariensis Osburn, 1914 (10–22 fms.).
**Synnotum aviculare* Pieper, 1881 (8–10 fms.) = *Bugula avicularia.*
**Nellia oculata* Busk, 1852 (10–18 fms.).
Scrupocellaria cornigera Pourtales, 1867 (10–15 fms.).
Scrupocellaria cervicornis Busk, 1852 (0–18 fms.).
Canda caraibica Levinsen, 1909 (15 fms.).
**Canda retiformis* Pourtales, 1867 = Scrupocellaria.
**Membranipora membranacea* Linnaeus, 1766 (shallow water) = Nitscheina.
?*Membranipora lacroixii* Audouin, 1826 (8 fms.).
**Membranipora tehuelcha* D'Orbigny, 1839 (on gulf weed) = *Nitscheina tuberculata.*
**Membranipora irregularis* D'Orbigny, 1839 (8–22 fms.) = Alderina.
**Membranipora savartii* Audouin, 1826 (10 fms.) = *Acanthodesia savartii.*
**Cupularia guiniensis* Busk, 1854 (10 fms.) = *Cupuladria canariensis.*
**Cupularia lowei* Busk, 1854 (12–22 fms.) = *Cupularia umbellata.*
**Cribrilina floridana* Smitt, 1873 (5–15 fms.) = Puellina.
Arachnopusia monoceros Busk, 1854 (5 fms.).
**Smittipora abyssicola* Smitt, 1873 (15 fms.) = *Velumella americana*
**Steganoporella magnilabris* Busk 1854 (15 fms.).
Steganoporella connexa Harmer, 1900 (12 fms.).
Thalamoporella rozierii Audouin, 1826 (10 fms.).
Thalamoporella granulata Levinsen, 1909 (in drift).
Thalamoporella falcifera Hincks, 1880 (shallow water).
Savignyella lafontii Audouin, 1826 (0–10 fms.).
Hippothoa distans MacGillivray, 1868 (0–12 fms.).
**Trypostega venusta* Norman, 1864 (5–15 fms.).
**Adeona violacea* Johnston, 1874 (5–18 fms.) = *Adeona plagiopora.*
**Bracebridgia subsulcata* Smitt, 1873 (10–12 fms.).
**Retepora marsupiata* Smitt, 1873 (10–18 fms.).
Rhynchozoon tuberculatum Osburn, 1914 (18 fms.).
Rhynchozoon solidum Osburn, 1914 (8 fms.).
Arborella dichotoma Osburn, 1914 (10 fms.) = Pollaploecium.
**Tubucellaria cereoides* Solander, 1756 (15 fms.).
Escharella costifera Osburn, 1914 (2 fms.) = Peristomella.
Schizoporella biaperta Michelin, 1842 (0–22 fms.) = Schizopodrella (Stephanosella).
**Schizoporella floridana* Osburn, 1914 (15–18 fms.) = Schizopodrella.
Schizoporella sanguinea Norman, 1868 (15 fms.) = Schizobrachiella.
Schizoporella unicornis Johnston, 1847 (1–10 fms.) = Schizopodrella.
**Schizoporella spongites* Pallas, 1766 (0–18 fms.) = Stylopoma.
**Escharina pesanseris* Smitt, 1873 (8 fms.) = Mastigophora.
**Microporella ciliata* Pallas, 1766 (5–18 fms.).
**Smittina trispinosa* Johnston, 1838 (0–12 fms.).
Lepralia audouinii D'Orbigny, 1852 (0–10 fms.).
**Lepralia porcellana* Busk, 1860 (5–15 fms.) = *Hippoporina cleidostoma.*
Lepralia uvulifera Osburn, 1914 (10 fms.).
Lepralia cucullata Busk, 1854 (near surface) = Watersipora.
**Lepralia rostrigera* Smitt, 1873 (10–15 fms.) = Hippaliosina.
Lepralia contracta Waters var. *serrata* Osburn, 1914 (5–18 fms.).
**Lepralia edax* Busk, 1859 (18 fms.) = *Hippoporidra calcarea.*
**Lepralia janthina* Smitt, 1873 (6 fms.) = Hippotrema.

Phylactella labrosa Busk, 1854 (22 fms.).
Phylactella collaris Norman, var. *aviculifera* Osburn, 1914 (1–15 fms.).
**Cellepora dichotoma* Hincks, 1862 (10 fms)=Schismopora.
Cellepora verruculata Smitt, 1872 (0–15 fms.).
Lagenipora ignota Norman, 1909 (12 fms.)=Costazzia.
**Holoporella albirostris* Smitt, 1873 (0–15 fms.).
Holoporella pusilla Smitt, 1873 (low tide).
**Holoporella magnifica* Osburn, 1914 (10 fms.).
**Holoporella turrita* Smitt, 1873 (12–15 fms.).
**Petralia bisinuata* Smitt, 1873 (10–18 fms.)=Petraliella.
Bowerbankia gracilis Leidy, 1855 (shallow).
Zoobotryon pellucidum Ehrenberg, 1831 (shallow).
Cylindroecium giganteum Busk, 1865 (0–several fms.).
Anguinella palmata Van Beneden, 1844 (shallow).
Amathia goodei Verrill, 1901 (shallow).

D. 2004. Atlantic Ocean, east of Cape Hatteras; 37° 19′ 45″ N.; 74° 26′ 06″ W.; 102 fms.; green mud, shells; March 23, 1883:
Cellaria sinuosa Hassall, 1842.

D. 2117. Caribbean Sea; 15° 24′ 40″ N.; 63° 31′ 30″ W.; 683 fms.; yellow mud, fine sand; bottom temp. 39.7°; January 17, 1884:
Levinsenella brasiliensis Busk, 1884.
Retepora marsupiata Smitt, 1873.
Tessaradoma gracile Sars, 1850, var.

D. 2136. Caribbean Sea; 17° 43′ 40″ N.; 75° 38′ 25″ W.; 52 fms.; coral, broken shells; February 29, 1884:
Quadricellaria caraibica, new species.
Tremogasterina malleolus, new species.

D. 2152. 2.5 miles nw. of Habana Light; 387 fms.; coral; bottom temp. 49°; April 30, 1884:
Cribrilina lineata, new species.
Gemellipora (?) *limbata* Smitt, 1873.
Microporella ampla, new species.
Rectonychocella abyssicola Smitt, 1873.
Tremoschizodina lata Smitt, 1873.

D. 2157. Gulf of Mexico, off Habana; 23° 10′ 04″ N.; 82° 21′ 07″ W.; 29 fms.; April 30, 1884:
Gemelliporidra magniporosa Canu and Bassler, 1923.

D. 2160. Off Habana, Cuba; 23° 10′ 31″ N.; 82° 20′ 37″ W.; 167 fms.; coral; April 30, 1884:
Dacryonella typica, new species.
Holoporella tubulosa, new species.

D. 2167. Off Habana, Cuba; 23° 10′ 40″ N.; 82° 20′ 30″ W.; 201 fms.; coral; May 1, 1884:
Antropora pustulata, new species.
Buffonellaria divergens Smitt, 1873.
Callopora curvirostris Hincks, 1861.
Crepidacantha longiseta, new species.
Figularia (?) *ampla*, new species.
Gemelliporidra typica Canu and Bassler, 1927.
Hincksina periporosa, new species.
Hippoporina cleidostoma Smitt, 1873.
Marssonopora uncifera, new species.
Membraniporella petasus, new species.
Trypostega venusta Norman, 1864.

D. 2319. North of Cuba; 23° 10′ 37″ N.; 82° 20′ 06″ W.; 143 fms.; gray coral; January 17, 1885:

Adeona plagiopora Smitt, 1873.
Alderina irregularis Smitt, 1873.
Callopora caudata, new species.
Callopora curvirostris Hincks, 1861.
Dacryonella typica, new species.
Diplosolen obelium Johnston, 1848.
Gemelliporidra typica Canu and Bassler, 1927.
Gephyrotes spinosum, new species.
Hincksina periporosa, new species.
Hippaliosina rostrigera Smitt, 1873.
Holoporella turrita Smitt, 1873.
Holoporella tubulosa, new species.
Hornera galeata Smitt, 1872.
Lagenipora verrucosa, new species.
Lichenopora radiata Auduoin, 1826.
Marssonopora uncifera, new species.
Mastigophora pesanseris Smitt, 1873,
Membraniporella petasus, new species.
Membrendoecium strictorostris, new species.
Proboscina robusta, new species.
Stylopoma spongites Pallas, 1766.
Tremogasterina lanceolata, new species.
Velumella americana, new species.

Fowey Light, Atlantic, 15 mi. s. Miami, Fla.; 40 fms.; collected by J. B. Henderson, November, 1914:

Adeona plagiopora Smitt, 1873.
Bracebridgia subsulcata Smitt, 1873.
Cigclisula serrulata Smitt, 1873.
Cupuladria canariensis Busk, 1852.
Exechonella pumicosa, new species.
Floridina antiqua, Smitt, 1873.
Floridinella typica, new species.
Gemellipora glabra Smitt, 1873.
Hippoporina cleidostoma Smitt, 1873.
Hippoporidra calcarea Smitt, 1873.
Hippodiplosia aculeata, new species.
Holoporella turrita Smitt, 1873.
Holoporella vagans Busk, 1885.
Mamillopora cupula Smitt, 1873.
Mastigophora pesanseris Smitt, 1873.
Mastigophora porosa Smitt, 1873.
Microporella ciliata Linnaeus, 1759.
Puellina radiata Moll, 1803.
Schismopora dichotoma Hincks, 1864.
Siphonoporella granulosa, new species.
Smittina trispinosa spathulata Smitt, 1873.
Steganoporella magnilabris Busk, 1854.
Tremogasterina granulata, new species.
Tremoschizodina lata Smitt, 1873.
Tubucellaria cereoides Ellis and Solander, 1786
Velumella americana, new species.

D. 2169. Off Habana, Cuba; 23° 10′ 28″ N.; 82° 20′ 27″ W.; 78 fms.; coral; May 1, 1884:
- *Acanthocella clypeata*, new species.
- *Aplousina tuberosa*, new species.
- *Crepidacantha longiseta*, new species.
- *Gemelliporidra magniporosa* Canu and Bassler, 1923.
- *Puellina radiata* Moll, 1803.

D. 2317. North of Cuba; 24° 25′ 45″ N.; 81° 46′ 45″ W.; 45 fms.; coral; 75° bottom temp.; June 15, 1885:
- *Aplousina tuberosa*, new species.
- *Crisia denticulata* Lamarck, 1812.
- *Hippothoa eburnea* Smitt, 1873.

D. 2320. North of Cuba; 23° 10′ 39″ N.; 82° 18′ 48″ W.; 130 fms.; fine coral; January 17, 1885:
- *Buffonellaria divergens* Smitt, 1873.
- *Dacryonella typica*, new species.
- *Gemellipora* (?) *limbata* Smitt, 1873.
- *Hippotrema janthina* Smitt, 1873.
- *Lagenipora verrucosa*, new species.
- *Lichenopora buski* Harmer, 1915.
- *Puellina innominata* Couch, 1844.
- *Stylopoma spongites* Pallas, 1766.
- *Tremogasterina lanceolata*, new species.

D. 2321. North of Cuba; 23° 10′ 54″ N.; 82° 18′ 00″ W.; 230 fms.; fine gray sand; January 17, 1885:
- *Antropora pustulata*, new species.
- *Diplosolen obelium* Johnston, 1848.

D. 2322. North of Cuba; 23° 10′ 54″ N.; 82° 17′ 45″ W.; 115 fms.; coral; January 17, 1885:
- *Gemelliporella asper* Canu and Bassler, 1923.
- *Velumella americana*, new species.

D. 2324. North of Cuba; 23° 10′ 25″ N.; 82° 20′ 24″ W.; 33 fms.; coral; bottom temp. 79.1°; January 17, 1885:
- *Adeona plagiopora* Smitt, 1873.
- *Lagenipora verrucosa*, new species.
- *Steganoporella magnilabris* Busk, 1854.

D. 2327. North of Cuba; 23° 11′ 45″ N.; 82° 17′ 54″ W.; 182 fms.; fine brown sand; January 17, 1885:
- *Steganoporella magnilabris* Busk, 1854.

D. 2330. North of Cuba; 23° 10′ 48″ N.; 82° 19′ 15″ W.; 121 fms.; fine gray coral; January 17, 1885:
- *Gemelliporidra typica* Canu and Bassler, 1927.

D. 2331. North of Cuba; 23° 10′ 31″ N.; 82° 19′ 55″ W.; 114 fms.; coral; January 17, 1885:
- *Pasythea eburnea* Smitt, 1873.

D. 2334. North of Cuba; 23° 10′ 42″ N.; 82° 18′ 24″ W.; 67 fms.; white coral; January 19, 1885:
- *Crepidacantha longiseta*, new species.
- *Lichenopora radiata* Audouin, 1826.
- *Trypostega venusta* Norman, 1864.

D. 2339. North of Cuba; 23° 10′ 40″ N.; 82° 20′ 15″ W.; 191 fms:
- *Smittina labellum*, new species.

D. 2343. North of Cuba; 23° 11′ 35″ N.; 82° 19′ 25″ W.; 279 fms.; fine coral; January 19, 1885:

Bryocryptella reticulata, new species.

D. 2354. East of Yucatan; 20° 59′ 30″ N.; 86° 23′ 45″ W.; 130 fms.; coral; January 22, 1885:

Dendrobeania lamellosa, new species.
Reteporella prominens, new species.

D. 2362. East of Yucatan; 22° 08′ 30″ N.; 86° 53′ 30″ W.; 25 fms.; coarse sand; January 30, 1885:

Gemelliporidra magniporosa Canu and Bassler, 1923.
Hippothoa eburnea Smitt, 1873.
Hippodiplosia pertusa Esper, 1794.
Holoporella subalba, new species.
Petraliella bisinuata Smitt, 1873.
Smittina trispinosa spathulata Smitt, 1873.

D. 2363. East of Yucatan; 22° 07′ 30″ N.; 87° 06′ 00″ W.; 21 fms.; coral; January 30, 1885:

Hippoporidra edax Busk, 1859.
Holoporella magnifica Osburn, 1914.
Holoporella subalba, new species.
Metrarabdotos unguiculatum, new species.
Petraliella bisinuata Smitt, 1873.
Schizopodrella floridana Osburn, 1914.

D. 2365. East of Yucatan; 22° 18′ 00″ N.; 87° 04′ 00″ W.; 24 fms.; coral; January 30, 1885:

Aplousina tuberosa, new species.
Callopora tenuirostris Hincks, 1880.
Hippoporina cleidostoma Smitt, 1873.
Holoporella subalba, new species.
Holoporella turrita Smitt, 1873.
Schizopodrella falcifera, new species.
Smittina trispinosa spathulata Smitt, 1873.
Steganoporella magnilabris Busk, 1854.

D. 2366. Gulf of Mexico, off Yucatan; 43 fms.; fine white coral; January 30, 1885:

Petraliella marginata, new species.

D. 2373. Gulf of Mexico, northern part; 29° 14′ 00″ N.; 85° 29′ 15″ W.; 25 fms.; coral; February 7, 1885:

Acanthocella clypeata, new species.

D. 2387.[5] Gulf of Mexico, northern part; 29° 24′ 00″ N.; 88° 04′ 00″ W.; 32 fms; sand, gravel, broken shells; March 4, 1885:

Cystisella americana, new species.
Hippoporidra calcarea Smitt 1873.

D. 2388. Gulf of Mexico, northern part; 29° 24′ 30″ N.; 88° 01′ 00″ W.; 35 fms.; yellow sand, black specks; March 4, 1885:

Cellaria nodosa, new name.

D. 2389. Gulf of Mexico, northern part; 29° 28′ 00″ N.; 87° 56′ 00″ W.; 27 fms.; gray sand, broken shells; March 4, 1885:

Acanthodesia savarti Savigny-Audouin, 1826.
Mucronella egyptiaca Waters, 1909.

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[5] Studies of material from stations D. 2387, D. 2388, and D. 2389 discovered since the completion of this work show the presence of many more species than those here listed.

D. 2392. Gulf of Mexico, northern part; 28° 47′ 30″ N.; 87° 27′ 00″ W.; 724 fms.; brown gray mud, bottom temp. 40.7°; March 13, 1885:

Bugula avicularia Linnaeus, 1758.
Semihaswellia sinuosa, new species.

D. 2404. Gulf of Mexico, west of Florida; 28° 44′ 00″ N.; 85° 38′ 25″ W.; 60 fms.; gray sand; March 15, 1885:

Tremogasterina malleolus, new species.

D. 2407. Gulf of Mexico, west of Florida; 28° 47′ 30″ N.; 84° 37′ 00″ W.; 24 fms.; coral, broken shells; March 15, 1885:

Nellia oculata Busk, 1852.

D. 2411. Gulf of Mexico, west of Florida; 26° 33′ 30″ N.; 83° 15′ 30″ W.; 27 fms.; fine white sand, black specks; March 18, 1885:

Mamillopora cupula Smitt, 1873.
Retepora marsupiata Smitt, 1872.

D. 2405. Gulf of Mexico, west of Florida; 28° 45′ N.; 85° 02′ W.; 30 fms; gray sand; March 15, 1885:

Adeona plagiopora Smitt, 1873.
Aetea truncata Landsborough, 1852.
Acanthodesia savarti Savigny-Audouin, 1826.
Alderina irregularis Smitt, 1873.
Aplousina gigantea Canu and Bassler, 1927.
Aplousina tuberosa, new species.
Bracebridgia subsulcata Smitt, 1873.
Buffonellaria reticulata, new species.
Callopora tenuirostris Hincks, 1880.
Canda retiformis Pourtales, 1867.
Cauloramphus opertus, new species.
Chaperia galeata Busk, 1852.
Crisia denticulata Lamarck, 1812.
Crisia elongata Milne Edwards, 1838.
Cupuladria canariensis Busk, 1852.
Diaperoecia radicata Kirkpatrick, 1888.
Domopora floridina, new species.
Fenestrulina malusi Savigny-Audouin, 1826.
Floridina antiqua Smitt, 1873.
Gemellipora glabra Smitt, 1873.
Halophila johnstoniae Gray, 1843.
Hippaliosina rostrigera Smitt, 1873.
Hincksina periporosa, new species.
Hippomenella rubra, new species.
Hippoporina cleidostoma Smitt, 1873.
Hippothoa eburnea Smitt, 1873.
Holoporella albirostris Smitt, 1873.
Holoporella magnifica Osburn, 1914.
Mamillopora cupula Smitt, 1873.
Mastigophora porosa Smitt, 1873.
Mecynoecia deflexa Smitt, 1873.
Metrarabdotos unguiculatum, new species.
Micropora coriacea Esper, 1791.
Microporella ciliata Linnaeus, 1759.
Mollia patellaria Smitt, 1873.
Nellia oculata Busk, 1852.
Petraliella marginata, new species.

Puellina floridana Smitt, 1873.
Puellina innominata, Couch, 1844.
Schizopodrella incrassata, new species.
Siphonoporella dumonti, new species.
Siphonoporella granulosa, new species.
Steganoporella magnilabris Busk, 1854.
Stenopsis fenestrata Smitt, 1873.
Stylopoma spongites Pallas, 1766.
Tremoschizodina lata Smitt, 1873.
Trypostega venusta Norman, 1864.
Vellumella americana, new species.

D. 2413. Gulf of Mexico, southwest of Florida; 26° 00′ 00″ N.; 82° 57′ 30″ W.; 24 fms.; fine sand, black specks; broken shells; March 19, 1885:
Bugula (Stirparia) caraibica Levinsen, 1909.

D. 2414. Gulf of Mexico, southwest of Florida; 25° 04′ 30″ N.; 82° 59′ 15″ W.; 26 fms.; fine white sand, broken shells; March 19, 1885:
Petraliella bisinuata Smitt, 1873.
Petraliella marginata, new species.

D. 2415. Atlantic, east of Florida; 30° 44′ 00″ N.; 79° 26′ 00″ W.; 440 fms.:
Holoporella tubulosa, new species.

D. 2619. Western Atlantic; 33° 38′ N.; 77° 36′ W.; 15 fms.; coarse yellow sand and broken shells; October 20, 1885:
Hemiseptella hexagonalis, new species.

D. 2640. Straits of Florida; 25° 05′ 00″ N.; 80° 15′ 00″ W.; 56 fms.; coral sand; April 9, 1886:
Hippoporidra calcarea Smitt, 1873.

D. 2647. Straits of Florida; 25° 48′ 00″ N.; 80° 04′ 00″ W.; 85 fms.; gray sand, foraminifera; April 9, 1886:
Nitscheina tuberculata Bosc, 1802.

D. 2650. Bahama Islands; 23° 34′ 30″ N.; 76° 34′ 00″ W.; 369 fms.; coarse white sand; bottom temp. 57.8°; April 12, 1886:
Palmicellaria aviculifera, new species.
Puellina radiata Moll, 1803.

D. 2672. Atlantic, east of Georgia; 31° 31′ N.; 79° 5′ W.; 277 fms.; coarse brown sand; bottom temp. 54.3°; May 5, 1886:
Aetea sica Couch, 1844.
Hippothoa eburnea Smitt, 1872.
Puellina innominata Couch, 1844.
Tremogasterina ventricosa, new species.

D. 2639. Straits of Florida; 25° 04′ 50″ N.; 80° 15′ 10″ W.; 56 fms.; coarse sand; April 9, 1886:
Adeona plagiopora Smitt, 1873.
Alderina irregularis Smitt, 1873.
Aplousina gigantea Canu and Bassler, 1927.
Aplousina tuberosa, new species.
Callopora pumicosa, new species.
Callopora tenuirostris Hincks, 1880.
Canda retiformis Pourtales, 1867.
Cigclisula serrulata Smitt, 1873.
Crepidacantha setigera Smitt, 1873.
Cupuladria canariensis Busk, 1852.
Cupularia doma D'Orbigny, 1852.
Diaperoecia radicata Kirkpatrick, 1888.

Floridina antiqua Smitt, 1873.
Floridinella parvula, new species.
Floridinella typica, new species.
Gemellipora glabra Smitt, 1873.
Gephyrotes spinosum, new species.
Hincksina periporosa, new species.
Hippoporina cleidostoma Smitt, 1873.
Holoporella albirostris Smitt, 1873.
Holoporella vagans Busk, 1885.
Lagenipora verrucosa, new species.
Lepralia palliolata, new species.
Mamillopora cupula Smitt, 1873.
Mastigophora pesanseris Smitt, 1873.
Mastigophora porosa Smitt, 1873.
Mecynoecia deflexa Smitt, 1872.
Metrarabdotos unguiculatum, new species.
Microporella ciliata Linnaeus, 1759.
Micropora coriacea Esper, 1891.
Oncousoecia arcuata, new species.
Peristomoecia floridana, new species.
Plagioecia dispar, new species.
Puellina innominata, Couch, 1844.
Schismopora dichotoma Hincks, 1864.
Schizopodrella incrassata, new species.
Siphonoporella granulosa, new species.
Smittina trispinosa spathulata Smitt, 1873.
Steganoporella magnilabris Busk, 1854.
Tremogasterina granulata, new species.
Tremoschizodina lata Smitt, 1873.
Trypostega venusta Norman, 1864.

D. 2662. Western Atlantic; 29° 24′ 30″ N.; 79° 43′ W.; 434 fms.; gray sand and broken shells; March 4, 1886:
Cellepora minutiporosa, new species.

D. 2782. Off Chili, South America; 51° 12′ 00″ S.; 74° 13′ 30″ W.; 258 fms.; bottom temp. 47.9°; February 6, 1888:
Nitscheina membranacea Linnaeus, 1766.

Cedar Keys, West Coast of Florida (Levy County):
Hippadenella floridana, new species.
Rhamphostomella magnirostris, new species.
Umbonula undulata, new species.

Egmont Key, Florida, at entrance to Tampa Bay:
Crisulipora orientalis, new species.
Diaperoecia radicata Kirkpatrick, 1888.
Mecynoecia deflexa Smitt, 1872.

PLIOCENE BRYOZOA OF PANAMA

The great antiquity of the Gulf fauna is exemplified in the fossil bryozoa from Bocas Island, Panama, the study of which is incorporated in the present work. This collection, originally submitted to us for age determination, proved upon detailed study to contain so many recent species that we pronounced these fossils as Pleistocene. We are informed by the collector, A. A. Olsson, that the rocks yielding the collection are all involved in the folding and structure of Bocas Island and that they can not be younger than Pliocene. It is, therefore, possible that in spite of their very recent aspect these fossils may be of still greater age than Pliocene. The list of this fauna follows, species still living in the Gulf of Mexico being marked with an asterisk.

PLIOCENE; MINNITIMMI CREEK, BOCAS ISLAND, ALMIRANTE BAY, PANAMA

Aetea truncata Lansborough, 1852.
Alderina irregularis Smitt, 1873.
Alderina pyriformis, new species.
Callopora curvirostris Hincks, 1861.
Cellaria nodosa, new name.
Coleopora granulosa, new species.
Crepidacantha poissoni Savigny-Audouin, 1826
Crisia elongata Milne-Edwards, 1838.
Cupuladria canariensis Busk, 1852.
Dacryonella typica, new species.
Entalophora proboscideoides Smitt, 1872.
Gemelliporidra multilamellosa Canu and Bassler, 1923.
Hippoporina cleidostoma Smitt, 1873.
Hippopodina feegensis Busk, 1880.
Hippodiplosia pertusa Esper, 1794.
Holoporella vagans Busk, 1885.
Idmonea atlantica Forbes, 1847.
Lepralia fissurata, new species.
Lichenopora buskiana, new name.
Mastigophora pesanseris Smitt, 1873.
Microporella normani, new name.
Nellia oculata Busk, 1852.
Petraliella bisinuata Smitt, 1873.
Petraliella bisinuata grandis, new variety.
Plagioecia sarniensis Norman, 1864.
Puellina radiata Moll, 1823.
Rhynchozoon corniger, new species.
Schismopora dichotoma Hincks, 1869.
Scrupocellaria retiformis Pourtales, 1867.
Schizopodrella isabelleana Smitt, 1873.
Siphonoporella granulosa, new species.
Smittina trispinosa spathulata Smitt, 1873.
Steganoporella brevis, new species.
Steganoporella magnilabris Busk, 1854.
Stylopoma spongites Pallas, 1766.
Tremopora radicifera Hincks, 1869.
Tremogasterina granulata, new species.
Tremogasterina malleolus, new species.
Tremogasterina sparsiporosa, new species.
Tremoschizodina anatina, new species.
Tubucellaria cereoides Ellis and Solander, 1786.
Vibracellina laxibasis, new species.

SYSTEMATIC DESCRIPTIONS

Order CHEILOSTOMATA Busk

Suborder ANASCA Levinsen

Division MALACOSTEGA Levinsen, 1909

Family BIFLUSTRIDAE Smitt, 1872

Membraniporae without ovicells. The zooecia are rectangular (seen on their dorsal face). No spines.

In this family we classify all the genera of the first group of Membraniporae as we divided them in 1920 (p. 85).

History.—*Biflustra* is a zoarial genus established by D'Orbigny, 1852, and classed in his family of Flustrellariidae. It embraced all of the bilamellar Membranipores. Three recent species were classed here—the first and the third are of the *Savartii* group (Waters, 1905) and the second is one of the Costulae. Busk, 1859, classed *Biflustra* in the Escharidae; he introduced here *Biflustra delicatula*, which we know to be a synonym of *Flustra savartii* Savigny-Audouin, 1826.

Smitt, 1872, formed the family of Biflustridae for the reception of the genus *Biflustra*. "The quadrangular shape of the zooecia, as well as their strong, usually high, and hardly calcified and granular margins, in most cases will make the biflustridan type recognizable." He cites three species: *Flustra lacroixii* Savigny-Audouin, 1826, although under this name he figures *Callopora filum* Jullien, 1902; *Biflustra denticulata*, which is of very different structure (*Hemiseptella*); and *Flustra savartii* Savigny-Audouin, 1826.

As *Biflustra* has had no definite standing and as the paleontologists have described under that name a great number of species of very different structure, we created in 1917 the genus *Acanthodesia* for *Flustra savartii* in order to avoid all confusion. *Biflustra* is retained for narrow bifoliate Membranipores of doubtful affinities, but we can maintain Smitt's name for the family. In the absence of known larvae, we can not say if this family is a natural one.

Genus ACANTHODESIA Canu and Bassler, 1920

ACANTHODESIA SAVARTI Savigny-Audouin, 1826

Plate 1, Figures 5, 6; text Figure 1.

1920. *Acanthodesia savarti* CANU and BASSLER, North American Early Tertiary Bryozoa. Bull. 106, U. S. National Museum, p. 100, pl. 21, figs. 2–4. (Bibliography and distribution.)

1923. *Acanthodesia savarti* CANU and BASSLER, North American Later Tertiary and Quaternary Bryozoa. Bull. 125, U. S. National Museum, p. 31. (Study of the varieties.)

Our specimens are bilamellar with undulated and twisted fronds. The serrate denticle is rare and there are no spicules. The opercular valve is thin, broad, transverse, in conformity with our drawings of specimens from the Philippines. In longitudinal sections there are two multiporous septulae. In transverse sections the zooecial walls are thick and have two large multiporous septulae.

Biology.—Our specimens were uncolored, but in the Philippine material we have found some of a brown-violet color. This is a species of shallow water (10 to 50 meters) generally.

Occurrence.—*Albatross* Station D. 2405, Gulf o Mexico; 28° 45′ 00″ N.; 85° 02′ 00″ W.; 30 fms.; gray sand, broken coral.

Albatross Station D. 2380, Gulf of Mexico; 29° 28′ 00″ N.; 87° 56′ 00″ W.; 27 fms.; gray sand, broken shells.

Tortugas, 16 meters (Osburn, 1914); Florida, 47 meters (Smitt).

Plesiotype.—Cat. No. 7445, U.S.N.M.

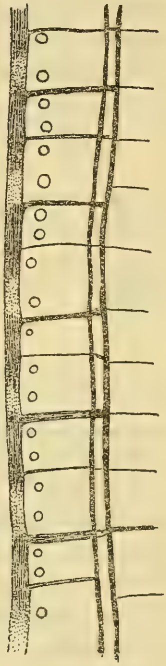

FIG. 1.—ACANTHODESIA SAVARTI SAVIGNY AUDOUIN, 1826. LONGITUDINAL SECTION, × 85, EXHIBITING THE TWO LATERAL SEPTULAE

Genus CUPULADRIA Canu and Bassler, 1920

CUPULADRIA CANARIENSIS Busk, 1852

Plate 1, Figures 7–9; text Figure 2

1914. *Cupularia guineensis* OSBURN, The Bryozoa of the Tortugas Islands, Florida. Publication Carnegie Institution, Washington, No. 182, p. 194 (American bibliography).

1919. *Cupuladria canariensis* CANU and BASSLER, Geology and Paleontology of the West Indies, Bryozoa. Publication Carnegie Institution, Washington, No. 291, p. 78, pl. 1, figs. 8–10. (Bibliography and geologic distribution.)

1923. *Cupuladria canariensis* CANU and BASSLER, North American Later Tertiary and Quaternary Bryozoa. Bull. 125, U. S. National Museum, p. 28, pl. 1, figs. 7–9.

Some hundreds of specimens, recent and fossil, have been examined and studied by us, and we find it still impossible to see any difference between *Cupuladria canariensis* and *Cupuladria guineensis* Busk, 1852.

The colonies are generally cupuliform, but some are conical; their diameter is quite variable. Each polygonal prism of the interior face is rectangular and is perforated by six rectangular pores. The latter are frequently four in number and sometimes only two; these variations can be observed on the same specimen.

The opercular valve is somewhat higher than broad and little thickened. The seta of the vibraculum is falciform. When the ectocyst covers the interior face, the large pores appear by transparency much smaller and circular. This deceiving aspect enables one to suppose the existence of two species. The vibraculum belongs to the proximal zooecium.

Biology.—The calcite of our living specimens is white but their ectocyst is light colored. The color of Osburn's specimens is "horn brown, due mainly to the chitinous bristles which form the mandible (seta) of the vibracula." Our specimens, like those of Osburn, are always free. The following observation of Osburn is very important: "When touched the bristles stand erect for some time." It confirms our views on the physiologic functions of the vibracula and of the setiform avicularia. These are organs of relation either with the surrounding medium or between the cells themselves.

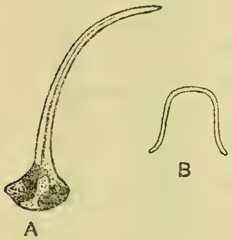

FIG. 2.—CUPULADRIA CANARIENSIS BUSK, 1852. *A*. VIBRACULUM, × 85, ILLUSTRATING ARTICULATION. *B*. OPERCULAR VALVE AND APERTURAL SCLERITE, × 85

This is an equatorial species which in the Mediterranean does not extend beyond the thirty-eighth parallel. Its presence in the Gulf of California indicates an old passageway between the Atlantic and the Pacific.

C. canariensis is one of the rare species characteristic of the abyssal deeps. The mobility of the colony is occasioned by the presence of numerous vibracula which permits them to escape being covered with mud. The bathymetric dispersion is very great, for it has been dredged on the sands of little depth at the Canary Islands.

The reader will find a detailed study of the genus *Cupuladria* in our volume on the Philippine bryozoa.

Occurrence.—*Albatross* Station D. 2405, Gulf of Mexico, 28° 45′ 00″ N.; 85° 02′ 00″ W.; 30 fms.; gray sand, broken coral.

Albatross Station D. 2639, Straits of Florida, 25° 04′ 50″ N.; 80° 15′ 10″ W.; 56 fms.; coral sand.

Atlantic, Fowey Light, 15 miles south of Miami, Fla.; 40 fms.

Tortugas, 16 meters (Osburn); Florida, 16–21 meters (Smitt).

Pliocene: Minnitimmi Creek, Bocas Island, Almirante Bay, Panama.

Plesiotypes.—Cat. No. 7829, U.S.N.M.

Genus QUADRICELLARIA D'Orbigny, 1851

The zoarium is articulated by segments. The zooecia are membraniporoid and arranged on four faces (of which two are narrower) placed back to back. No ovicell.

Genotype.—*Quadricellaria elegans* D'Orbigny, 1851. *Quadricellaria caraibica,* new species here described, may be considered as a recent genotype.

Range.—Cretaceous (Turonian), Recent.

Affinities.—The discovery in the present seas of this old genus is very important; it shows the great vitality of the genera of the group Ascophora or of the Flustrines as the old authors wrote it. Originating as far back as the Cretaceous, they persist still in the equatorial zone of the recent seas. Jullien, 1881, classed most of the Cretaceous species of *Quadricellaria* in his genus *Smittipora* but D'Orbigny's name has priority.

The number of specimens obtained is not large enough for us to affirm definitely the absence of ovicells. While waiting more information, it appears best to introduce this genus into the group of Membraniporae without ovicell.

QUADRICELLARIA CARAIBICA, new species

Plate 2, Figures 1–3

Description.—The zoarium is bushy, radicelled, formed of numerous articulated, dichotomous branches; the segments are rectangular and formed of four longitudinal series of zooecia arranged back to back and of which two are wider. The zooecia are distinct, very long, subrectangular with a convex distal border; the mural rim is thin and little salient, complete. The opesium is semielliptical, very elongated, with a straight proximal border; the cryptocyst is shallow, flat, smooth, longer than the opesium. The opercular valve is small, entirely adjacent to the mural rim.

Measurements.—Large opesia $\begin{cases} ho = 0.20 \text{ mm.} \\ lo = 0.10 \text{ mm.} \end{cases}$

Large zooecia $\begin{cases} Lz = 0.60 \text{ mm.} \\ lz = 0.30 \text{ mm.} \end{cases}$

Structure.—The zooecium which terminates a segment and which bears the two new branches is very convex in its distal portion, which gives it the aspect of a false ovicell. The ectocyst covers all the zooecium and is terminated by the opercular valve, which is the constant structure in the Membraniporae. The cryptocyst is inclined toward the opesium, so that the mural rim enlarges into two small lateral facettes. All of our segments came from the same colony, which was without ovicells.

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This species corresponds rigorously to the genus *Quadricellaria* D'Orbigny, 1851. All the Cretaceous species, except one, described by this author have this structure. This discovery shows again that the study of the equatorial bryozoa is indispensable to the paleontologist.

Biology.—The ectocyst is not pigmented; its natural tint is light colored. We have observed some zooecia closed by a calcareous lamella perforated at the center. The collection of numerous specimens is necessary to study the complete structure of this important species.

Occurrence.—*Albatross* Station D. 2136, Caribbean Sea; 17° 43′ 40″ N.; 75° 38′ 25″ W.; 52 fms.; coral, broken shells.

Cotypes.—Cat. No. 7574, U.S.N.M.

Family ELECTRINIDAE D'Orbigny, 1851

Genus NITSCHEINA Canu, 1900

Harmer ("Siboga," 1926) adopts *Nichtina* (*Nitscheina*) Canu, 1900, for the *M. membranacea* group in place of *Membranipora* which he retains for unplaced members of the Membraniporae. Although we have previously employed *Membranipora* as a valid genus, we now follow this eminent authority.

NITSCHEINA MEMBRANACEA Linnaeus, 1766

Plate 1, Figure 4

1914. *Membranipora membranacea* Osburn, Bryozoa from the Tortugas Islands, Florida. Publication Carnegie Institution, Washington. No. 182, p. 193 (American bibliography).

This is an almost universal species and has been noted in the Temperate Zones of both hemispheres. Observed in California and in Alaska by Miss Robertson and recorded by Osburn at the Tortugas. It was unknown in South America until the *Albatross* dredged very beautiful specimens off Chili.

The species differs from *Nitscheina* (*Membranipora*) *tuberculata* Bosc, 1802 (=*Membranipora tehuelca* D'Orbigny, 1839), in its small tubercles which are vertical (not oblique) and never united together.

Occurrence.—*Albatross* Station D. 2782, off Chili, South America; 51° 12′ 00″ S.; 74° 13′ 30″ W.; 258 fms.; blue mud.

Plesiotype.—Cat. No. 7548, U.S.N.M.

NITSCHEINA TUBERCULATA Bosc, 1802

1914. *Membranipora tehuelca* Osburn, The Bryozoa of the Tortugas Islands, Florida. Publication Carnegie Institution, Washington. No. 182, p. 193. (American bibliography.)

1921. *Membranipora tehuelca* Robertson, Bryozoa from the Bay of Bengal. Records of the Indian Museum, vol. 22, p. 47.

1922. *Membranipora tuberculata* MARCUS, Südafrikanische Bryozoen aus der Sammlung des Gothenburger Museum. Küngl Vetenskaps och Vitterhets Samhalles Handlingar, vol. 25, p. 15, fig. 8.
1923. *Membranipora tuberculata* CANU and BASSLER, North American Later Tertiary and Quaternary Bryozoa. Bull. 125, U. S. National Museum, p. 22, pl. 33, figs. 3–5. (Bibliography and distribution.)

Marcus has erroneously placed in the synonymy of this species *Biflustra denticulata* Smitt, 1872, which is quite a different species belonging to the genus *Hemiseptella.*

The present species is very fragile and in drying, the zooecia become greatly deformed. The development of tubercles is very irregular even on the same specimen, as is apparent in one of our figures of 1923.

Biology.—It was believed formerly that this species was confined to the American Continent but the discoveries of Marcus showed that it had traveled around Africa and had extended into the Indian Ocean, where Miss Robertson noted it, and also into the western Pacific, where we have observed it in the Philippines. This is then a universal species, quite cosmopolitan, transported on algae by the great marine currents. In the Northern Hemisphere it does not pass beyond the fiftieth parallel.

Occurrence.—*Albatross* Station D. 2647. Straits of Florida, 25° 48′ 00″ N.; 80° 04′ 00″ W.; 85 fms.; gray sand, foraminifera.

Atlantic: Straits of Florida; Tortugas (Osburn); Bermuda (Verrill).

Geographic distribution.—Pleistocene of California. South Africa (Marcus); Philippines.

Cat. No. 7549, U.S.N.M.

Family FLUSTRIDAE Smitt, 1867

Genus FLUSTRA Linnaeus, 1761

FLUSTRA (CARBASEA) CAPITATA, new species

Plate 28, Figures 4, 5

Description.—The zoarium is free, unilamellar, formed of narrow fronds with five longitudinal series of zooecia. The zooecia are distinct, separated by a common salient thread, elongated, somewhat lozenge-shaped. The mural rim is thin and the opesium entire. The opercular valve is adjacent to the mural rim and its border is much chitinized. The ovicell is very large, endozooecial, very convex; the ectooecium is incompletely calcified and leaves a circular area on which an avicularium is sometimes placed. The avicularium is distal, oblique, always adjacent to the mural rim; the beak is oriented toward the aperture; the mandible is semicircular.

Measurements.—Opercular valve: $lo = 0.30$ mm.

Zooecium $\begin{cases} Lz = 0.90\text{–}1.00 \text{ mm.} \\ lz = 0.35\text{–}0.40 \text{ mm.} \end{cases}$

Affinities.—The ovicelled zooecia have the larger dimensions; the mural rim bears a pair of spines. This species is well characterized by its large ovicell.

Occurrence.—*Albatross* Station D. 2750, off Chili, South America; 18° 30′ N.; 63° 31′ W.; 496 fms.; fine gray sand.

Cotypes.—Cat. No. 7499, U.S.N.M.

Family HINCKSINIDAE Canu and Bassler, 1927

Genus APLOUSINA Canu and Bassler, 1927

Membraniporae with endozooecial ovicell; no spines, no avicularium, and no dietellae.

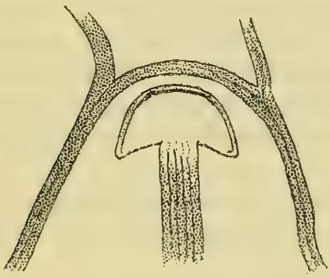

FIG. 3.—APLOUSINA GIGANTEA CANU AND BASSLER, 1927 DIAGRAMMATIC DRAWING OF A ZOOECIUM, × 85, SHOWING THE TENTACULAR SHEATH ATTACHED TO THE OPERCULAR VALVE. THIS IS FIXED TO AN EXTERIOR THICKENING OF THE ECTOCYST

Genotype.—*Aplousina gigantea* Canu and Bassler, 1927.

Range.—Miocene—Recent.

APLOUSINA GIGANTEA Canu and Bassler, 1927

Plate 2, Figure 6, text Figure 3

1927. *Aplousina gigantea* CANU and BASSLER, Classification Cheilostomatous Bryozoa. Proc. U. S. Nat. Mus., vol. 69, p. 3, pl. 1, fig. 1.

Description. The zoarium encrusts shells. The zooecia are very large, lozenge-shaped, not separated from each other; the mural rim is very thin, filiform. The opercular valve is large, transverse, semilliptical and removed from the distal border of the zooecium. The ovicell is very small, transverse, little salient, ornamented with a small frontal callosity.

Measurements.—Opercular valve $\begin{cases} ho = 0.12 \text{ mm.} \\ lo = 0.18 \text{ mm.} \end{cases}$

Zooecia $\begin{cases} Lz = 0.84\text{–}0.90 \text{ mm.} \\ lz = 0.60\text{–}0.64 \text{ mm.} \end{cases}$

Structure.—The tentacular sheath is attached to the sclerite which borders the opercular valve. The length of the tentacles is half that of the zooecia. The parietal muscles are numerous. This species is larger than the Miocene species, *A.* (*Membrendvecium*) *grandis*, Canu and Bassler, 1923.

Biology.—We have observed this beautiful species only on the coast of Florida, where it appears abundant. It was in reproduction March 15, 1885, and April 9, 1886. Its large dimensions, the tenuity of its tentacles, and the absence of avicularia indicate that it lived especially in localities where a marine current incessantly renewed the plancton.

Occurrence.—*Albatross* Station D. 2405, Gulf of Mexico; 28° 45′ 00″ N.; 85° 02′ 00″ W.; 30 fms.; gray sand, broken coral,

Albatross Station D. 2639, Straits of Florida; 25° 04′ 50″ N.; 80° 15′ 10″ W.; 56 fms.; coral sand.

Holotype.—Cat. No. 7452, U.S.N.M.

APLOUSINA TUBEROSA, new species.

Plate 2, Figures 4, 5

Description.—The zoarium encrusts shells, serpulae and especially *Steganoporella magnilabris.* The zooecia are large, distinct, separated by a furrow, elliptical; the proximal gymnocyst is very small; the mural rim is very thin, flat, granulated, with smooth termen. The opesium is very large and of the form of the zooecia. The ovicell is very small, transverse, little convex, always accompanied by two lateral tuberosities.

Measurements.—Opesia $\begin{cases} ho = 0.50 \text{ mm.} \\ lo = 0.32 \text{ mm.} \end{cases}$

Zooecia $\begin{cases} Lz = 0.60 \text{ mm.} \\ lz = 0.40 \text{ mm.} \end{cases}$

Variations.—The micrometric measurements vary from single to double even on the same specimen. The zooecia which begin a series are deformed and oval.

Affinities.—This species differs from *Callopora filum* Jullien, 1903, in its endozooecial ovicell, in its mural rim enlarged at the base and in which the termen is smooth.

Biology.—This is a magnificent species of the shelly bottoms. It was in reproduction (ovicelled) May 1, 1884, and March 15, 1885. The colony and the ectocyst are light colored like the substratum. It lived as a true parasite on *Steganoporella magnilabris;* the movement of the gigantic opercula of this species does not trouble it and it even impedes them by its rapid development.

We have observed several cases of total regeneration. The species did not cross the Tropics and did not penetrate into the Caribbean Sea. However, we can consider as tropical all the Gulf of Mexico faunas because of the special location of the Gulf.

Occurrence.—*Albatross* Station D. 2169, off Habana, Cuba; 23° 10′ 28″ N.; 82° 20′ 27″ W.; 78 fms.; coral.

Albatross Station D. 2317, north of Cuba; 24° 25′ 45″ N.; 81° 46′ 45″ W.; 45 fms.; coral.

Albatross Station D. 2365, east of Yucatan; 22° 18′ 00″ N.; 87° 04′ 00″ W.; 24 fms.; white rock, coral.

Albatross Station D. 2405, Gulf of Mexico; 28° 45′ 00″ N.; 85° 02′ 00″ W.; 30 fms.; gray sand, broken coral.

Albatross Station D. 2639, Straits of Florida; 25° 04′ 50″ N.; 80° 15′ 10″ W.; 56 fms.; coral sand.

Cotypes.—Cat. Nos. 7453, 7454, U.S.N.M.

Genus HINCKSINA Norman, 1903

HINCKSINA PERIPOROSA, new species

Plate 2, Figures 8–11

Description.—The zoarium encrusts bryozoa, corals, nullipores, hydroids, and shells. The zooecia are distinct, separated by a deep furrow, *surrounded* by a line of interjunctural *pores*, oval; the gymnocyst is small, convex; the mural rim is very thin and bears 16–18 spicules. The opesium has the form of the zooecium. The ovicell is very small, a little convex, transverse. There are pyriform zooeciules between the zooecia; their appearance is sporadic.

Measurements.—Opesium $\begin{cases} ho = 0.45 \text{ mm.} \\ lo = 0.20\text{–}0.25 \text{ mm.} \end{cases}$

Zooecia $\begin{cases} Lz = 0.60\text{–}0.65 \text{ mm.} \\ lz = 0.30\text{–}0.32 \text{ mm.} \end{cases}$

Structure.—The interjunctural pores are covered by the ectocyst. Their significance is unknown; they appear to result from an incomplete calcification. These pores do not furnish a generic character for they are found also in *Callopora circumclathrata* Hincks, 1881, in *Cauloramphus disjunctus*, new species from the Philippines, in *Hincksina multispinata* Canu and Bassler, 1923, and in *Mystriopora* (?) *areolata* Canu and Bassler, 1923, both from the California Pleistocene. The zooeciules are always very small and pyriform. Their sporadic arrangement indicates a zoarial function.

Affinities.—This species differs from *Hincksina multispinata* in the much larger micrometric measurements and in the presence of larger and less numerous pores. It differs from *Mystriopora* (?) *areolata* in the smaller micrometric measurements. It much resembles *Electra di stefanoi* Cipolla, 1920, from the Sicilian Pliocene and if the author had figured the ovicell we might have made this identification.

Biology.—We have observed several cases of total regeneration. The figured ancestrula is surrounded by zooecia closed by a perforated calcareous membrane and with regenerated zooecia. Some of the regenerated zooecia are formed by a zooeciule replacing an ordinary zooecium. The larva is very active and affixes itself on all marine objects, but principally on the animals with carapace, living or dead. It is thus a parasite of *Steganoporella magnilabris*. Its large bathymetric extension has no connection with its geographic distribution; it is probable that it will be found in many other localities. Almost all of our specimens were dead; the only living ones were in reproduction March 15, 1885.

Occurrence.—*Albatross* Station D. 2167, off Habana, Cuba; 23° 10′ 40″ N.; 82° 20′ 30″ W.; 201 fms.; coral.

Albatross Station D. 2319, north of Cuba; 23° 10′ 37″ N.; 82° 20′ 06″ W.; 143 fms.; gray coral.

Albatross Station D. 2405, Gulf of Mexico; 28° 45′ 00″ N.; 85° 02′ 00″ W.; 30 fms.; gray sand, broken coral.

Albatross Station D. 2639, Straits of Florida; 25° 04′ 50″ N.; 80° 15′ 10″ W.; 56 fms.; coral sand.

Cotypes.—Cat. No. 7519, U.S.N.M.

Genus MEMBRENDOECIUM Canu and Bassler, 1917

MEMBRENDOECIUM STRICTOROSTRIS, new species

Plate 2, Figure 7

Description.—The zoarium encrusts nullipores and dead shells. The zooecia are distinct, separated by a deep furrow, a little elongated, oval, ornamented frequently by a convex gymnocyst. The opesium is oval, the point at the top; the mural rim is thick, beveled, enlarged at the base. The ovicell is small, endozooecial, convex, transverse. In the interzooecial angles there is a small avicularium, long, very *narrow*, acuminated.

Measurements.—Opesium $\begin{cases} ho = 0.30\text{–}0.35 \text{ mm.} \\ lo = 0.20\text{–}0.25 \text{ mm.} \end{cases}$

Zooecia $\begin{cases} Lz = 0.45\text{–}0.60 \text{ mm.} \\ lz = 0.30\text{–}0.40 \text{ mm.} \end{cases}$

Affinities.—The micrometric measurements are quite variable, ranging from one to twice the size and have only an approximate value. The gymnocyst is frequent but in no wise constant and entire colonies are deprived of it. There are cases of total regeneration.

The species differs from *Membrendoecium ovatum* of the Philippines in its long, narrow avicularia. It differs from *Membrendoecium savarti* MacGillivray, 1895, in its mural rim much less enlarged at the base. We have described five fossil species from the Eocene and one from the Miocene of America, so that the genus has therefore persisted in the same region since the Claibornian.

The species was in reproduction and fixation January 17, 1885.

Occurrence.—*Albatross* Station D. 2319, north of Cuba; 23° 10′ 37″ N.; 82° 20′ 06″ W.; 143 fms.; gray coral.

Holotype.—Cat. No. 7552, U.S.N.M.

Genus VIBRACELLINA Canu and Bassler, 1917

VIBRACELLINA LAXIBASIS, new species

Plate 32, Figure 2

Description.—The zoarium encrusts very small globular pebbles. The zooecia are distinct, separated by a deep furrow, small, somewhat elongated, oval, sometimes ornamented with a very short gymnocyst. The mural rim is thin, salient. Its interior part is finely granular and slightly *enlarged* on the sides and at the *base;* the termen is sharp. The opesium is oval and very finely denticulated. The vibraculum is small, elliptical, auriculated. The ovicell is endozooecial and very small.

Measurements.—Opesium $\begin{cases} ho = 0.20 \text{ mm.} \\ lo = 0.12\text{–}0.16 \text{ mm.} \end{cases}$

Zooecia $\begin{cases} Lz = 0.36 \text{ mm.} \\ lz = 0.24 \text{ mm.} \end{cases}$

Variations.—On the rather small substratum the cells are necessarily irregular and of variable dimensions. The ancestrula is surrounded either by five cells and a vibraculum or by six cells and a vibraculum, but they do not at all appear to result from budding of this ancestrula. It is, moreover, difficult to trace the zooecial axes on the convex specimens.

Affinities.—This species is smaller than *Vibracellina viator* and *V. crassatina* of the Philippines and *V. capillaria* Canu and Bassler, 1920. It is, on the contrary, larger than *Vibracellina pusilla* Canu and Bassler, 1923, from the Pliocene of Florida. Its affinities are rather vith *Vibracellina simplex* Canu and Bassler, 1923, from the Miocene of Florida, but differs in its broader and more decorated mural rim and in its denticulated opesium.

Occurrence.—Pliocene: Minnitimmi Creek, Bocas Island, Almirante Bay, Panama.

Cotypes.—Cat. No. 70868, U.S.N.M.

Genus ANTROPORA Norman, 1903

ANTROPORA PUSTULATA, new species

Plate 3, Figure 11; Plate 16, Figure 12

Description.—The zoarium encrusts corals and fragments of shells. The zooecia are distinct, separated by a furrow, elongated pyriform; the gymnocyst is smooth, convex; the mural rim is little salient, thin, pyriform; the cryptocyst is concave, smooth. The opesium is elliptical, marginated, finely crenulated, ornamented with a distal, oblique lamella, serving as a border to the deep opesium. The ovicell is hyperstomial, independent of the distal zooecium. The mural rim bears exteriorily four to six small hollow spines and two oblique triangular avicularia. Irregular zooeciules, perforated, in the form of small pustules, are arranged sporadically between the zooecia.

Measurements.—Opesium $\begin{cases} ho = 0.25 \text{ mm.} \\ lo = 0.14 \text{ mm.} \end{cases}$

Zooecia $\begin{cases} Lz = 0.50\text{–}0.75 \text{ mm.} \\ lz = 0.35\text{–}0.45 \text{ mm.} \end{cases}$

Structure.—The gymnocyst is much developed, contrary to that observed in *Antropora granulifera* Hincks, 1880. It is broad, convex, and smooth.

There are two opesia with the same proximal border. The external (superior) opesium is elliptical, elongated, a little narrowed on the transversal axis; its distal border is confused with that of the mural rim. The inner opesium is subcircular, submedian; its distal border is visible at the bottom of the cell. The cryptocyst entirely surrounds the inner opesium, but the proximal portion between the two opesia forms a concavity more or less deep, which continues below the mural rim and forms a kind of endozooecial ovicell. We suppose that the opercular muscles are lodged in this distal concavity.

The hypostege is deep and perfected. It is regularly arranged between the mural rim and the salient, crenulated thread which surrounds the proximal half of the opesium.

The avicularia are constant and zooecial; they are apparently indispensable for the movements of the opercular valve, but we can not understand what might be the action of their minute mandible.

The perforated kenozooecia arranged sporadically between the cells are covered and closed by the ectocyst.

Total regeneration is revealed by a double mural rim.

Affinities.—This species differs from *Antropora granulifera* Hincks, 1880, in the presence of a large gymnocyst and of six small distal spines, in its less oblique avicularia, in its smooth cryptocyst, and in its sporadic kenozooecia.

Harmer, 1926, discovered that the ovicells of *Antropora granulifera* are endozooecial. Here they are clearly hyperstomial but closed by the operculum. This important difference between the two species is inexplicable to us.

Biology.—This species appears to live in deep waters. It was ovicelled in May, 1884. Corals form the preferred substratum.

Occurrence.—*Albatross* Station D. 2321, Gulf of Mexico, north of Cuba; 23° 10′ 54″ N.; 82° 18′ 00″ W.; 230 fms.
Albatross Station D. 2167, Gulf of Mexico, off Habana; 23° 10′ 40″ N.; 82° 20′ 30″ W.; 201 fms.

Cotypes.—Cat. No. 7456, U.S.N.M.

Family FARCIMINARIIDAE Busk, 1884

Genus LEVINSENELLA Harmer, 1926

The ovicells are strongly prominent. The zooecia are without spinous processes; the distal wall has a number of scattered uniporous septulae. The avicularia are capitate, attached to the distal wall at their proximal part and firmly fixed with their basal wall to the frontal membrane of the distal zooecium. The colonies are not jointed. (Levinsen, 1909.)

This genus differs from *Farciminaria* Busk, 1852, in the presence of a distal avicularium and in the square section of the branches.

Genotype.—*Levinsenella* (*Columnaria*) *borealis* Levinsen, 1909.

LEVINSENELLA BRASILIENSIS Busk, 1884

Plate 1, Figure 3; text Figure 4

1884. *Farciminaria brasiliensis* BUSK, Polyzoa collected by *Challenger*. Scientific Results Voyage *Challenger*, vol. 10, pt. 30, p. 50, pl. 31, fig. 2.

Our specimens are very close to Busk's species and differ only in the avicularia, in which the mandible is perpendicular and not parallel to the zooecial plane. They were living and ovicelled January 27, 1884.

FIG. 4.—LEVINSENELLA BRASILIENSIS BUSK, 1884. OPERCULAR VALVE AND APERTURA, × 85, EACH BORDERED BY A SCLERITE

The opercular valve is absolutely analogous to that in the Flustridae and the Membraniporae.

Occurrence.—D. 2117, Caribbean Sea; 15° 24′ 40″ N.; 63° 31′ 30″ W.; 683 fms.; yellow mud, fine sand.

Atlantic: North of Bahia, South America, 648 meters.

Plesiotypes.—Cat. No. 7477, U.S.N.M.

Genus NELLIA Busk, 1852

NELLIA OCULATA Busk, 1852

1873. *Nellia oculata* SMITT, Floridan Bryozoa, pt. 2. Kongl. Svenska Vetenskaps-Akademiens Handlingar, vol. 11, No. 4, p. 3, pl. 11, figs. 53, 54.

1914. *Nellia oculata* OSBURN, The Bryozoa of the Tortugas Islands, Florida. Publication Carnegie Institution, Washington. No. 182, p. 191 (American bibliography).

1920. *Nellia oculata* CANU and BASSLER, North American Early Tertiary Bryozoa. Bull. 106, U. S. National Museum, p. 196, pl. 82, figs. 6–10. (Supplementary bibliography.)

1922. *Nellia oculata* MARCUS, Bryozoen von den Aru-Inseln. Abhandl. Senckenb. Naturf. Gesellschaft, vol. 35, p. 423.

1923. *Nellia oculata* CANU and BASSLER, North American Later Tertiary and Quaternary Bryozoa. Bull. 125, U. S. National Museum, p. 55, pl. 2, figs. 5–7.

Measurements.—Opercular valve $\begin{cases} ho = 0.06\text{–}0.10 \text{ mm.} \\ lo = 0.08\text{–}0.10 \text{ mm.} \end{cases}$

Zooecia $\begin{cases} Lz = 0.50\text{–}0.54 \text{ mm.} \\ lz = 0.26 \text{ mm.} \end{cases}$

Diameter of branches, 0.30 mm.

The colonies are attached to sponges and occasionally to shells (Osburn). The radical tubes spring out from the middle of the front side just below the apertural area of the zooecia (Smitt).

Occurrence.—*Albatross* Station D. 2405, Gulf of Mexico; 28° 45′ 00″ N.; 85° 02′ 00″ W.; 30 fms.; gray sand, broken coral.

Albatross Station D. 2407, Gulf of Mexico; 28° 47′ 30″ N.; 84° 37′ 00″ W.; 24 fms.; coral, broken shells.

Florida, 21–222 meters (Smitt); Tortugas, 16–29 meters (Osburn); Texas and St. Thomas, West Indies (Levinson).

Pliocene: Minnitimmi Creek, Bocas Island, Almirante Bay, Panama.

Geographic distribution.—Pacific: Torres Strait, Bass Strait, Queensland, Victoria, Cape Grenville, Cape Joubert (23 meters), Gasparstrasse (29 meters), Philippines, Heard Island, and Crozet Island. Indian Ocean: Mergui Archipelago, Gulf of Arabia, Ceylon, Sudanese Red Sea, Zanzibar, Wasin. Atlantic: Bahia, Brazil.

Geologic distribution.—Eocene (Lutetian) of the Paris Basin (Canu); Oligocene (Vicksburgian) of Alabama and Mississippi (Canu and Bassler); Miocene (Burdigalian) Cercado de Mao, Santo Domingo (Canu and Bassler); Miocene (Helvetian) of Touraine and Egypt (Canu); Miocene of Australia (MacGillivray).

Family ALDERINIDAE Canu and Bassler, 1927

This family was proposed for all the Membraniporae in which the ovicell is hyperstomial. It comprises, therefore, groups 3 and 4 of our classification of 1920. It is probable that certain articulated genera will some day be classed in this family, but their larval system not being known, it is preferable to leave them where their authors have placed them. There are also some exceptions to make regarding the genus *Amphiblestrum*, of which the anatomy is absolutely unknown; some species belong perhaps to the Opesiulidae.

Genus ALDERINA Norman, 1903

ALDERINA IRREGULARIS Smitt, 1873

Plate 3, Figure 3; Plate 32, Figure 4

1873. *Membranipora irregularis* Smitt, Floridan Bryozoa. Kongl. Svenska Vetenskaps-Akademiens Handlingar, vol. 11, p. 8, pl. 11, fig. 63.

1914. *Membranipora irregularis* Osburn, The Bryozoa of the Tortugas Islands, Florida. Publication Carnegie Institution, Washington, No. 182, p. 194.

1920. *Alderina irregularis* Canu and Bassler, North American Early Tertiary Bryozoa. Bull. 106, U. S. National Museum, p. 142. (Not D'Orbigny, 1839, Waters, 1904, Busk, 1861, Manzoni, 1875.)

Measurements.—Opesium $\begin{cases} ho = 0.36 \text{ mm.} \\ lo = 0.24 \text{ mm.} \end{cases}$

Zooecia $\begin{cases} Lz = 0.48\text{–}0.50 \text{ mm.} \\ lz = 0.36 \text{ mm.} \end{cases}$

Structure.—The micrometric measurements shown on our specimens differ very little from those which we published in 1922.

"The ovicell is transverse and formed by two calcified layers; the superior one is very finely granulated, incomplete, surrounding an area which is irregular and more or less linear. It is hyperstomial and opens by a large special orifice which the opercular valve never closes. The latter is bordered by a very thick sclerite. The mural rim is granular and enlarged at the base." (Canu and Bassler, 1920.)

"The granulation of the border varies with the amount of calcification. Ooecia are present. In younger stages these are quite prominent, but with latter calcification they become included in the general crust." (Osburn, 1914.)

Our specimens encrust shells, nullipores, and débris.

Affinities.—This species is the equatorial representative of the northern *Alderina imbellis* Hincks, 1860, but differs from it in its transverse and nonelongated ovicell and its irregularly linear and nonrectangular ovicellarian area.

Under the name of *Membranipora irregularis* the authors have confused several species, and we gave the history of them in 1920. The bibliography is only that which we indicate above because this species was with certainty dredged only in the Gulf of Mexico.

Occurrence.—*Albatross* Station D. 2319, north of Cuba; 23° 10′ 37″ N.; 82° 20′ 06″ W.; 143 fms.; gray coral.

Albatross Station D. 2405, Gulf of Mexico; 28° 45′ 00″ N.; 85° 02′ 00″ W.; 30 fms.; gray sand, broken coral.

Albatross Station D. 2639, straits of Florida; 56 fms.; coral sand.

Pliocene: Minnitimmi Creek, Bocas Island, Almirante Bay, Panama.

Plesiotypes.—Cat. Nos. 7451, 70831, U.S.N.M.

ALDERINA (?) PYRIFORMIS, new species

Plate 32, Figure 3

Description.—The zoarium is unilamellar. The zooecia are distinct, separated by a deep furrow, elongated, *pyriform*, ornamented sometimes with a short gymnocyst; the mural rim is salient, very thin superiorly, enlarged at the base, with a sharp termen. There are six distal spines placed on the exterior part of the mural rim and often a pair of lateral spines. The ovicell is hyperstomial, salient, globular, transverse; it is formed by two calcareous pellicules of which the superior is incomplete and leaves a large frontal cicatrix.

Measurements.—Opesium $\begin{cases} ho = 0.35\text{–}0.37 \text{ mm.} \\ lo = 0.20\text{–}0.32 \text{ mm.} \end{cases}$

Zooecia $\begin{cases} Lz = 0.60\text{–}0.70 \text{ mm.} \\ lz = 0.30\text{–}0.35 \text{ mm.} \end{cases}$

Affinities.—This new species differs from *Alderina cesticella* Canu and Bassler, 1923, in its much larger zooecia and in the number of its spines. The primoserial zooecia arise always from a lateral bud of a zooecium, a very frequent phenomenon in the Membranipores. There are, however, some species (*Acanthodesia*) where the budding is always distal. The nature of budding has not been sufficiently studied by the zoologists, and it may perhaps furnish excellent generic or specific characters. Our unique specimen does not bear avicularia.

Occurrence.—Pliocene: Minnitimmi Creek, Bocas Island, Almirante Bay, Panama.

Holotype.—Cat. No. 70832, U.S.N.M.

Genus GEPHYROTES Norman, 1903

1920. *Gephyrotes* CANU and BASSLER, North American Early Tertiary Bryozoa. Bull. 106, U. S. National Museum, p. 300.

In introducing this genus into our nomenclature of 1920 we considered especially the spiramen which we thought corresponded to a special function[6]. Also all the species do not have the same frontal structure; often it is totally different from that of the genotype; in *Gephyrotes spinosa* it is identical with that in *Acanthocella*. If this genus is indeed natural, it will be proof once more that the aspect of the frontal can not furnish generic characters since it results simply from the ordinary variations of the primitive spines. If we are deceived in our views, it is necessary to range the species with dietellae in *Cribrilina* as Levinsen thought in 1909; but the conclusion remains the same for *Cribrilina*.

Lang, 1922, gave the greatest importance to the form and the arrangement of the costules. This is not our view, for the exterior ornamentation can not serve to establish a natural classification.

GEPHYROTES SPINOSUM, new species

Plate 4, Figure 11

Description.—The zoarium encrusts stones. The zooecia are distinct, separated by a furrow, elliptical, a little elongated; the frontal is convex; the costules, 16 to 18 in number, are narrow, a little distinct, arranged transversely; they are separated by two or three very small

[6] Moreover, we consider that the absence of dietellae is still an important difference from the group *Membraniporella-Cribrilina*.

lacunae; they bear two or three very salient lumen pores which give the frontal a *spinous* aspect. The frontal is terminated distally by a wide, smooth convex mucro; it forms with the wide apertural arch a kind of broad oblique peristome surrounding a kind of spiramen; the latter is itself protected in front by a small more or less salient tongue. The aperture is buried by the characteristic arch; the peristome is thin and bears on each side of the aperture a large, short, hollow spine, and distally two broad, claviform, bifid spines, often joined together to form a small special tongue.

Measurements.—Zooecia $\begin{cases} Lz = 0.45\text{–}0.50 \text{ mm.} \\ lz = 0.25\text{–}0.30 \text{ mm.} \end{cases}$

Structure.—This species is quite original and well characterized by its spinous costules. The apertural arch is very constant; the spiramen could correspond to a special function like that of the Galeopsidae and indispensable to the zooecial life.

The lacunae are so small that they must be subject to the phenomena of capillarity, of which it will be necessary to make a special study.

The apertural arch is altogether distinct from what we have observed in *Cribrilina lineata* and which is formed by the junction of two wide oral spines. Here it forms an integral part of the oral mucro and constitutes with it a true special armature in which the spiramen is perforated.

The arrangement of the costules is totally different from that of the genotype, *Gephyrotes nitido-punctata* Smitt, 1868. Their structure is that of *Acanthocella.*

The two large lateral spines observed on each side of the aperture are perhaps in reality very small pedunculate avicularia corresponding to the oral avicularia noted in almost all the species of the genus. Our rare specimens did not bear a single ovicell.

Occurrence.—*Albatross* Station D. 2319, north of Cuba; 23° 10′ 37″ N.; 82° 20′ 06″ W.; 143 fms.; gray coral.
Albatross Station D. 2639, Straits of Florida; 25° 04′ 50″ N.; 80° 15′ 10″ W.; 56 fms.; coral sand.

Holotype.—Cat. No. 7508, U.S.N.M.

Genus MARSSONOPORA Lang, 1914

MARSSONOPORA UNCIFERA, new species

Plate 3, Figures 1, 2

Description.—The zoarium encrusts shells. The zooecia are arranged in linear series; they are oval, elongated, and united with each other by filiform zooeciules with very small orifice and arranged in the form of stolons. The opesium is oval; the mural rim is thin and bears a dozen spines in the form of *claws.* The ovicell is hyperstomial, globular, salient, always closed by the operculum.

Structure.—Lang, 1914, considered the orifices placed on the caudal portion of the zooecia as avicularia. We have seen no mandibles on our living specimens, and the orifices observed are indeed the apertures of successive zooeciules forming the caudal portion of the zooecia. The zooeciules form thus true stolons of variable length which are not necessarily terminated by a zooecium. Our Figure 1 shows this phenomenon as perfect evidence. In their form these zooeciules are related to those of *Trypostega;* however, the latter are always isolated and in direct connection with the proximal zooecium. It is probable that these zooeciules are deprived of polypides. They differ from true stolons of Ctenostomata in the presence of an orifice.

The figure of Lang seems to indicate that the ovicell is closed by a special operculum as in *Callopora*, but his species is a fossil one, and we know how difficult it is to determine by the examination of the skeleton alone the relation of the operculum and the ovicell. In our specimens without any doubt the operculum closes the ovicell. In spite of this divergence, we do not believe we ought to create a new genus for the stoloniferous Membranipores, for it is preferable to attribute to the fossils the characters of the recent species.

Biology.—Our specimens from locality D. 2167 were alive when dredged. They were in reproduction May 1, 1884.

Occurrence.—*Albatross* Station D. 2167, off Habana, Cuba; 23° 10′ 40″ N.; 82° 20′ 30″ W.; 201 fms.; coral.
Albatross Station D. 2319, north of Cuba; 23° 10′ 37″ N.; 82° 20′ 06″ W.; 143 fms.; gray coral.

Cotypes.—Cat. Nos. 7543, 7544, U.S.N.M.

Genus CALLOPORA Gray, 1848

CALLOPORA TENUIROSTRIS Hincks, 1880

Plate 3, Figure 4

1918. *Membranipora tenuirostris* WATERS, Bryozoa of the Cape Verde Islands. Linnean Society's Journal, Zoology, vol. 34, p. 9. (Bibliography and geographic distribution.)

1920. *Callopora tenuirostris* CANU and BASSLER, North American Early Tertiary Bryozoa. Bull. 106, U. S. National Museum, p. 114, pl. 29, fig. 10, 11. (Bibliography.)

Measurements.—Opesia $\begin{cases} ho = 0.40 \text{ mm.} \\ lo = 0.24 \text{ mm.} \end{cases}$

Zooecia $\begin{cases} Lz = 0.40\text{–}0.54 \text{ mm.} \\ lz = 0.36 \text{ mm.} \end{cases}$

Variations.—The micrometric measurements are very variable; specimens from Oran measure 0.50 mm. by 0.44 mm. Waters's figure of 1898 shows 0.40 mm. by 0.28 mm., and fossils from the Jacksonian measure 0.40–0.45 mm. by 0.20–0.25 mm.

The mural rims are generally separated. They are thick, but when they are covered over by the ectocyst they appear thin. The interzooecial avicularium is large.

Affinities.—This species must not be confused with *Membranipora plana* Hincks, 1880, of which we have discovered beautiful specimens at Oran and in which the micrometric measurements are much larger; nor with *Callopora parvirostris* Canu and Bassler, 1923, of the American Miocene, in which the avicularium is very small. Waters illustrated the mandible in 1885 and the operculum in 1898. We add the ancestrula. Our specimens encrust corals, shells, and Cellepores.

Biology.—Our specimens were living and in reproduction January 30, 1885. This is a species of waters of little depth from 10 to 89 meters, but because of its great vitality it is probable that it can adapt itself to less favorable bathymetric conditions.

Occurrence.—*Albatross* Station D. 2365, east of Yucatan; 22° 18′ 00″ N.; 87° 04′ 00″ W.; 24 fms.; white rock coral.

Albatross Station D. 2405, Gulf of Mexico; 28° 45′ 00″ N.; 85° 02′ 00″ W.; 30 fms.; gray sand, broken coral.

Albatross Station D. 2639, Straits of Florida; 25° 04′ 50″ N.; 80° 15′ 10″ W.; 56 fms.; coral sand.

Geologic distribution.—Eocene (Priabonian) of the Vicentin (Waters); Oligocene of Anguilla (Canu and Bassler); Jacksonian of Mississippi (Canu and Bassler); Helvetian of Tourraine (Canu); Pliocene of Italy (Waters).

CALLOPORA CURVIROSTRIS Hincks, 1861

Plate 3, Figures 9, 10; Plate 32, Figure 8

1903. *Membranipora guernei* JULLIEN, Bryozoaires provenant des campagnes de *l'Hirondelle* (1886–1888). Resultats des Campagnes scientifiques du Prince de Monaco, fasc. 23, p. 40, pl. 5, fig. 3.

1918. *Membranipora curvirostris* WATERS, Bryozoa of the Cape Verde Islands. Journal Linnean Society, Zoology, vol. 34, p. 9. (Bibliography.)

1923. *Callopora guernei* CANU and BASSLER, North American Later Tertiary and Quaternary Bryozoa. Bull. 125, U. S. National Museum, p. 42, pl. 45, figs. 3, 4.

Measurements.—Opesia $\begin{cases} ho = 0.45 \text{ mm.} \\ lo = 0.35\text{–}0.40 \text{ mm.} \end{cases}$

Zooecia $\begin{cases} Lz = 0.50\text{–}0.55 \text{ mm.} \\ lz = 0.40\text{–}0.45 \text{ mm.} \end{cases}$

Variations.—Our specimens encrust shells and large dead colonies of *Stylopoma spongites.* Above each avicularium there is frequently a curious uncovered space very irregular in form. It is difficult to explain the formation and the origin of these spaces. Waters, 1918, thought that they must be considered as aborted zooecia. In their more perfect form they appear to us to be the unoccupied portion of an ordinary zooecium but regenerated by a falciform avicularium. On our specimens from the Gulf of Mexico they are generally absent or diffuse.

Although the specimens dredged in the Philippines belong to the variety *albida* Busk, 1885, those from the Gulf of Mexico are very typical and conform to Hincks's figure of 1880. They are deprived of tuberosities on the mural rim. However, we figure a curious specimen in which the zooecia are a little smaller and the mural rim is ornamented with tuberosities very irregularly arranged.

Biology.—All of our specimens were dead. We have observed some cases of total regeneration.

Occurrence.—*Albatross* Station D. 2167. Off Habana, Cuba; 23° 10′ 40″ N.; 82° 20′ 30″ W.; 201 fms.; coral.

Albatross Station D. 2319, North of Cuba; 23° 10′ 37″ N.; 82° 20′ 06″ W.; 143 fms.; gray coral.

Pliocene: Minnitimmi Creek, Bocas Island, Almirante Bay, Panama.

Pleistocene (Mount Hope); Panama Canal Zone.

Plesiotypes.—Cat. Nos. 7466, 7467, 70833, U.S.N.M.

CALLOPORA PUMICOSA, new species

Plate 3, Figure 7

Description.—The zoarium encrusts nullipores; it is formed essentially of a thin calcareous pellicle perforated by a very large number of polygonal *pores* arranged in irregular quincunx and supporting the zooecia. The latter are isolated, much separated from each other; they are convex, pyriform; the gymnocyst is large and smooth. The opesium is elliptical and not surrounded by a mural rim. The ovicell is globular, smooth, hyperstomial, operculated, and without any connection with the opercular valve.

Measurements.—Opesia $\begin{cases} ho = 0.23 \text{ mm.} \\ lo = 0.11 \text{ mm.} \end{cases}$

Zooecia $\begin{cases} Lz = 0.45 \text{ mm.} \\ lz = 0.30 \text{ mm.} \end{cases}$

Observations.—The nature of the zooecial walls and of the frontal is that of *Pyripora*; but the ovicell is hyperstomial and there are no spines.

This is one of the most curious species dredged by the *Albatross;* the nature and function of the porous crust are absolutely unknown but nevertheless it is indeed an integral part of the colony, since the zooecia can communicate among themselves only through it. The biology of this species as of many other bryozoa, is absolutely enigmatical.

Occurrence.—*Albatross* Station D. 2639, Straits of Florida; 25° 04′ 50″ N.; 80° 15′ 10″ W.; 56 fms.; coral sand.

Holotype.—Cat. No. 7468, U.S.N.M.

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CALLOPORA CAUDATA, new species

Plate 3, Figure 8

Description.—The zoarium encrusts corals, the zooecia are arranged in uniserial series, ramified at right angles; they are oval, provided with a smooth convex gymnocyst, and terminated by a long, very thin, caudal portion. The ovicell is large, globular, smooth, never closed by the operculum.

Measurements.—Opesia $\begin{cases} ho = 0.20 \text{ mm.} \\ lo = 0.16 \text{ mm.} \end{cases}$

Zooecia $\begin{cases} Lz = 0.70\text{–}0.90 \text{ mm.} \\ lz = 0.20\text{–}0.22 \text{ mm.} \end{cases}$

Affinities.—The form and structure are that of a *Pyripora* but there is present a hyperstomial ovicell. We have discovered in the Philippines another uniserial species, *Callopora uniseriata*, in which the dimensions are much larger and in which the caudal portion is very small.

We do not see the necessity of creating a new genus for the reception of this uniserial species in which all the functions are identical with those of other *Callopora*. Certain zooecia are simply deprived of lateral septules, a suppression which is simply the result of their special mode of development. Certain uniserial Cretaceous species considered as *Pyripora* are perhaps also *Callopora* but the number of specimens collected is not sufficiently large to positively affirm the nonexistence of an ovicell.

Our specimens were living and ovicelled, January 17, 1885.

Occurrence.—*Albatross* Station D. 2319, north of Cuba; 23° 10′ 37″ N.; 82° 20′ 06″ W.; 143 fms.; gray coral.

Holotype.—Cat. No. 7465, U.S.N.M.

CALLOPORA TENUISSIMA, new species

Plate 26, Figures 1, 2

Description.—The zoarium encrusts shells. The zooecia are distinct, much elongated, elliptical, or fusiform. The mural rim is *very thin*, smooth. The opesium has the form of the zooecium. The ovicell is small, globular, finely granular. The avicularium is falciform, unguiculated with two small lateral denticles; it is placed in the proximal portion of a zooecium with aborted polypide.

Measurements.—Zooecia $\begin{cases} Lz = 0.55\text{–}0.60 \text{ mm.} \\ lz = 0.30\text{–}0.35 \text{ mm.} \end{cases}$

Aborted zooecia $\begin{cases} Lz = 0.50\text{–}0.55 \text{ mm.} \\ lz = 0.20\text{–}0.23 \text{ mm.} \end{cases}$

Affinities.—The zooecia with aborted polypides are smaller and especially narrower than the ordinary zooecia. They are always primoserial, but all the primoserial zooecia do not bear avicularia.

In the genus *Flabellaris* Waters, 1898, there are frequently internal avicularia. They can not form a constant generic character, for *Amphiblestrum perminutum* Hincks, 1880, contains analagous avicularia.

This species differs from *Callopora curvirostris* Hincks, 1880, in the great delicacy of its mural rim and in the larger dimensions of the zooecia with aborted polypide.

Occurrence.—*Albatross* Station D. 2387, Gulf of Mexico; 29° 24′ N.; 88° 04′ W.; 32 fms.

Holotype.—Cat. No. 7469, U.S.N.M.

Genus CAULORAMPHUS Norman, 1903

CAULORAMPHUS OPERTUS, new species

Plate 4, Figures 3–8

Description.—The zoarium encrusts shells. The zooecia are distinct, separated by a deep furrow, at the bottom of which are small interjunctural pores; the mural rim is salient, very thick, and supports 10 pairs of wide thin spines covering the frontal and four large erect distal spines. The pedunculate avicularium is long, thin, and horn shaped.

Measurements.—Opesia $\begin{cases} ho = 0.20 \text{ mm.} \\ lo = 0.10 \text{ mm.} \end{cases}$

Zooecia $\begin{cases} Lz = 0.40\text{–}0.50 \text{ mm.} \\ lz = 0.20\text{–}0.25 \text{ mm.} \end{cases}$

Structure.—The arrangement of the spines is quite unusual and does not resemble that of the spines observed in the other species of the genus. They are flat, almost adjacent, and are inserted in the angle between the dietellae; a very delicate central canalicule runs throughout their length. They are not erect but are recumbent and their ensemble forms a kind of roof above the ectocyst. The four distal spines are large, erect, and articulated at their base.

The arrangement of the dietellae is not the arrangement studied by Norman and characterizing the genus. The dietellae are here parietal and completely surround the zooecium.

The interjunctural pores are visible only on specimens boiled in Javelle water. They are analogous to those which we have observed in *Hincksina* and in *Callopora*. They are covered by the ectocyst. Our photographs give a good idea of this remarkable little species.

Occurrence.—*Albatross* Station D. 2405, Gulf of Mexico; 28° 45′ 00″ N.; 85° 02′ 00″ W.; 30 fms.; gray sand, broken coral.

Cotypes.—Cat. No. 7471, U.S.N.M.

Genus MEMBRANIPORELLA Smitt, 1873

1920. *Membraniporella* CANU and BASSLER, North American Early Tertiary Bryozoa. Bull. 106, U. S. National Museum, p. 281. (Description and text figure.)

Structure.—The frontal is formed by more or less coalesced spines; it is not covered by an ectocyst. The real frontal ectocyst is arranged under the ensemble of costules; it bears the true aperture closed by a simple valve.

Smitt, 1864, noted the flustrine nature of the genotype *Lepralia nitida* Johnston, 1848 (that is to say, the absence of a compensatrix), and figured (pl. 6, fig. 1) the parietal muscular system. Also in 1867 he placed it in *Membranipora.* Levinsen, 1909, established the great analogy of the genus *Membraniporella* with *Callopora* Gray, 1848. Finally, in the paleontologic evolution, the cribrimorphs began with *Membranipora* and have always accompanied them since the Cenomanian. There is then no longer any serious reason for putting the two groups in distinct families. The union of the spines above the ectocyst is only a manifestation of calcification and solely a particular means of adaptation or of protection. Is this union of the spines such an essential function of the animal as to justify the creation of a special genus? We still do not know. However, as this generic distinction appears to facilitate the determination, we maintain it and recognize the genus *Membraniporella,* classing it in the *Calloporidae.* For the same reason we ought to create a cribrimorph genus corresponding to each of the membraniporoid genera provided with areal spines. We have some examples in the *Hincksina* stage. In the Membranipores the aperture is always bordered by a sclerite formed by the chitinous thickening of the ectocyst; the opercular valve closes exactly with the peripheral sclerite. In drawings of the opercular valve they are always separated in order to show their presence. The apertural sclerite no longer exits in the cribrimorphs, for it has become useless, the ectocyst adhering to the calcareous armature which surrounds the aperture. Our drawings of the valves of the cribrimorphs can then indicate only the single opercular sclerite.

The visible exterior orifice is not the true aperture since the latter opens on the subadjacent ectocyst, but as it has exactly the same form it is the custom to name it also aperture.

MEMBRANIPORELLA PETASUS, new species

Plate 4, Figures 1, 2

Description.—The zoarium encrusts nullipores and chitinous sponges. The zooecia are distinct, separated by a deep furrow, elliptical, elongated, swollen; the frontal is quite convex; the costules are broad, flat, 9–10 in number, separated by linear lacunae in the middle of their length and by small irregular lacunae in the vicinity of the median axis. The opesium is semielliptical, transverse, with a concave proximal border, larger and with the form of a hat on the ovicelled zooecia; the peristome bears three or four short palmate bifid spines, of which the two lateral ones are wide and in the form of a small bifid tongue. The ovicell is large, globular, smooth, hyperstomial.

Measurements.—Aperture $\begin{cases} ha = 0.10 \text{ mm.} \\ la = 0.20 \text{ mm.} \end{cases}$

Zooecia $\begin{cases} Lz = 0.50 \text{ mm.} \\ lz = 0.40 \text{ mm.} \end{cases}$

Structure.—We have been able to observe only three small dead specimens, and our observations are necessarily restricted. In its arrangement the ovicell is perhaps not closed by the operculum, but we are not positively certain. It is formed of two calcareous pellicles; the superior pellicle is incomplete in front, leaving thus a small frontal cicatrix; it is completed on the two sides by the two bifid tongues, which are, moreover, intimately united. Its orifice is placed lower than the frontal mucro.

The arrangement of the costules is not at all the ordinary disposition observed in other species of *Membraniporella;* their extremities are united, leaving between them small, irregularly arranged lacunae. This arrangement is due to the primitive form of the areal spines, which were probably flattened at their extremity like the oral spines. The aspect of the frontal is modified by the form of the spines and by their ramifications. This form of spine in other Membranipores is never a generic character. There is then no serious reason for giving it here a more important significance. Norman, 1909, has noted at Maderia a variety *intermedia* of *Membraniporella nitida* Johnston, 1848, in which the frontal shows modifications quite similar.

Affinities.—This species differs from *Membraniporella nitida intermedia* Norman, 1909, in the presence of two oral bifid tongues and in the absence of avicularia. It differs from *Cribrilina alcicornis* Jullien, 1882, in which the orifice is also ornamented by four superb palmate spines, in less numerous and wider costules, and in the presence of large linear lacunae.

Occurrence.—*Albatross* Station D. 2167, off Habana, Cuba; 23° 10′ 40″ N.; 82° 20′ 30″ W.; 201 fms.; coral.
Albatross Station D. 2319, north of Cuba; 23° 10′ 37″ N.; 82° 20′ 06″ W.; 143 fms.; gray coral.

Cotypes.—Cat. Nos. 7550, 7551, U.S.N.M.

Genus CRIBRILINA Gray, 1848

The genus *Cribrilina* differs from *Membraniporella* in the closer spacing of the costules and in their smaller dimensions, their structure in spite of exterior appearances being essentially the same. This difference, including even the perforation of the ovicells in certain species of *Cribrilina*, is quite feeble. Certainly if this generic distinction is maintained, we will find species with intermediate frontals very difficult to classify. At present we have not changed the nomenclature because of the small number of recent species known. Moreover and in consequence of this observation, an exact determination of a *Cribrilina* can be made only after a special preparation of its costular system. The number of specimens of the same species is almost always quite small and it is then often hard to destroy them in order to make the technical preparations; but it is necessary to decide in favor of science, which is becoming more and more exact.

CRIBRILINA LINEATA, new species

Plate 3, Figures 5, 6

Description.—The zoarium encrusts nullipores; it is formed of isolated zooecia, arranged in *linear* series. The zooecia are large, elliptical, elongated; the frontal is very convex surrounded by a kind of smooth gymnocyst to which the costules are attached; the costules are narrow, adjacent, and separated by very small and linear lacunae; they bear at their extremity a salient lumen pore; they are united on the median axis by a salient thread; they are 16 in number. The aperture is semielliptical, transverse, with concave proximal border; the peristome bears two or three short, broad spines and two lateral tongues which develop and unite together sometimes to form an arch above the aperture. The ovicell is hyperstomial, closed by the operculum; it bears a large longitudinal keel and two lateral circular scars.

Measurements.—Aperture $\begin{cases} ha = 0.15 \text{ mm.} \\ la = 0.25 \text{ mm.} \end{cases}$

Zooecia $\begin{cases} Lz = 1.00 \text{ mm.} \\ lz = 0.60 \text{ mm.} \end{cases}$

Structure.—The opercular valve is very thin, the costules are thin and translucent; they are juxtaposed and separated sometimes by very narrow and linear lacunae; they bear an apparent lumen line and three or four small lumen pores; finally they are joined at their base and form the false gymnocyst which surrounds each zooecium. This structure is quite identical with that which Norman, 1903, figured for *Cribrilina annulata.* He did not illustrate the lumen line because, as he wrote, the opaqueness of the costules prevented the view of it, but in the text he affirms its presence as well as that of the lumen pores. It should be noted also that the variety *spitzbergensis* of the same species bears as here two lateral tongues to the aperture.

Biology.—Our specimens were in reproduction April 30, 1884. Each colony contains only a very small number of zooecia. The protective influence of the apertural arch is rather difficult to understand: we have observed it only on the ovicelled zooecia; it must retard very much the extrusion of the tentacles.

Affinities.—This species is deprived of avicularia, but in the Costules their presence is not yet considered as of generic importance. For Cretaceous (Campanian) species very similar in aspect and ornament with an apertural arch Lang, 1922, created the genus *Phrynopora.*

Occurrence.—*Albatross* Station D. 2152, 2½ miles northwest of Habana Light, 387 fms.; coral.

Holotype.—Cat. No. 7828, U.S.N.M.

Genus ACANTHOCELLA Canu and Bassler, 1917

The costules bear a row of very prominent lumen pores and are separated by lacunae of greater or less size. The aperture is semielliptical; the ovicell is hyperstomial and closed by the opercular valve which is much chitinized.

Genotype.—*Cribrilina tubulifera* Hincks, 1881.

Range.—Eocene (Jacksonian)—Recent.

Structure.—We established this genus in 1917 from a study of fossil specimens from the Jacksonian of the Carolinas. We badly interpreted the function of the opercular valve and we now modify the diagnosis in order to make it conform to the new observations made on recent specimens.

This genus has the same general structure as *Membraniporella* and *Cribrilina.* The only difference is in the ornamentation of the costules, which appears to us now of very small value, for it does not correspond to an important modification of an essential function of the zooecium. The ornamentation of the frontal depends exclusively on the form of the primitive spines, of simple specific value in Membraniporae as in the Flustridae.

According to our principles of classification, these three genera form really only a single genus for which it is necessary to preserve the name of *Cribrilina.*

The known species of this subgenus are as follows:

Acanthocella tubulifera Hincks, 1881, Recent (Australia).

Acanthocella suggerens Waters, 1881, Miocene (Australia).

Acanthocella erinacea Canu and Bassler, 1922, Jacksonian (Carolina).

Acanthocella clypeata, new species, Recent (Florida).

ACANTHOCELLA CLYPEATA, new species

Plate 4, Figures 9, 10; text Figure 5

Description.—The zoarium encrusts shells. The zooecia are distinct, elliptical, little elongated; the frontal is convex with the form of a *shield*; the costules, eight or nine in number are arranged transversely, separated by large lacunae, rectangular, decreasing in size toward the median zooecial axis; the trabeculae of junction are arranged concentrically around the frontal center; each costule bears three lumen pores of which the most exterior one is very salient and in the form of a hollow spine. The aperture is semielliptical, transverse; the peristome, thin and salient, bears two or three short, cylindrical hollow spines; the opercular valve is much chitinized. The ovicell is small, hyperstomial closed by the operculum.

Measurements.—Apertura $\begin{cases} ha = 0.08 \text{ mm.} \\ la = 0.15 \text{ mm.} \end{cases}$

Zooecia $\begin{cases} Lz = 0.50\text{–}0.55 \text{ mm.} \\ lz = 0.35 \text{ mm.} \end{cases}$

Structure.—The figured specimen, living when dredged, permits us to recognize the real structure of this elegant species. The chitinous ectocyst entirely covers the interior of the zooecium; its distal portion is calcified around the aperture and intimately united to the mural rim and to the first costules; the exterior orifice is therefore absolutely similar to the aperture. The opercular valve is much chitinized but it is not detachable. The costules are separated by very large lacunae; their lumen line is very apparent, but the lumen pores are not, although, on the contrary, they are quite visible in a species from the Jacksonian. The trabeculae have a longitudinal lumen line, and a transverse line of junction is very apparent. We have not observed diatellae, but our preparation was incomplete. The distal spines have the same structure as the costules; this phenomenon appears to be general in all the Costules.

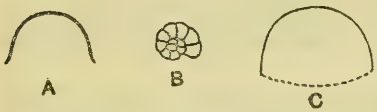

FIG. 5.—ACANTHOCELLA CLYPEATA, NEW SPECIES. *A.* OPERCULAR VALVE, × 85. *B.* A SMALL FORAMINIFER, × 85, FOUND WITHIN A ZOOECIUM. *C.* CRIBRILINA LINEATA, NEW SPECIES, OPERCULUM, × 85

Affinities.—This new species differs from *Acanthocella erinacea* Canu and Bassler, 1922, in the presence of four pairs of transverse costules (and not six), in its much smaller dimensions, and in the very salient lateral lumen pores. It differs from *Cribrilina tubulifera* Hincks, 1881, in the much wider zooecia, in less numerous costules, and much larger lacunae.

Biology.—The species was in reproduction May 1, 1884. It is very rare.

Occurrence.—*Albatross* Station D. 2169, off Habana, Cuba; 23° 10′ 28″ N.; 82° 20′ 27″ W.; 78 fms.; coral.

Albatross Station D. 2373, Gulf of Mexico; 29° 14′ 00″ N.; 85° 29′ 15″ W.; 25 fms.; coral.

Holotype.—Cat. No. 7447, U.S.N.M.

Family BUGULIDAE Gray, 1848

Genus BUGULA Oken, 1815

BUGULA (STIRPARIA) CARAIBICA Levinsen, 1909

1909. *Bugula caraibica* LEVINSEN, Morphological Studies upon the Chilostomatous Bryozoa, p. 104, pl. 11, fig 2.

1914. *Bugularia caraibica* OSBURN, Bryozoa from the Tortugas Islands, Florida. Publication Carnegie Institution, Washington, No. 182, p. 188.

Our specimens are rare. They differ from *Bugula microecia* Osburn, 1914, in the absence of small oral avicularia and of distal spines on the dorsal. "Growing in loose tufts of a fine purple color" (Osburn).

Occurrence.—*Alabatross* Station D, 2413, Gulf of Mexico; 26° 00′ 00″ N.; 82° 57′ 30″ W.; 24 fms.; fine sand, black specks, broken shells.

Tortugas (Osburn); St. Croix, Danish West Indies (Levinsen).

BUGULA AVICULARIA Linnaeus, 1758

Plate 4, Figures 13, 14

1889. *Bugula avicularia* JELLY, A synomymic Catalogue of Marine Bryozoa, p. 22. (Bibliography.)

1912. *Synnotum avicularia* OSBURN, Bryozoa of the Woods Hole Region. Bulletin Bureau of Fisheries, vol. 30 (1910), p. 226, pl. 21, fig. 27.

This is a new species for the region of the Gulf of Mexico. It is known, however, from the Atlantic side of Greenland, from Canada, and the United States. The literature upon it is very large. The geographic distribution is still not yet complete. Our specimens were living and ovicelled.

Occurrence.—*Albatross* Station D. 2392, Gulf of Mexico; 28° 47′ 30″ N.; 87° 27′ 00″ W.; 724 fms.; brown-gray mud.

Plesiotypes.—Cat. No. 7457, U.S.N.M.

Genus DENDROBEANIA Levinsen, 1909

DENDROBEANIA LAMELLOSA, new species

Plate 5, Figures 9–14

Description.—The zoarium is free, unilamellar, of large, broad ramified fronds. The radical fibers are attached on the two sides of the colony; the latter is chitinous. The zooecia are distinct, much elongated, somewhat fusiform; the proximal gymnocyst is very small and often absent; the mural rim is very thin and bears two distal spines and four to six lateral spines. The pedunculate avicularium is large, elongated, acuminated, with the shape of a kidney bean; the mandible is small, in the form of a small tongue. The ovicell is large, globular, smooth.

Measurements.—Zooecia $\begin{cases} Lz = 0.75 \text{ mm.} \\ lz = 0.35 \text{ mm.} \end{cases}$

Affinities.—The form and size of the avicularium being of specific importance in the different genera of this family, we give a photograph of that of the present species. Another photograph shows the structure and the mode of articulation of the spines.

This species differs from *Dendrobeania flabellata* Gray, 1847, in the presence of numerous zooecial series on the branches and in the presence of four to six lateral spines in addition to the pair of distal spines.

It differs from *D. murrayana* Johnston, 1847, in its much wider fronds (3 to 4 mm.), in its larger spines, in the interopesial position of the avicularium, in the different form of the avicularium, in the absence of a dorsal sinuosity on the avicularium, and in the mandible placed higher and never extending beyond the peduncule of the avicularium.

Occurrence.—*Albatross* Station D. 2354, east of Yucatan; 20° 59′ 30″ N.; 86° 23′ 45″ W.; 130 fms.; coral.

Cotypes.—Cat. No. 7487, U.S.N.M.

Genus HALOPHILA Busk, 1852

HALOPHILA JOHNSTONIAE Gray, 1843

Plate 4, Figure 12

1872. *Halophila johnstoniae* Smitt, Floridan Bryozoa. Kongl. Svenska Vetenskaps-Akademiens Handlingar, vol. 10, p. 17, pl. 5, fig. 47.

1889. *Bugula johnstoniae* Jelly, A synonymic catalogue of marine Bryozoa, p. 25. (Bibliography.)

1890. *Halophila johnstoniae* Kirkpatrick, Hydroida and Polyzoa. Collection made in Torres Strait, Scientific Proceedings Royal Dublin Society, new ser., vol. 6, p. 611.

1926. *Halophila johnstoniae* Harmer, Polyzoa "Siboga" Expedition, p. 449, pl. 30, fig. 14, pl. 31, figs. 19–21. (Ovicell.)

Our specimens are rare but they were ovicelled.

Desiccation deforms many of the cells; however, our photograph shows that the essential characters are still quite visible, permitting identification. Preparations in Canada balsam show the zooecial form better.

Harmer, 1926, believes that two species have been confused under this name. He reduces considerably Miss Jelley's bibliography and thinks that Ortman's species of 1890 is (?) his *Bugula longicauda*.

Our specimens correspond rigorously to the figure of Smitt, 1872. As we do not have the necessary elements for comparison, we are not able to modify the synonymy.

The genus *Halophila* may be provisionally preserved, as the ovicell now known is somewhat divergent from typical *Bugula*. It is deprived of avicularia.

Occurrence.—*Albatross* Station D. 2405, Gulf of Mexico; 28° 35′ 00″ N.; 85° 02′ 00″ W.; 30 fms.; gray sand, broken coral.

Geographic distribution.—Pacific: New Zealand (Gray); Bass Strait (Busk) and Torres Strait, Australia, 5–11 fathoms (Kirkpatrick); N. Celebes, 80 meters (Harmer).

Plesiotypes.—Cat. No. 7510, U.S.N.M.

Family SCRUPOCELLARIIDAE Levinsen, 1909

Genus SCRUPOCELLARIA Van Beneden, 1845

SCRUPOCELLARIA RETIFORMIS Pourtales, 1867

1872. *Caberea retiformis* SMITT, Floridan Bryozoa. Kong. Svenska Vetenskaps-Akademiens Handlingar, vol. 10, no. 11, p. 16, pl. 5, figs. 43–46.
1913. *Canda retiformis* WATERS, Bryozoa from Zanzibar. Proceedings of the Zoological Society of London, p. 479, p. 69, figs. 1, 2, 6. (Bibliography and geographic distribution.)
1914. *Canda retiformis* OSBURN, Bryozoa from the Tortugas Islands, Florida. Publication Carnegie Institution, Washington, no. 182, p. 192 (cited only).

This species has not been found in America since 1872. We have observed some beautiful specimens. The differences from *Canda caraibica* Levinsen, 1909, have been given by Osburn, 1914. In accordance with Harmer's studies, this species should be classified in *Scrupocellaria*.

Occurrence.—*Albatross* Station D. 2405, Gulf of Mexico; 28° 45′ 00″ N.; 85° 02′ 00″ W.; 30 fms.; gray sand, broken coral.

Albatross Station D. 2639, Straits of Florida; 25° 04′ 50″ N.; 80° 15′ 10″ W.; 56 fms.; coral sand.

Florida, 68 and 270 meters (Smitt).

Pliocene: Minnitimmi Creek, Bocas Island, Almirante Bay, Panama.

Family HIANTOPORIDAE MacGillivray, 1895

Genus TREMOGASTERINA Canu, 1911

The ovicell is hyperstomial and closed by the operculum. The aperture bears two small cardelles; the operculum, often chitinized, is attached to the ectocyst; the peristome bears three to five hollow spines. The frontal is placed above the ectocyst; it is formed of an olocyst surmounted by a rugose or granulated pleurocyst more or less developed; a central area is perforated by reniform pores. The zooecia are separated by interjunctural pores. Large adventitious avicularia appear between the apertures.

Genotype.—*Tremogasterina problematica* Canu, 1911. Recent genotype, *Tremogasterina* (*Lepralia*) *celleporoides* Busk, 1884.

Range.—Cretaceous (Rocanean)—Recent.

The known species are as follows:

Tremogasterina (*Lepralia*) *celleporoides* Busk, 1884, Australia.
Tremogasterina (*Escharipora*) *mucronata* Smitt, 1872, Florida.
Tremogasterina granulata, new species, Florida.
Tremogasterina ventricosa, new species, Atlantic off Carolina.
Tremogasterina lanceolata, new species, Gulf of Mexico.

Tremogasterina malleolus, new species, Gulf of Mexico.

Tremogasterina problematica Canu, 1911, Rocanean of Argentina.

Tremogasterina (*Poricella*) *maconnica* Canu, 1904, Eocene of Tunis.

Tremogasterina horrida Canu and Bassler, 1923, Miocene of Florida.

Tremogasterina truncatorostris Canu and Bassler, 1923, Miocene of San Domingo.

Tremogasterina (*Galeopsis*) *convexus* Canu and Bassler, 1920, Eocene (Midwayan).

Tremogasterina (*Lepralia*) *areolata* Reuss, 1874, Tortonian of Austria.

Tremogasterina (*Cribrilina*) *cuspidata* Canu and Bassler, 1923, Miocene of Cuba.

Structure.—We have been able to examine a number of recent specimens provided with their chitinous appendages but unfortunately dried. Never have we been able to see the superior ectocyst as in all the other escharian bryozoa (Ascophora). On the contrary, through the frontal pores we have always been able to distinguish the subjacent ectocyst. Moreover, the proximal limit of the opercula being always indecisive, reveals its true nature as an opercular valve attached to the ectocyst. Nevertheless, the anatomical study, after decalcification, of specimens preserved in alcohol is very desirable.

The calcification of the frontal is very difficult to understand. This frontal is formed essentially by an olocyst perforated in the middle by more or less scattered reniform pores, arranged in triangle or like a rose. The superior pleurocyst begins on the sides and invades almost all the frontal, leaving only in the middle an area in which are the reniform pores. We have not been able to observe young zooecia in formation on the zoarial margins nor have we observed directly the development of the pleurocyst. Smitt, 1872, in studying *Tremogasterina mucronata* seems to have been more fortunate, but he is too brief. He remarks:

> As the calcification goes on, at first it fills up the furrows between the zooecia, marking their limits through irregular rows of secondary pores. At last the whole front side of the zooecia is covered by this layer, with the exception of a great hole in their middle into which the above-named lunate pores open themselves.

The pleurocyst is clearly visible around the peristome and on all the ovicells. Removed from all endocystal elements, at least apparently so, its formation is absolutely mysterious. Lang, 1922, has shown an analogous development of secondary tissue in the cribrimorph *Tricephalopora* group. The chamber thus formed between the ectocyst and the calcified frontal appears to us to be a hypostege in connection with the hydrostatic function; it is a kind of external compensatrix. The entrance of water by the pores permits the extrusion of the tentacles while its exit allows their invagination. While in the other Anasca (Flustrines) the hyposteges communicate easily among each other, here they are absolutely individual. This is a specialization which is complete in the Ascophora.

Affinities.—This genus has the structure of the Hiantoporidae in the presence of interjunctural pores and of the large avicularia but we have not seen traces of costules nor of areal spines. In the form of the frontal pores as well as the size of the distal spines, it belongs perhaps to the Arachnopusiidae, but we do not know yet if these two families are really distinct. Finally the presence of cardelles, which denotes the presence of a compensatrix in the Ascophora, indicates an ultimate and unexpected perfection. The place of the genus in the family Hiantoporidae is therefore very doubtful. Smitt, 1872, who was able to understand so well the relationships of the bryozoa, had the same doubts. He says:

> The present species, without doubt, comes nearest to the true Escharae. Their best systematic place, at least provisionally, will be in the beginning of the Escharine series.

In support of this hypothesis we are able to cite the nature of the opercula, which are very close to those of the Petraliidae.

It is then very difficult to introduce the genus in a known family. We consider it provisionally as an ancestral form which engendered *Arachnopusia* and *Hiantopora*, and since we are ignorant of the larva, we prefer to class it doubtfully in the Hiantoporidae in order not to change the present nomenclature.

We have added a second genotype to the genus so as to have a recent species represented. *Lepralia celleporoides* Busk, 1884, appears to have the greatest geographic distribution. We would have chosen *Escharipora mucronata* Smitt, 1872, which is the older, if we had had the good fortune to rediscover it.

Distribution.—The different species of the genus have been observed at all depths from 12 to 448 meters. This bathymetric disposition has as a corollary a great geographic distribution. In fact the genus has been observed in the Atlantic, in the Pacific, and in the China Sea. In the Northern Hemisphere it does not go beyond the thirty-first parallel, and it is therefore a tropical genus. Its paleontologic distribution was consequently larger, and we have seen fossil representations in the Miocene (Tortonian) from Europe and even in the Eocene of Tunis. The oldest species is Cretaceous (Rocanean of Argentina). The genus appears then to have migrated from the Southern Hemisphere toward the Northern Hemisphere. Canu, 1923, has shown that the genus *Mucronella*, in which the first representatives have been found in the Cretaceous of Madagascar, has undergone the same phenomenon.

TREMOGASTERINA GRANULATA, new species

Plate 13, Figures 3, 4; Plate 33, Figure 2; text Figures 6 *b–f*

Description.—The zoarium is unilamellar, often cylindrical. The zooecia are distinct, separated by a line of small interjunctural pores, elongated, claviform; the frontal is much calcified, *granulated*, convex, perforated at the middle by a small pore (pseudoascopore). The aperture is suborbicular, somewhat elongated or a little transverse; the proximal border is concave; there are two salient cardelles at the bottom of the peristomie. The ovicell is hyperstomial, much imbedded in the distal zooecium, large, globular, formed of two calcareous superposed lamellae, the exterior of which is also much granulated; the orifice is large and closed by the operculum. The avicularia are large, triangular, much elongated, with a very thin beak and two lateral denticles.

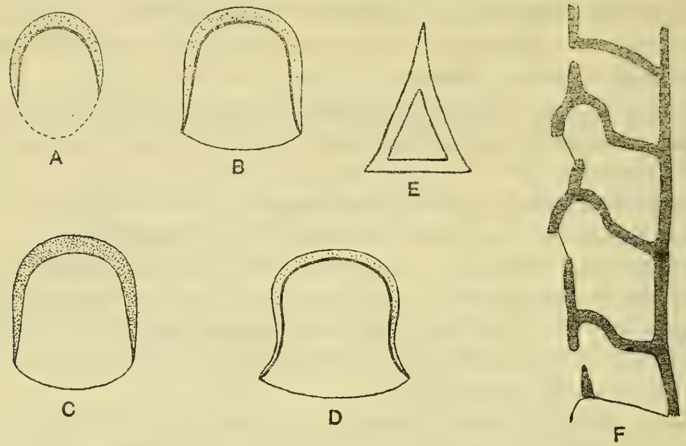

FIG. 6.—GENUS TREMOGASTERINA CANU, 1911, *A.* TREMOGASTERINA LANCEOLATA NEW SPECIES. OPERCULAR VALVE, × 85. *B–F.* TREMOGASTERINA GRANULATA, NEW SPECIES. *B.* ORDINARY OPERCULUM, × 85. *C.* OPERCULUM WITH THICK CHITINOUS BAND. *D.* ANOTHER FORM OF OPERCULUM, × 85. *E.* MANDIBLE, × 85. *F.* LONGITUDINAL SECTION THROUGH AN OVICELLED SPECIMEN, × 20. THE ZOOECIAL WALL IS MUCH CALCIFIED. THE OVICELL IS HYPERSTOMIAL, CLOSED BY THE OPERCULUM

Measurements.—Aperture $\begin{cases} ha = 0.20 \text{ mm.} \\ la = 0.20 \text{ mm.} \end{cases}$

Zooecia $\begin{cases} Lz = 0.75 \text{ mm.} \\ lz = 0.35 \text{ mm.} \end{cases}$

Avicularia $\begin{cases} Lav = 0.50 \text{ mm.} \\ lav = 0.20 \text{ mm.} \end{cases}$

Structure.—The opercular valve is much chitinized; it is ornamented with a continuous sclerite distant from the border; it easily separates from the ectocyst but it is attached to it. It is therefore almost analagous to the operculum of *Petralia.*

Each zooecium is adjacent to two avicularia. The frontal of the latter is very difficult to understand.

On the interior the two cardelles are salient; the frontal is smooth and perforated by the two reniform pores or by three pores arranged in a triangle; the avicularia are not visible, and in spite of their exterior aspect they are clearly adventitious and probably have a zooecial function.

When the calcification is not too intense, four spines are visible on the very thin peristome; the latter is altogether detached from the pleurocyst which covers the frontal; the latter phenomenon is, moreover, visible on all the species of the genus.

The ectocyst is visible on the inner face of the colonies; it is not on the exterior face, but the specimens dredged alive have a beautiful clear white color.

On the fossil specimens the small cribriform area is little apparent and often closed; the small spines of the peristome are still visible.

Affinities.—This species differs from *Tremogasterina mucronata* Smitt, 1873, in the constant absence of the oral mucro and in the absence of three scattered pores on the frontal. It differs from *Tremogasterina horrida* Canu and Bassler, 1923, from the Miocene of Florida in its larger dimensions, in its smaller cribriform area, in its smaller interjunctural pores, and in its unilamellar zoarium. The three species are very closely related.

Occurrence.—*Albatross* Station D. 2639, Straits of Florida; 25° 04′ 50″ N.; 80° 15′ 10″ W.; 56 fms.; coral sand.
Fowey Light, 15 miles south of Miami, Fla., 40 fms.
Pliocene: Minnitimmi Creek, Bocas Island, Almirante Bay, Panama.

Cotypes.—Cat. Nos. 7603, 70863, U.S.N.M.

TREMOGASTERINA VENTRICOSA, new species

Plate 13, Figures 1, 2

Description.—The zoarium encrusts nullipores. The zooecia are distinct, separated by a line of interjunctural pores, very large, ventricose; the frontal is convex, rugose, and often bears a large mucro in the vicinity of the aperture; a large orbicular concavity contains a variable number of small reniform pores arranged concentrically. The aperture is suborbicular, very little elongated; the peristome is very thin and accompanied by five beautiful hollow spines arranged above it. The ovicell is globular, very large, rugose. The avicularia are elliptical, very salient; their orifice is triangular with a complete pivot.

Measurements.—Aperture $\begin{cases} ha = 0.25 \text{ mm.} \\ la = 0.22 \text{ mm.} \end{cases}$

Zooecia $\begin{cases} Lz = 1.00 \text{ mm.} \\ lz = 0.55 \text{ mm.} \end{cases}$

Avicularia $\begin{cases} Lav = 0.45 \text{ mm.} \\ lav = 0.30 \text{ mm.} \end{cases}$

Variations.—This is a very variable species. The mucro is very inconstant, often absent; the number of small pores of the frontal area varies from one zooecium to another; the beak of the avicularium is very pointed or rounded; next to transverse zooecia there are very elongated zooecia. Each avicularium is adjacent to three zooecia but rarely a zooecium is adjacent to two avicularia.

Affinities.—Very close to *Tremogasterina mucronata* Smitt, 1873, in the presence of its frontal mucro, this present species differs in the presence of its concave cribriform area and in the occurrence of five instead of four spines. The figured specimen only has been found.

Occurrence.—*Albatross* Station D. 2672, Atlantic, east of Georgia; 31° 31′ 00″ N.; 79° 05′ 00″ W.; 277 fms.; coarse brown sand.

Holotype.—Cat. No. 7601, U.S.N.M.

TREMOGASTERINA LANCEOLATA, new species

Plate 13, Figure 9; text Figure 6*a*

Description.—The zoarium encrusts nullipores. The zooecia are distinct, separated by a line of interjunctural pores, very elongated, elliptical; the frontal is convex, very finely granulated; it bears a cribriform concavity perforated by one to five pores. The aperture is pyriform, elongated; two small cardelles separate a large anter from a small, narrow, concave poster; the peristome is thin, salient, ornamented with three large hollow spines. The avicularia are very large, much elongated, *lanceolated,* with two denticles for pivot.

Measurements.—Aperture $\begin{cases} ha = 0.17 \text{ mm.} \\ la = 0.12 \text{ mm.} \end{cases}$

Zooecia $\begin{cases} Lz = 0.80 \text{ mm.} \\ lz = 0.30\text{-}0.50 \text{ mm.} \end{cases}$

Avicularia $\begin{cases} Lav = 0.60 \text{ mm.} \\ lav = 0.25 \text{ mm.} \end{cases}$

Structure.—This is a very fragile species of which minute fragments only have been studied. When the frontal calcification is not too great, five pores are visible in the cribriform area; there is only one of them on the calcified frontals.

The operculum is very thin, absolutely indistinct in its proximal portion, and in consequence directly attached to the ectocyst; it bears an internal and complete sclerite characteristic of the genus.

This species is very well characterized by its large lanceolate avicularia.

Occurrence.—*Albatross* Station D. 2319, north of Cuba; 23° 10′ 38″ N.; 82° 20′ 06″ W.; 143 fms.; gray coral.
Albatross Station D. 2320, north of Cuba; 23° 10′ 39″ N.; 82° 18′ 48″ W.; 130 fms.; fine coral.

Holotype.—Cat. No. 7836, U.S.N.M.

TREMOGASTERINA MALLEOLUS, new species

Plate 13, Figures 5–8; Plate 33, Figure 8

Description.—The zoarium is unilamellar and appears to spread over large surfaces on algae. The zooecia are distinct, separated by a line of very small interjunctural pores; the frontal is convex, rugose, ornamented by three reniform pores arranged in a triangle. The aperture is suborbicular; the peristome is very thin and accompanied externally by four long hollow spines. The ovicell is enormous, globular, rugose, embedded in the distal zooecium, closed by the operculum. On the frontal a very salient mucro is developed; it is enlarged at its summit in the form of a *hammer*. The avicularia are small, with pivot; their beak is truncated.

Measurements.—Aperture $\begin{cases} ha = 0.17 \text{ mm.} \\ la = 0.17 \text{ mm.} \end{cases}$

Zooecia $\begin{cases} Lz = 0.75 \text{ mm.} \\ lz = 0.50 \text{ mm.} \end{cases}$

Variations.—The rich decoration of this species renders it very difficult to study and to figure; it appears to be adapted to quiet waters. The mucro is much attenuated in the convex portions of the zoarium; it is, on the contrary, much developed in the concave portions; it shows, therefore, the general rule observed in all the other bryozoa.

In the intensity of calcification the large frontal pores are obliterated and become little visible.

Sporadically a normal zooecium is replaced by a gigantic avicularium of the same form as the others. Its length is also 0.75 mm.

Each zooecium is adjacent to two avicularia of which one is always larger than the other.

Affinities.—This new species differs very little from *Tremogasterina truncatorostris* Canu and Bassler, 1923, from the Miocene of Santo Domingo; its mucro is much more developed and its ovicell is smaller. Better fossil specimens may perhaps show the identity of the two species.

Biology.—The species was in reproduction and fixation on February 29, 1884.

On the fossil specimens all the small ornamentation which surrounds the aperture disappears easily or is much attenuated. Nevertheless the species is still recognizable by its micrometric dimensions and its very polymorphic avicularia with truncated beak. The interjunctural pores are often visible on the inferior noncellular face.

Occurrence.—*Albatross* Station D. 2404, Gulf of Mexico; 28° 44′ 00″ N.; 85° 16′ 00″ W.; 60 fms.; gray sand.

Albatross Station D. 2136, Caribbean Sea; 17° 43′ 40″ N.; 75° 38′ 25″ W.; 52 fms.; coral, broken shells.

Pliocene: Minnitimmi Creek, Bocas Island, Almirante Bay, Panama.

Cotypes.—Cat. Nos. 7602, 70864, U.S.N.M.

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TREMOGASTERINA SPARSIPOROSA, new species

Plate 33, Figure 3

Description.—The zoarium is unilamellar. The zooecia are distinct, separated by a furrow at the bottom of which interjunctural pores are visible, elongated, elliptical. The frontal is convex, finely granular, perforated by four or five round, irregular, separated pores and terminated by a cylindrical mucro more or less salient. The apertura is elliptical, elongated, bordered by a thin peristome. The avicularia are rather large, arranged between the aperture and in the axis of a distal zooecium. They have a fragile pivot and their beak is truncated. The ovicell is globular, somewhat transverse, granular, not closed by the operculum.

Measurements.—Aperture $\begin{cases} ha = 0.18\text{–}0.20 \text{ mm.} \\ la = 0.16\text{–}0.18 \text{ mm.} \end{cases}$

Zooecia $\begin{cases} Lz = 0.75\text{-}0.90 \text{ mm.} \\ lz = 0.45\text{–}0.50 \text{ mm.} \end{cases}$

Affinities.—The avicularia are large when they surmount a distal zooecium; they are small in the contrary case.

This new species differs from the recent *Tremogasterina mucronata* Smitt, 1873, in its round and nonconcentrically arranged pores and in its truncated avicularia. It differs from the recent *Tremogasterina ventricosa* in its narrow aperture, in its much smaller zooecia, and in its long and truncated avicularia. It differs from *Tremogasterina malleolus* in its round, more numerous, and more scattered pores and in its greater micrometric dimensions. The large avicularia measure 0.60 mm. by 0.26 mm.

Occurrence.—Pliocene: Minnitimmi Creek, Bocas Island, Almirante Bay, northwest Panama.

Holotype.—Cat. No. 70865, U.S.N.M.

Genus TREMOPORA Ortmann, 1890

TREMOPORA RADICIFERA Hincks, 1881

1889. *Membranipora radicifera* JELLY, Synonymic Catalogue of Marine Bryozoa, p. 162. (Bibliography.)

We have found only a small specimen of this species but it is typical and well preserved. The zooecia are separated by the interjunctural pores and on the dorsal there are small hydrostatic tuberosities. The occurrence of this species in the recent Gulf of Mexico is quite probable.

Occurrence.—Pliocene: Minnitimmi Creek, Bocas Island, Almirante Bay, Panama.

Distribution.—A widespread species of recent times and in the Miocene of France, Austria, etc.

Family AETEIDAE Smitt, 1867

Genus AETEA Lamouroux, 1812

AETEA TRUNCATA Landsborough, 1852

Plate 1, Figure 1; Plate 32, Figure 1

1914. *Aetea truncata* OSBURN, The Bryozoa of the Tortugas Islands, Florida. Publication Carnegie Institution, Washington, No. 182, p. 186. (Bibliography.)

Common in shallow water and down to 5 fathoms, creeping over shells and seaweed (Osburn). A single specimen on shell.

Harmer ("Siboga," 1926) figures the position of the retracted polypide as well as the jointed filiform appendages which appear sporadically in this species. He proves also that the ovicells noted in the genus *Aetea* are not typical and that they are in reality external ovisacs analogous to those of the Ctenostome genus *Nolella*.

Occurrence.—*Albatross* Station D. 2405, Gulf of Mexico; 28° 45′ N.; 85° 02′ W.; 30 fms.

Pliocene: Minnitimmi Creek, Bocas Island, Almirante Bay, Panama.

AETEA SICA Couch, 1844

Plate 1, Figure 2

1914. *Aetea sica* OSBURN, The Bryozoa of the Tortugas Islands, Florida. Publication Carnegie Institution, Washington, No. 182, p. 186. (Bibliography.)

Tortugas at 10 fathoms on shells (Osburn). One specimen on shell.

Occurrence.—*Albatross* Station D. 2672, Atlantic, east of Georgia; 31° 31′ 00″ N.; 79° 5′ 00″ W.; 277 fms.; coarse brown sand.

Plesiotype.—Cat. No. 7450, U.S.N.M.

Division COILOSTEGA Levinsen, 1909

Family OPESIULIDAE Jullien, 1888

Subfamily ONYCHOCELLIDAE Jullien, 1881

Genus SMITTIPORA Jullien, 1881

Smitt (1872) gave two figures[7] of his *Vincularia abyssicola* of which one (fig. 60, specimen encrusting a *Retepora*) shows only the zooecia with ectocyst and the large onychocellaria; in the text he does not describe zooecia without the ectocyst and the form of the opesium. Moreover the zooecia of *Velumella americana* covered with the ectocyst present absolutely and frequently the same aspect with three regular facettes noted by Jullien as characteristic. This peculiarity

[7] We are not sure that the two figures given by Smitt (in Floridan Bryozoa) of *Vincularia abyssicola* belong to the same species; this description (of the genus *Smittipora*) refers solely to fig. 60. (Translation after Jullien, Bulletin de la Societé Zoologique de France, vol. 6, 1881, p. 15.)

is due to the drying up of the ectocyst and has little connection with the true form of the cryptocyst, for the zooecia without ectocyst have a simple salient mural rim often enlarged into facettes when the cryptocyst is deep. Moreover, the latter have very distinct and often deep opesiular indentations. It is likely that Figure 60 of Smitt corresponds to our *Velumella americana* but it has been distinctly picked out by Jullien as the type of his genus *Smittipora*, although unfortunately none of the Cretaceous species which he classes in the genus have either opesiular indentations or onychocellaria. We have made the same observations on our *Velumella philippinensis*, new species. A dried ectocyst with facettes covers a cryptocyst with opesiular indentations surrounded by a rather regular mural rim and without corresponding facettes.

The genus *Smittipora* is therefore not established on sufficient characters since it is the manifest result of an error of interpretation of Smitt's Figure 60.

If Jullien had read closely Smitt's text, he would have understood that this figure represented only the zooecia with ectocyst and did not reveal the form of the opesium. Logically, it is necessary then to exclude the genus *Smittipora* from the nomenclature.

Since Figure 60 is incomplete and appears to represent another species, Figure 61 remains then the only representative of *Vincularia abyssicola*. The structure revealed by Smitt's drawing, in perfect accord with our photographs, is that which we have indicated in our genus *Rectonychocella*. There are no opesiular indentations to the cryptocyst; the opesium is elliptical or subelliptical; the opesiular muscles are placed very high, a little below the hinge of the opercular valve. The onychocellaria are very variable in form and size but they always have the same structure; they are small in *Vincularia abyssicola*, they are equal to the zooecia, and elliptical in *Rectonychocella solida* (genotype), and they are narrow and lanceolated in our specimens from the American Jacksonian.

The genus *Rectonychocella* corresponds to the genus *Ogivalia* Jullien, 1881, but with bimembranous onychocellaria.

Our classification of 1922 is correct except that it is necessary to suppress the genus *Diplopholos* and place its species in *Velumella*. The zooecial dimorphism on which it was established is only apparent and results simply from the great irregularity of the opesium, a frequent and ordinary phenomenon in all the Onychocellidae. The following table gives a summary of our classification:

Onychocellaria falciform:
- Opesiular indentations nonsymmetrical ---------- Onychocella.
- No opesiular indentations ---------- Ogivalia.

Onychocellaria bimembranous:
- Opesiular indentations symmetrical ---------- Velumella.
- No opesiular indentations ---------- Rectonychocella.

Genus RECTONYCHOCELLA Canu and Bassler, 1917

RECTONYCHOCELLA ABYSSICOLA Smitt, 1873

Plate 5, Figures 1–3

1873. *Vincularia abyssicola* SMITT, Floridan Bryozoa. Kongl. Svenska Vetenskaps-Akademiens Handlingar, vol. 11, p. 6, pl. 1, fig. 61 (not 60).
1881. *Vincularia abyssicola* HINCKS, Contributions, General History of Marine Polyzoa. Annals and Magazine of Natural History, ser. 5, vol. 7, p. 155 (sep. 42), pl. 10, fig. 4.
1882. *Vincularia abyssicola* HINCKS, Annals and Magazine of Natural History, ser. 5, vol. 9, p. 85.
1884. *Smittipora abyssicola* HINCKS, Annals and Magazine of Natural History, ser. 5, vol. 13, p. 358 (sep. 114).
1887. *Smittipora abyssicola* HINCKS, Critical notes on the Polyzoa. Annals and Magazine of Natural History, ser. 5, vol. 19, pp. 161, 164.
1891. *Onychocella abyssicola* HINCKS, Contributions. General History Marine Polyzoa, Annals and Magazine of Natural History, ser. 6, vol. 5, p. 177.
1893. *Onychocella abyssicola* HINCKS, Annals and Magazine of Natural History, ser. 6, vol. 11, p. 204.

Measurements.—Opesium $\begin{cases} ho = 0.25\text{–}0.30 \text{ mm.} \\ lo = 0.25 \text{ mm.} \end{cases}$

Zooecia $\begin{cases} Lz = 0.75 \text{ mm.} \\ lz = 0.50 \text{ mm.} \end{cases}$

Structure.—Our specimen is incrusting, but grows into free, cylindrical stems formed of six longitudinal series of zooecia, conforming perfectly thus with the specimen studied and figured by Smitt.

The mural rim is somewhat salient, but it is often absent, and the zooecia are then separated by a furrow. The cryptocyst is convex and finely granulated. The opesium is often marginated, either regularly elliptical or presenting only a concave proximal border.

The onychocellarium is much smaller than the zooecia; it is ogival and rather irregular in its dimensions. Smitt's specimen appears to bear somewhat larger onychocellaria—the only appreciable difference.

The micrometric dimensions are quite variable. We have measured a large zooecium of 1.00 mm. by 0.75 mm. and small opesia of 0.20 by 0.15 mm.

A small portion was covered by the ectocyst, and we were thus able to prepare the opercular valve. It is exactly similar to that figured for *Velumella* by Levinsen, 1909. The attachments of the opesiular muscles are at the same place. The figure of Nordgaard for *Rectonychocella solida* appears to us then incomplete in its inferior part.

The ancestrula is small and surrounded by five very irregular zooecia.

Affinities.—This species differs from the genotype *Rectonychocella solida* Nordgaard, 1907, in the presence of much smaller onychocellaria.

Our photograph is very similar to Smitt's Figure 61. The opesium is elongated, without opesiular indentations, with concave proximal border. The onychocellaria are small, and the mandible is narrow. Harmer, 1926, represents *Smittipora abyssicola* as having a transverse opesium with two opesiular indentations, with a convex proximal border in which the onychocellarium is large and the mandible is very broad. These characters, absolutely opposed to those which we have observed on Smitt's species, causes us to reject his determination. We give the new name *Velumella harmeriana* to the species figured by him, which is distinct also in its opesium and its mandible from *Velumella levinseni*.

The figure of Hincks, 1881 (Singapore or Philippines), conforms also to the drawing of Smitt. Perhaps the slight difference observed in the form of the mandible would authorize the formation of a variety or of a distinct species. We do not understand why Harmer compared this species with his *Smittipora cordiformis* found by him in the Malay region. The opesium is not elongated there; its proximal border is concave with feeble opesiular indentations, the onychocellarium is large, and the mandible is very broad. We have not accepted the synonymy of Harmer, and we refer to his species as *Velumella cordiformis* Harmer, 1926.

Biology.—The considerable reduction of the onychocellarium, compared with the dimensions measured on other specimens of the genus, seem to indicate that *Rectonychocella abyssicola* lives in a rather rapid marine current.

Occurrence.—*Albatross* Station D. 2152, 2½ miles northwest of Florida, Habana Light; 387 fms.; coral. 110 meters, on a Nullipore (Smitt); off Cojima, Cuba, 628 meters (Hincks).

Plesiotype.—Cat. No. 7576, U.S.N.M.

Genus VELUMELLA Canu and Bassler, 1917

VELUMELLA AMERICANA, new species

Plate 6, Figures 9, 10; text Figure 7

1873. *Vincularia abyssicola* Smitt, Floridan Bryozoa, pt. 2. Kongl. Svenska Vetenskaps-Akademiens Handlingar, vol. 11, No. 4, p. 6, pl. 1, fig. 60 (not 61).

1914. *Smittipora abyssicola* Osburn, Bryozoa of the Tortugas Islands, Florida. Publication Carnegie Institution, Washington, No. 182, p. 195.

Description.—The zoarium encrusts shells, serpulae, and especially nullipores. The zooecia are distinct, separated by a deep furrow, hexagonal, elongated, often ogival; the mural rim is thin in its distal part, enlarged laterally into facettes along the sides according to the depth of the cryptocyst; the cryptocyst is concave longitudinally, smooth, more or less deep. The opesium is large, somewhat elongated, semielliptical, with a convex proximal border and two rather deep lateral opesiular indentations; it is surrounded by a very little salient cushion. The ovicell is small and endozooecial. The onychocellarium is as large as the adjacent zooecia, elliptical or fusiform; its opesium is oval, the point below; the mandible is large, ornamented with two membraneous wings forming an oval ensemble attached to a rachis triangular proximally and setiform at its extremity.

Measurements.—Opesium $\left\{\begin{array}{l} ho = 0.25 \text{ mm.} \\ lo = 0.25 \text{ mm. (with opesiules).} \end{array}\right.$

Zooecia $\left\{\begin{array}{l} Lz = 0.70\text{–}0.80 \text{ mm.} \\ lz = 0.40\text{–}0.50 \text{ mm.} \end{array}\right.$

Variations.—Not a zooecium resembles its neighbor nor does a single onychocellarium resemble another; polymorphism is considerable. The frontal bears three facettes—a median facette formed by the cryptocyst and two lateral facettes formed by the enlargement of the mural rim—but they are not regular. The orientation of the zooecia is indecisive, a phenomenon rather rare in the encrusting bryozoa and caused here by the presence of certain zooecia which engender two or three equal zooecia and by the position of many onychocellaria intercalated sporadically between two adjacent longitudinal series.

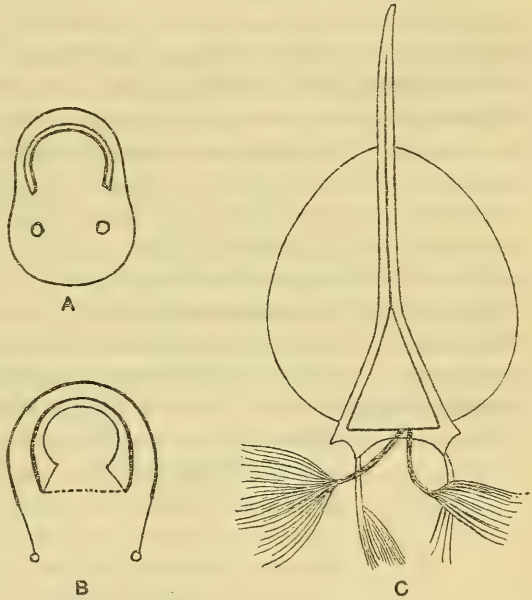

FIG. 7.—VELUMELLA AMERICANA NEW SPECIES. *A.* PORTION OF THE ECTOCYST, × 85, COVERING THE OPESIUM, SHOWING THE APERTURAL STRUCTURE. *B.* DRAWING, × 85. *C.* MANDIBLE OF THE ONYCHOCELLARIUM WITH THE ELEVATOR AND OCCLUSOR MUSCLES, × 85

Structure.—The ectocyst is thick. The opercular valve is completely surrounded by a kind of peristome formed by the small cushion which surrounds the opesium; it is itself bordered distally and laterally by a little thickened sclerite but of a deeper color. The dimensions are rather constant and slightly transverse, namely, length of opercular valve 0.16 mm.; width, 0.16 to 0.18 mm. The aperture exactly closed by the valve is bordered by a large sclerite, placed on the internal side of the cushion and attached to the two extremities of the opercular sclerite. On the external side of the opesial cushion there is another exterior sclerite prolonged under the valve up to the opesiule. This character is little visible on the photograph, for it is manifested especially by a slight modification in the color of the ectocyst. When the ectocyst is dried, it is supported on the facettes of the frontal and assumes the aspect of Smitt's Figure 60 but with much less regularity; this appearance causes us to suppose that it represents more the present species than that shown in Figure 61. On the same dried ectocyst the trace of opesiular muscles is indicated by two small concavities placed exactly at the level of the opesiular indentations.

The onychocellarium is provided with a large bimembranous mandible. The membrane is very thin and oval. When the mandible is raised it hides a part of the distal zooecium; when it is lowered it hides entirely the cryptocyst of the onychocellarium[8] and the rachis is inserted in the groove which separates the two proximal zooecia; the free portion of the rachis is very flexible and takes different forms. Two vigorous pairs of muscles move the mandible. Each onychocellarium is fundamentally pentagonal, for it is always adjacent to five zooecia. It is only very exceptionally and in the vicinity of the ancestrula that it is lozenge-shaped and adjacent to four zooecia.

Biology.—The ectocyst alone is colored yellow. Our living specimens were in reproduction from January to May, 1885. We have not found parasites on the living specimens.

Affinities.—This species differs from *Velumella pusilla*, new species, in its much larger dimensions and in the large oval membranes of the mandibles. It differs from *Rectonychocella elongata* of the Miocene of North Carolina in the constant presence of opesiular indentations.

Occurrence.—*Albatross* Station D. 2319, north of Cuba; 23° 10′ 37″ N.; 82° 20′ 06″ W.; 143 fms.; gray coral.

Albatross Station D. 2322, north of Cuba; 23° 10′ 54″ N.; 82° 17′ 45″ W.; 115 fms.; coral.

Albatross Station D. 2405, Gulf of Mexico; 28° 45′ 00″ N.; 85° 02′ 00″ W.; 30 fms.; gray sand, broken coral.

Fowey Light, 15 miles south of Miami, Fla., 64 miles from Florida; 77 meters (Smitt), Tortugas; low water to 24 meters (Osburn).

Cotypes.—Cat. No. 7612, U.S.N.M.

Subfamily MICROPORIDAE Hincks, 1880

Genus DACRYONELLA Canu and Bassler, 1917

The polypidian convexity protrudes very little and is inconstant. The opesiules are large, round, lateral indentations. The ovicell is endozooecial. There are no opesial processes (therefore an opercular

[8] This phenomenon is general in all the Opesiulidae. We have found it in the mandibular opercula of *Steganoporella* and in opercular mandibles of *Siphonoporella*.

valve). The opesium is elongated (therefore the parietal muscles are much developed). The avicularia are very small, constant, placed in all the interzooecial angles, and have the form of small tear drops.

Genotype.—Dacryonella octonaria Canu and Bassler, 1917. Recent genotype, *Dacryonella typica* new species.

Range.—Cretaceous (Santonian)—Recent.

Structure.—In 1920 we pointed out the morphologic characters of this genus based on a fossil species found in the Eocene (Jacksonian). The study of recent specimens has entirely confirmed our deductions and we have no changes to make. However, it is preferable to accept for a second genotype a recent species from the Gulf of Mexico which will always be easy to procure for further study relative to the anatomy or to the larval system. We have discovered four other recent species in the Philippines.—*Dacryonella ogivalina, D. papillata, D. trapezoides,* and *D. subvespertilio.*

Up to the present this is a tropical genus. The presence in the European Cretaceous (Santonian) of the island of Rügen indicates the warmth of the Cretaceous seas of Europe and how important for the paleontologist is the study of the recent equatorial faunas.

DACRYONELLA TYPICA, new species

Plate 5, Figures 4–8; Plate 32, Figures 11, 12; text Figure 8*a*

Description.—The zoarium encrusts other bryozoa, hydrocorallines, corals, serpulae, and nullipores. The zooecia are distinct, separated by an elongated furrow, pyriform; the mural rim is thin, salient, much attenuated in the proximal part of the zooecium; the cryptocyst is smooth, shallow, somewhat convex. The opesium is elongated, pyriform, limited by the mural rim; the proximal border is more or less convex. The ovicell is small, endozooecial, convex, smooth. The small interzooecial avicularia are thin, elongated, triangular, very constant.

Measurements.—Opesium $\begin{cases} ho = 0.20 \text{ mm.} \\ lo = 0.15 \text{ mm.} \end{cases}$

Zooecia $\begin{cases} Lz = 0.45 \text{ mm.} \\ lz = 0.30 \text{ mm.} \end{cases}$

Variations.—Our measurements are average for the variations are so great on the same colony that it is impossible to give them accurately. The species of this genus are, moreover, quite variable; it is very difficult to differentiate those with nearly similar measurements, and one must have several specimens to make an exact determination. The ancestrular zooecia have a small opesium with a large cryptocyst; the marginal zooecia have a very large opesium and a small cryptocyst.

Structure.—The lateral indentations of the opesium appear to indicate the place of the opesiular muscles, but we have not been able to confirm this because our specimens had become dried. The ectocyst, moreover, is very thin. The opercular valve is semielliptical, transverse, and measures about 0.12 mm. by 0.07 mm.; on our preparations it appears thicker in its median portion. The small avicularia measure at the maximum 0.10 mm. by 0.05 mm.; we do not understand their utility for zooecia relatively so large.

Affinities.—This recent species differs from *Dacryonella octonaria* Canu and Bassler, 1917, of the Eocene (Jacksonian) in its oval opesium, its deeper opesiular indentations, and its unilamellar zoarium.

Biology.—The colonies have a light rose color. Our specimens were dredged alive and were in reproduction January 17, 1885. This is a species of deep waters and a commensal of the marine currents. We have observed some cases of total regeneration in the vicinity of the ancestrula.

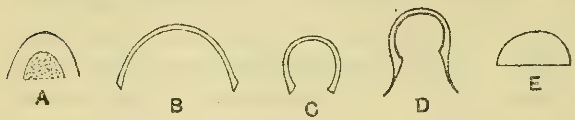

Fig. 8.—Opercular valves of Opesiulae. *A.* Dacryonella typica, new species. Valve somewhat thickened in the middle. *B.* Floridinella typica, new species. *C, D.* Floridina antiqua Smitt, 1873. *E.* Micropora coriacea Esper, 1791

Occurrence.—*Albatross* Station D. 2319, north of Cuba; 23° 10′ 37″ N.; 82° 20′ 06″ W.; 143 fms.; gray coral.

Albatross Station D. 2320, north of Cuba; 23° 10′ 39″ N.; 82° 18′ 48″ W.; 130 fms.; fine coral.

Albatross Station D. 2160, off Habana, Cuba; 23° 10′ 31″ N.; 82° 20′ 37″ W.; 167 fms.; coral.

Pliocene: Minnitimmi Creek, Bocas Island, Almirante Bay, Panama.

Cotypes.—Cat. Nos. 7484, 7485, 70838, U.S.N.M.

Genus FLORIDINELLA Canu and Bassler, 1917

The ovicell is endozooecial and separated from the zooecia by a fold. The polypidian convexity is not prominent. The opesiular indentations are large and rounded. The opesium is constricted by two symmetrical lateral teeth at the level of the opercular articulation.

Genotype.—*Floridinella vicksburgica* Canu and Bassler, 1917. Recent genotype, *F. typica*, new species.

We based this genus on fossil specimens from the Oligocene (Vicksburgian), but the study of recent specimens has not caused us to make any changes in our diagnosis. As in similar cases, the recent species should be accepted as a second genotype.

The opercular valve is supported on two small lateral condyles, but it is always adjacent to the mural rim. In *Floridina,* on the contrary, it is isolated from the mural rim. Moreover, on our specimens we have never observed onychocellaria. This absence of adventitious organs appears to indicate a genus which is commensal in the great marine currents.

FLORIDINELLA TYPICA, new species

Plate 6, Figures 6, 7; text Figure 8*b*

Description.—The zoarium encrusts shells and nullipores. The zooecia are distinct, separated by a furrow, irregularly oval, somewhat elongated; the mural rim is very thin, smooth, salient, complete; the cryptocyst is shallow, flat, granulated. The opesium is large, subtrifoliated; the proximal border is concave or convex with very small opesiular indentations; the two lateral condyles are small and deep. The ovicell is endozooecial, small, little salient. There are frequently small interzooecial tuberosities.

Measurements.—Opercular valve $\begin{cases} ha = 0.08 \text{ mm.} \\ la = 0.14 \text{ mm.} \end{cases}$

Zooecia $\begin{cases} Lz = 0.50 \text{ mm.} \\ lz = 0.40 \text{ mm.} \end{cases}$

Variations.—This species is very irregular in its micrometric measurements, but its general aspect is rather constant. The two lateral condyles on which the opercular valve is supported are not always very apparent, for they are deeply located and attached to the inferior part of the mural rim. The small interzooecial tuberosities, although sporadic, are very characteristic. The opesiular indentations are not always visible, for the proximal border of the opesium is often concave.

This species is not so beautiful, so vigorous, or so characteristic as the fossil genotype, *Floridinella vicksburgica*, but as it is the only recent species to be procured in abundance we have chosen it as the recent type of the genus.

Biology.—Our living specimens were ovicelled.

Occurrence.—*Albatross* Station D. 2639, Straits of Florida; 25° 04′ 50″ N.; 80° 15′ 10″ W.; 56 fms.; coral sand.

Fowey Light, 15 miles south of Miami, Fla.; 40 fms.

Cotypes.—Cat. No. 7497, U.S.N.M.

FLORIDINELLA PARVULA, new species

Plate 6, Figure 8

Description.—The zoarium encrusts nullipores and gastropod mollusks. The zooecia are *small*, distinct, separated by a deep furrow, oval, short; the mural rim is thin, small salient, much attenuated proximally; the cryptocyst is short, flat, shallow. The opesium is oval, elongated, trifoliate; the two lateral condyles are salient; the proximal border is convex with two irregular opesiular indentations. The ovicell is small and endozooecial. Sometimes small tubercles appear sporadically between the zooecia.

Measurements.—Opesium $\begin{cases} ho = 0.12 \text{ mm.} \\ lo = 0.07 \text{ mm.} \end{cases}$

Zooecia $\begin{cases} Lz = 0.25 \text{ mm.} \\ lz = 0.20 \text{ mm.} \end{cases}$

Biology.—All of our specimens were dead. The number of species of bryozoa which encrust gastropods is rather restricted, and they are generally small. They appear to find in the irregularities of the surface of mollusks conditions unfavorable to their development.

Occurrence.—*Albatross* Station D. 2639, Straits of Florida; 25° 04′ 50″ N.; 80° 15′ 10″ W.; 56 fms.; coral sand.

Holotype.—Cat. No. 7498, U.S.N.M.

Genus FLORIDINA Jullien, 1881

The retractor muscles of the polypide are attached in the median axis of the zooecium. The opesiular indentations are symmetrical, very large, limited above by the two very salient opesial processes and placed on each side of a much produced, semitubular, polypidian convexity. The zooecium is closed by an operculum attached to the ectocyst; the opercular axis of rotation is located above the two opesial processes. The onychocellaria are straight, without the small distal canal, rounded at their apex; the mandible is bimembranous. Ovicell endozooecial.

The genus *Floridina* is apparently restricted to the equatorial zone in the Gulf of Mexico for it has not yet been found in any other locality. We have observed it fossil in the Jacksonian of Mississippi, Georgia, and North Carolina. It disappeared in the Vicksburgian of Alabama and Mississippi, probably due to cooling of the temperature.

FLORIDINA ANTIQUA Smitt, 1873

Plate 6, Figure 1; text Figures 8*c*, *d*

1873. *Mollia antiqua* SMITT, Floridan Bryozoa, pt. 2. Kongl. Svenska Vetenskaps-Akademiens Handlingar, vol. 11, no. 4, p. 12, pl. 2, fig. 73 (not Busk 1853).

1881. *Floridina antiqua* JULLIEN, Nouvelle division des Bryozoaires cheilostomiens. Bulletin de la Société Zoologique de France, vol. 6, p. 14.

Structure.—The microporoid structure of this species did not escape Smitt who allied it with the group *Micropora*, *Thalamoporella*, and *Steganoporella* with a certainty really remarkable at an epoch when the anatomical studies were still much restricted. Jullien in 1881 and 1888 was the first to discover the function of the opesiular muscles and to determine the structure of the frontal. Our generic definition of 1920 is correct, as our new study of the genotype confirms it.

The ectocyst entirely surrounds the zooecium; a sclerite little thickened surrounds the termen of the mural rim. The aperture, semi-elliptical and transverse, is bordered with a strong sclerite in which the sclerite of the opercular valve is exactly inserted. We are obliged to separate these two sclerites on our figures in order to show their independence, but on the specimen it is impossible to separate them.

The opercular valve is supported laterally on the two condyles of the opesium. It is always removed from the mural rim, especially laterally. The attachments of the opeciular muscles are indicated in the opercular preparations by two black points rather removed from the hinge joint of the valve.

The opesium, very constant in its general form, is very irregular in its dimensions; the two lateral condyles are large and salient. The mural rim is salient and the cryptocyst is somewhat granulated.

The onychocellarium is oval, often triangular in its distal portion. The two membraneous wings of the mandible are very fragile and we have not yet been able to make a good preparation of them.

In 1920 we determined as *Floridina antiqua* a Jacksonian species much larger and much more vigorous. We were deceived by the enlargement of the figure of Smitt, who has never given the magnification of his drawing. It is necessary then to change the name of the fossil species to which we here apply the new name *Floridina robusta*.

Measurements.—Opesium $\begin{cases} ho = 0.14\text{–}0.16 \text{ mm.} \\ lo = 0.20 \text{ mm.} \end{cases}$

Zooecia $\begin{cases} Lz = 0.40\text{–}0.50 \text{ mm.} \\ lz = 0.40 \text{ mm.} \end{cases}$

Opercular valve $\begin{cases} ho = 0.08 \text{ mm.} \\ lo = 0.10 \text{ mm.} \end{cases}$

Onychocellaria $\begin{cases} hon = 0.30 \text{ mm.} \\ lon = 0.16\text{–}0.20 \text{ mm.} \end{cases}$

Biology.—Our living specimens were ovicelled April 9, 1885. The ectocyst only is pigmented with a clear brown. This color is not constant and depends on the substratum, for one of our specimens is rose colored on one side and green on the other, according to the color of the nullipore which it encrusts. The greater part of the time the pigmentation appears to be that of the phytoplancton. To the present time this species has not been dredged from great depths.

Occurrence.—*Albatross* Station D. 2405, Gulf of Mexico; 28° 45′ 00″ N.; 85° 02′ 00″ W.; 30 fms.; gray sand, broken coral.

Albatross Station D. 2639, Straits of Florida; 25° 04′ 50″ N.; 80° 15′ 10″ W.; 56 fms.; coral sand.

Fowey Light, 15 miles south of Miami, Fla.; 40 fms.

Florida, 47–71 meters (Smitt).

Plesiotypes.—Cat. Nos. 7495, 7496, U.S.N.M.

Genus MICROPORA Gray, 1848

MICROPORA CORIACEA Esper, 1791

Text Figure 8*e*

1873. *Micropora coriacea* SMITT, Floridan Bryozoa. pt. 2. Kongl. Svenska Vetenskaps-Akademiens Handlingar, vol. 11, no. 4, p. 13, pl. 2, fig. 74.

1920. *Micropora coriacea* CANU and BASSLER, North American Early Tertiary Bryozoa. Bull. 106, U. S. National Museum, p. 235, pl. 4 figs. 20–22. (Bibliography, geographic and geologic distribution.)

Measurements.—Aperture $\begin{cases} ha = 0.06 \text{ mm.} \\ la = 0.12 \text{ mm.} \end{cases}$

Zooecia $\begin{cases} Lz = 0.44\text{–}0.50 \text{ mm.} \\ lz = 0.26\text{–}0.30 \text{ mm.} \end{cases}$

Variations.—Our micrometric measurements are a little less than those exhibited on the fossil specimens; they, however, conform to the usual variations of the species.

The aperture is closed by a true light-colored very simple operculum which we have illustrated. Smitt gave its length 0.12–0.16 mm. in conformity with our measurements.

Biology.—Our specimens encrust shells and nullipores. Many of them were living and ovicelled in March and April, 1885.

Occurrence.—*Albatross* Station D. 2405, Gulf of Mexico; 28° 45′ 00″ N.; 85° 02′ 00″ W.; 30 fms.; gray sand, broken coral.

Albatross Station D. 2639, Straits of Florida; 25° 04′ 50″ N.; 80° 15′ 10″ W.; 56 fms.; coral sand.

Florida, 58 to 218 meters (Smitt).

Family CALPENSIIDAE Canu and Bassler, 1923

Genus HEMISEPTELLA Levinsen, 1909

HEMISEPTELLA DENTICULATA Smitt, 1873

Plate 9, Figure 9

1873. *Biflustra denticulata* SMITT, Floridan Bryozoa. Kongl. Svenska Vetenskaps-Akademiens Handlingar, vol. 11, no. 4, p. 18, pl. 4, figs. 89–91.

Measurements (after Smitt).—

Operculum $\begin{cases} ho = ? \\ lo = 0.10 \text{ mm.} \end{cases}$

Zooecia $\begin{cases} Lz = 0.58 \text{ mm.} \\ lz = 0.28 \text{ mm.} \end{cases}$

Structure.—The figures of Smitt are perfectly exact. We class the species in *Hemiseptella* because of the presence of opesial spicules, but we have not seen the trace of opesiular muscles on the ectocyst. The irregularity of the proximal portion of the opesium indicates that the retractor muscles of the polypide are not attached to the zooecial median axis. The ectocyst is light colored when it is not pink, very thin, and almost transparent.

Biology.—The colony expands often over large surfaces and one of our specimens measured 4 by 2 centimeters. It becomes pigmented easily. Smitt cited the cryptocyst as being of a marine-bluish hue; one of our specimens was rose and green and covered by a flesh-colored ectocyst.

We have observed colonies developed on the two sides of a dead shell. This is a phenomenon that is not rare, but the explanation of it is difficult. It is necessary to admit either an accidental turning of the shell or its vertical position between two stones which serve to support it. This is almost a littoral species.

Occurrence.—Tortugas, Florida, 16 meters (Smitt); Punta Rosa, Florida.

Plesiotype.—Cat. No. 7513, U.S.N.M.

HEMISEPTELLA HEXAGONALIS, new species

Plate 28, Figure 9

Description.—The zoarium is incrusting. The zooecia are distinct, separated by a very thin and shallow furrow, hexagonal, somewhat elongated; the mural rim is thin and finely granulated; the cryptocyst is concave, little developed, much smaller than the opesium, granulated. The opesium is large, elongated, dissymetric in its proximal portion, often subtrifoliate; it is bordered by short and widely spaced spicules. In all the interzooecial angles there is a large smooth and hollow tubercle.

Measurements.—Opesium $\begin{cases} ho = 0.30 \text{ mm.} \\ lo = 0.24 \text{ mm.} \end{cases}$

Zooecium $\begin{cases} Lz = 0.45 \text{ mm.} \\ lz = 0.35 \text{mm.} \end{cases}$

Affinities.—The micrometric dimensions are quite variable; of the primoserial, adjacent zooecia, there is one of them always shorter. The initial zooecium of a series is frequently broader. The cryptocyst is little developed on the marginal zooecia.

This species differs from *Hemiseptella* (*Biflustra*) *denticulata* Smitt, 1873, in its granulated and much smaller cryptocyst. It differs from *Membranipora denticulata* Busk, 1856, of Mazatlan in the presence of large tubercles and in its hexagonal zooecia. It differs from *Hemiseptella tuberosa* Canu and Bassler, 1923, from the Pleistocene of South Carolina in its much larger dimensions. The very special form of the opesium does not permit us to compare this species with *Nitscheina* (*Membranipora*) of the *membranacea* group.

Occurrence.—*Albatross* Station D. 2619, western Atlantic; 33° 38′ N.; 77° 36′ W.; 15 fms.; coarse yellow sand and broken shells.

Holotype.—Cat. No. 7512, U.S.N.M.

Genus CUPULARIA Lamouroux, 1821

CUPULARIA DOMA D'Orbigny, 1852

Plate 6, Figures 2–5

1923. *Cupularia doma* Canu and Bassler, North America Later Tertiary and Quaternary Bryozoa. Bull. 125, U. S. National Museum, p. 77, pl. 1, fig. 18, pl. 15, figs. 1–5.

The reader is referred to our work of 1923 for the bibliography and remarks upon this species which, although associated in the recent and ancient Gulf of Mexico with the widespread *C. umbellata* Defrance, 1823, is readily distinguished by its more conical form and its spinous processes not joined together.

Occurrence.—*Albatross* Station D. 2639, Straits of Florida; 25° 04′ 50″ N.; 80° 15′ 10″ W.; 56 fms.; coral sand. Florida, 47 meters (Smitt).

Plesiotypes.—Cat. No. 7830, U.S.N.M.

CUPULARIA UMBELLATA Defrance, 1823

Plate 7, Figures 1–3

1914. *Cupularia lowei* Osburn, Bryozoa of the Tortugas Islands, Florida. Publication Carnegie Institution, Washington, no. 182, p. 194.

Our specimens from the Gulf of Mexico are not as fully developed as the European fossil specimens, for in the French Redonnian it is not rare to find zoaria 1 centimeter in diameter. This species is so common that we are convinced many variations are possible. It appeared with the inauguration of the Miocene and it has rapidly propagated in the Atlantic, but on the American side is now much less common and is in course of extinction.

Occurrence.—Various localities in the Gulf of Mexico; Tortugas, 19–35 meters (Osburn); Florida, 47 meters (Smitt). Atlantic; Beaufort, N. C. (Osburn); Cape Fear River, 11 meters (Smitt).

Plesiotypes.—Cat. No. 7831, U.S.N.M.

Family STEGANOPORELLIDAE Hincks, 1884

Genus STEGANOPORELLA Smitt, 1873

STEGANOPORELLA MAGNILABRIS Busk, 1854

Plate 7, Figures 8–10; Plate 32, Figure 6

1923. *Steganoporella magnilabris* Canu and Bassler, North American Later Tertiary and Quaternary Bryozoa. Bull. 125, U. S. National Museum, p. 63, pl. 14, figs. 12, 13. (Bibliography.)

1926. *Steganoporella magnilabris* Harmer, Polyzoa "Siboga" Expedition, pt. 2, p. 277, pl. 17, figs. 1–3, 7, 9, 12, text fig. 10. (Bibliography and anatomical studies.)

Measurements.—Operculum (A zooecia) $\begin{cases} ho = 0.40\text{–}0.45 \text{ mm.} \\ lo = 0.50 \text{ mm.} \end{cases}$

Operculum (B zooecia) $\begin{cases} 0.60 \text{ mm.} \\ 0.75 \text{ mm.} \end{cases}$

Zooecia $A \begin{cases} hz = 1.00 \text{ mm.} \\ lz = 0.75 \text{ mm.} \end{cases}$

Zooecia $B \begin{cases} 1.25\text{–}1.50 \text{ mm.} \\ 0.75 \text{ mm.} \end{cases}$

Structure.—Since the fine work of Harmer, 1890, and that of Waters, 1913, the internal structure of this remarkable animal is now very well known. We agree entirely with the masterly work of Harmer, 1926.

The ectocyst, naturally light colored, is thick and entirely covers all the zooecia; it is smooth but generally dirty. The hinge of the operculum is placed at the level of the orifice of the polypidian tube. The trace of opesiular muscles is quite visible and revealed by two concavities symmetrically disposed on the dried specimens.

The structure of the A opercula is quite special and well known; but that of the B opercula has been up to the present poorly interpreted because absolutely unexpected. In short, it is the structure of an avicularium with its rachis with two small pillars arranged in a triangle. It is therefore a mandibular operculum. It fills the triple function of assuring the closing of the zooecium, the entrance of the hypostege and oxygenation compatible with the extreme vigor of the zooecia. The hooks of the peripheral sclerite grip the mural rim and assure the closing. The size of this mandibular operculum is exactly that of the cryptocyst which it covers entirely and exactly when the cell is open.

The occlusur muscles of the A opercula are attached to the longitudinal sclerites and at the level of the superior extremity of the tentacular sheath; they form three vigorous bundles; we reproduce an unretouched photograph. When the mandibular B operculum is open all the interior of the cell thus visible is lined by a membranous cryptocyst covering the entire muscular system and perforated only at the level of the polypidian tube for the passage of the numerous tentacles.

Variations.—The micrometric variations are considerable. Smitt had already in 1872 discovered that the size of the opercula varied from 0.40 to 0.86 mm. The figures of Harmer, 1890, indicate much greater variations. Our specimens from the Philippines have zooecial dimensions much smaller; those from Honolulu are still smaller. It is then in the Gulf of Mexico that the species developed best and Harmer cited the large dimensions of the specimens from Jamaica.

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Biology.—According to Osburn, the zoarium encrusts shells, coral, and sponges. All our specimens were unilamellar and free; they creep over fragile, destructible, or easily detached organisms.

The ectocyst is, according to the rule, light colored; it is of the same color as the nullipores on which the zoarium is often attached; we have thus the beautiful rose-tinted specimens attached to nullipores of the same color. Moreover, "the color varies from pink to reddish brown" (Osburn).

The ovisac containing the eggs and embryos is placed in the distal portion of the ordinary (not mandibular) zooecia in the vicinity of the vestibule. The spermatic cells are dispersed in the general cavity of the two kinds of zooecia.

Because of its large dimensions, this species even when living is easily encrusted by the small species of bryozoa. The latter develop very rapidly on the ectocyst; they are not in the least disturbed by the movement of the mandibular operculum which they impede when the latter remained closed for a long time. We have several colonies dredged alive on which three or four cellules are entirely covered and rendered immobile by the small Membranipores or Cribrimorphs. The instinct of the larvae of these parasites is quite remarkable, for they appear to understand that the large animals can subsist only when in the midst of great planctonic richness.

This is a species of shallow water from 15 to 50 meters. It can live at greater depths; Ortman noted it from Japan to 320 meters and we ourselves have observed it from the Philippines at 283 and 372 meters, but these are the exceptional cases in which the specimens are rare or dead. It is very vigorous and almost universal, for it has been observed in all the oceans. It is especially equatorial, but it passes beyond the Tropics, for it is found in the Pacific as far as Japan and the Sandwich Islands. As it does not encircle a single continent, it must have found a passage of dissemination in the ancient seas. In fact, it is already known in the fossil state in the American and Australian Miocene. Perhaps our *Steganoporella parvula* from the lower Miocene of Bowden, Jamaica, is the primitive and ancestral variety. In Europe it is replaced by the superb *Steganoporella elegans* Milne Edwards, 1838, very common in all the Miocene formations.

Occurrence.—*Albatross* Station D. 2324 north of Cuba; 23° 10′ 25″ N.; 82° 20′ 24″ W.; 33 fms.; coral.

Albatross Station 2327, north of Cuba; 23° 11′ 45″ N.; 82° 17′ 54″ W.; 182 fms.; fine brown sand.

Albatross Station D. 2365, east of Yucatan; 22° 18′ 00″ N.; 87° 04′ 00″ W.; 24 fms.; white rock coral.

Albatross Station D. 2405, Gulf of Mexico, 28° 44′ 00″ N.; 85° 16′ 00″ W.; gray sand.

Albatross Station D. 2639 Straits of Florida; 25° 04′ 50″ N.; 80° 15′ 10″ W.; 56 fms.; coral sand.

Fowey Light, 15 miles south of Miami, Fla., 40 fms.

Pliocene: Minnitimmi Creek, Bocas Island, Almirante Bay, Panama.

Florida, 24-60 meters (Smitt); Tortugas, 24 meters (Osburn); Caribbean Sea, Pedro Bank, Jamaica, 16–19 m. (Harmer); St. Vincent (Harmer). Atlantic; Bermuda (Verril).

Geographic distribution.—Atlantic: Abrothos Island, Brazil, 32 meters. Pacific: Honolulu, 32–64 meters; Port Molle, Queensland, 18–32 meters; Torres Strait, 16–32 meters; various localities in the Malay Peninsula and the Philippines; Japan, slight depth to 320 meters; China Sea, Singapore, 19 meters; Tizard Reef, 43 meters; Borneo and Hong Kong. Indian Ocean: Almirante Island, 32–40 meters; Wasin, British East Africa, 16 meters; Chuaka, Zanzibar Channel, 3 meters.

Geologic distribution.—Miocene and Pliocene of Florida.

Plesiotypes.—Cat. Nos. 7597, 7598, 70860, U.S.N.M.

STEGANOPORELLA BREVIS, new species

Plate 32, Figure 7

Description.—The zoarium is unilamellar. The zooecia are distinct, united by their mural rim, little elongated, *short,* rectangular or hexagonal; the interior mural rim is wide, finely granulated, oblique; the cryptocyst is large, concave, smooth. The opesium is semielliptical, transverse, limited distally by a vestibular arch; the polypidan tube is small, median, little salient, placed between the two opesiules. The large zooecia (B) have the form of an 8; the opesium is very large; the distal plate is very small and reduced to an arched slit placed between the mural rim and a salient cushion.

Measurements.—Ordinary zooecia $(a)\begin{cases} Lz=0.90 \text{ mm.} \\ lz=0.60\text{–}0.70 \text{ mm.}\end{cases}$

Opesium $\begin{cases} ho=0.15 \text{ mm.} \\ lo=0.25 \text{ mm.}\end{cases}$

Avicularian zooecia $(B)\begin{cases} Lz=1.05 \text{ mm.} \\ lz=0.75 \text{ mm.}\end{cases}$

Opesium $\begin{cases} ho=0.30 \text{ mm.} \\ lo=0.50 \text{ mm.}\end{cases}$

Affinities.—This species is very well characterized by the form and the nature of the B zooecium with an avicularian operculum. It is smaller than *Steganoporella magnilabris* Busk, 1854, which is so widely distributed in the Gulf of Mexico.

Occurrence.—Pliocene: Minnitimmi Creek, Bocas Island, Almirante Bay, northwest Panama.

Holotype.—Cat. No. 70859, U.S.N.M.

Genus SIPHONOPORELLA Hincks, 1880

SIPHONOPORELLA DUMONTI, new species

Plate 7, Figure 4–7; text Figure 9

Description.—The zoarium is free; the fronds are cylindrical, bifurcated, rarely lamellar. The zooecia are distinct, separated by a deep furrow, very elongated, rectangular; the mural rim is salient, finely crenulated; the cryptocyst is deep, flat, granular. The opesium is oval, little elongated; the polypidian tube is broad, salient, eccentric. the avicularian zooecia are long, narrow, provided with a polypidian tube; the mandible is large, spatulated. There is a salient tubercle in each of the interzooecial angles.

Measurements.—Opesium $\begin{cases} ho = 0.30 \text{ mm.} \\ lo = 0.20 \text{ mm.} \end{cases}$

Zooecia $\begin{cases} Lz = 0.60 \text{ mm.} \\ lz = 0.36 \text{ mm.} \end{cases}$

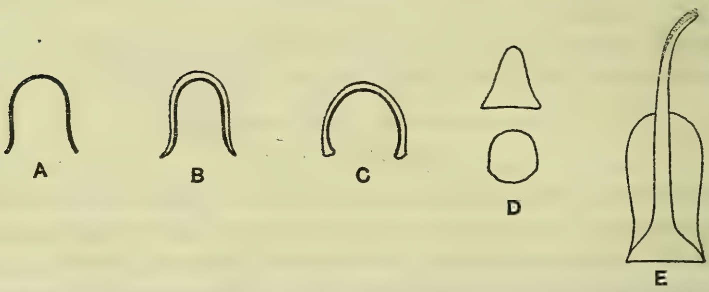

FIG. 9.—SIPHONOPORELLA DUMONTI, NEW SPECIES. *A–C.* DIFFERENT ASPECTS OF THE OPERCULAR VALVE. IN *A* THE SCLERITE OF THE VALVE IS EXACTLY SUPERPOSED ON THE EXTERIOR SCLERITE OF THE ECTOCYST. *D.* THE TWO PORTIONS OF AN AVICULARIAN MANDIBLE. THEY ARE UNITED BY TWO STRONG LATERAL SCLERITES. *E.* AN ORDINARY ONYCHOCELLARIUM, × 85

Structure.—The internal structure is that of a simplified *Steganoporella;* there is only an oblique and short polypidian tube. The opercular valve is simple, as those of Membranipores, and isolated from the mural rim. It is inserted exactly into the ectocystal sclerite which forms the aperture.

The B zooecia have also a polypidian tube, but their opercular valve is transformed into a true mandible of a size altogether equal to that of the cryptocyst and of the same form. When it is lowered it is exactly bordered by the mural rim. It has a mandibular structure very close to that of *Steganoporella.* In *Labiopora* the differentiation is complete, for here the B zooecia are transformed into true interzooecial avicularia.

Affinities.—This species differs from *Siphonoporella granulosa* in its free zoarium, its rectangular zooecia, and the much smaller zooecial, dimensions. The dimensions of the opercular valve are quite variable.

Named in honor of Gen. G. A. L. Dumont, the distinguished military attaché of the French Embassy in the United States, who has done so much for the encouragement of good feeling between France and the United States.

Occurrence.—*Albatross* Station D. 2405, Gulf of Mexico; 28° 45′ 00″ N.; 85° 02′ 00″ W.; 30 fms.; gray sand, broken coral.

Cotypes.—Cat. No. 7592, U.S.N.M.

SIPHONOPORELLA GRANULOSA, new species

Plate 8, Figure 1

Description.—The zoarium encrusts dead shells and corals. The zooecia are distinct, separated by a small furrow, large, elongated, elliptical; the mural rim is thick, salient, crenulated. The opesium is large, semielliptical; the polypidian tube is wide, oblique, salient, with an oblique orifice; the cryptocyst is flat, deep, *granular.* The B zooecia are long, narrow; the opesium is elliptical, nonterminal; the polypidian tube is visible but not salient.

Measurements.—Opesium $\begin{cases} ho = 0.25 \text{ mm.} \\ lo = 0.30 \text{ mm.} \end{cases}$

Zooecia $\begin{cases} Lz = 0.70 \text{ mm.} \\ lz = 0.50 \text{ mm.} \end{cases}$

Diameter of polypidian tube = 0.16 mm.

Length of B zooecia = 0.85 mm.

Structure.—The structure is identical with that of *Siphonoporella dumonti.* The mandible of the B zooecia exactly and entirely covers the cryptocyst when it is lowered; its form and its size are then regulated by the frontal calcification.

Occurrence.—*Albatross* Station D. 2405, Gulf of Mexico; 28° 45′ 00″ N.; 85° 02′ 00″ W.; 30 fms.; gray sand, broken coral.

Albatross Station D. 2639, Straits of Florida; 25° 04′ 50″ N.; 80° 15′ 10″ W.; 56 fms.; coral sand.

Fowey Light, 15 miles south of Miami, Fla., 40 fms.

Pliocene: Minnitimmi Creek, Bocas Island, Almirante Bay, Panama.

Holotype.—Cat. No. 7593, U.S.N.M.

Family ASPIDOSTOMIDAE Jullien, 1888

Genus MOLLIA Lamouroux, 1821

MOLLIA PATELLARIA Smitt, 1873

Plate 8, Figures 2, 3; text Figure 10

1873. *Mollia patellaria* SMITT, Floridan Bryozoa. Kongl. Svenska Vetenskaps-Akademiens Handlingar, vol. 11, no. 4, p. 12, pl. 2, fig. 72.

Measurements.—Opesium $\begin{cases} ho = 0.12 \text{ mm.} \\ lo = 0.15 \text{ mm.} \end{cases}$

Zooecia $\begin{cases} Lz = 0.40 \text{ mm.} \\ lz = 0.30 \text{ mm.} \end{cases}$

Structure.—The opesium is trifoliate; the two lateral condyles serve as a support to the opercular valve. The latter is very simple and analogous to that in the Membranipores. The proximal portion of the opesium which it does not cover probably serves as a passage for the opesiular muscles, but we still have no material proof of their presence and the genus could just as well be classed next to *Amphiblestrum.*

The zooecia are disjoined; a single point of junction unites them to each of the adjacent zooecia. On the inferior face they are surrounded by a series of small nonadjacent tuberosities. According to Waters, 1879, they serve as attachments of very small radicular threads.

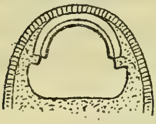

Fig. 10.—Mollia patellaria Smitt, 1873. Drawing of a zooecium, ×85, showing the apertural sclerite somewhat removed from the mural rim and supported with the opercular sclerite on the two opesial condyles

The ovicell is hyperstomial, salient, globular, closed by the opercular valve.

Affinities.—Smitt, 1872, identified his species with *Eschara patellaria* Moll, 1803, but it differs from it in its more closely arranged adjacent zooecia, its much smaller ovicells, and in the two opesiular condyles placed higher. The best figure of Moll's species given by Waters in 1879 has served us for comparison. In the Gulf of Mexico, this species has been found only on nullipores.

Occurrence.—*Albatross* Station D. 2405, Gulf of Mexico; 28° 45′ 00″ N.; 85° 02′ 00″ W.; 30 fms.; gray sand, broken coral. Florida, 58 meters (Smitt).

Plesiotype.—Cat. No. 7559, U.S.N.M.

Family ARACHNOPUSIIDAE Jullien, 1888

Genus EXECHONELLA Canu and Bassler, 1927

EXECHONELLA PUMICOSA, new species

Plate 14, Figure 1; text Figure 11*a*

Description.—The zoarium encrusts shells. The zooecia are distinct, separated by a deep furrow, very large, oval, somewhat elongated; the frontal is convex, *very porous;* each pore (or lacuna) is surrounded by a salient peristome. The aperture is large, suborbicular, a little elongated or a little transverse, formed of a large anter separated from a smaller poster by two lateral indentations; two small lamellae arrest the movements of the operculum; the peristome is thick salient. One of the peripheral pores is transformed sometimes into a small round avicularium.

Measurements.—Aperture $\begin{cases} ha=0.20 \text{ mm.} \\ la=0.20 \text{ mm.} \end{cases}$

Zooecia $\begin{cases} Lz=0.85 \text{ mm.} \\ lz=0.65\text{–}0.75 \text{ mm.} \end{cases}$

Variations.—The operculum is never rigorously orbicular; it is somewhat elongated or a little transverse; it always bears two large very thick chitinous bands; their inferior extremity is exactly at the level of the indentations of the aperture which mark the axis of rotation of the operculum. This arrangement is quite visible on our photograph, but because of desiccation, the operculum is inverted, the poster being visible; when the polypide extends its tentacles, the anter becomes erect and the poster is embedded in the zooecium. The operculum is very fragile and its movements are limited by two small lamellae (proximal and distal) quite visible at the bottom of the peristome. The size of the operculum renders its preparation very difficult; it is deformed and torn very easily.

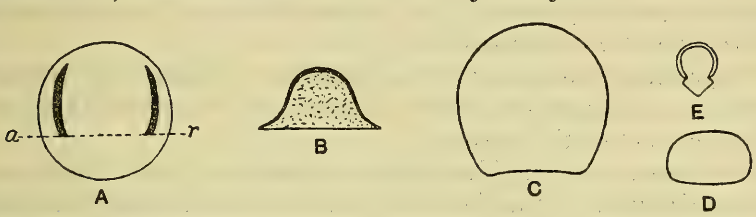

FIG. 11.—OPERCULAR. EXECHONELLA PUMICOSA, NEW SPECIES. *A.* SOMEWHAT ELONGATED OPERCULUM, × 85, SHOWING THE AXIS OF ROTATION (*ar*) *B.* PUELLINA FLORIDANA SMITT 1873. A MUCH CHITINIZED OPERCULUM, × 85. *C.* FIGULARIA? AMPLA, NEW SPECIES. OPERCULUM, × 85. *D.* STENOPSIS FENESTRATA SMITT, 1875. OPERCULUM × 85. *E.* TRYPOSTEGA VENUSTA NORMAN. OPERCULUM, × 85

The cellule *a* of our photograph shows that the operculum is not attached either to the subadjacent ectocyst or to the compensatrix. We do not know yet if the latter exists on the interior of the zooecium under the ectocyst, or perhaps if the space between the frontal and the ectocyst replaces it in order to form a special hydrostatic system.

The similarity of the operculum with that of the Hippoporae seems to indicate that there is really an interior compensatrix, but the anatomical study alone can furnish positive arguments.

We have found two species of this genus in the American Claibornian and Jacksonian but the geographic distribution of the genus is much greater. We have noted it in our monograph on the Philippine bryozoa as present in France (Lutetian, Aquitanian, Burdigalian) and in Australia (Miocene). *Exechonella pumicosa* is the third recent species which we have recognized.

Affinities.—This species differs from *Exechonella magna* MacGillivray, 1895, in its smaller zooecial dimensions and in its much more porous frontal.

Occurrence.—Fowey Light, 15 miles south of Miami, Fla.; 40 fms.

Holotype.—Cat. No. 7838, U.S.N.M.

Division PSEUDOSTEGA Levinsen, 1909

Family CELLARIIDAE Hincks, 1880

Genus CELLARIA Lamouroux, 1812

CELLARIA NODOSA, new name

Plate 8, Figures 9, 10

1873. *Cellaria tenuirostris* Smitt (not Busk, 1852), Floridan Bryozoa. Kongl. Svenska Vetenskaps-Akademiens Handlingar, vol. 11, no. 4, p. 4, pl. 1, fig. 57–59.

Measurements.—Aperture $\begin{cases} ha = 0.05 \text{ mm.} \\ la = 0.08\text{–}0.09 \text{ mm.} \end{cases}$

Zooecia $\begin{cases} Lz = 0.60 \text{ mm.} \\ lz = 0.20 \text{ mm.} \end{cases}$

Affinities.—This species is admirably illustrated by Smitt whose figures are perfectly exact. Our photographs only indicate the size at our usual × 20 enlargements.

The ovicelled zooecia are wider than the others; their presence occasions an enlargement of the segments, which present thus a sort of very characteristic *nodosity.*

Smitt was in error in identifying his specimens with *Salicornaria tenuirostris* Busk, 1852, as they differ in the much more slender segments swelling in places, in the enlarged form of the ovicelled zooecia, in the lozenge-shaped and nonrhomboidal form of the avicularia, in the presence of a canalicule in the avicularium, and in a much smaller aperture (0.08 and not 0.13). We have therefore given another name to this charming species. It is regrettable that it did not preserve its chitinous appendages.

Occurrence.—*Albatross* Station D. 2388, Gulf of Mexico; 29° 24′ 30″ N.; 88° 01′ 00″ W.; 35 fms.; yellow sand, black specks.

Caribbean Sea off Carysfort reef, 84 meters; west of Tortugas, 110 meters (Smitt).

Pliocene: Minnitimmi Creek, Bocas Island, Almirante Bay, Panama.

Holotype.—Cat. No. 7472, U.S.N.M

CELLARIA SINUOSA Hassall, 1842

This is the first time that this beautiful species, very common in Europe, has been found in the vicinity of the American coasts. We do not believe that we are deceived in our determination.

Occurrence.—*Albatross* Station D. 2004. Atlantic Ocean, east of Cape Hatteras, 37° 19′ 45″ N.; 74° 26′ 06″ W.; 102 fms.; green mud, shells.

Suborder ASCOPHORA Levinsen

Family COSTULAE Jullien, 1888. (Family CRIBRILINIDAE Hincks, 1880)

Genus PUELLINA Jullien, 1886

PUELLINA RADIATA, Moll, 1803

Plate 10, Figure 11

1873. *Cribrilina radiata* SMITT, Floridan Bryozoa. Kongl. Svenska Vetenskaps-Akademiens, Handlingar, vol. 11, p. 22, pl. 5, figs. 107, 108.
1920. *Puellina radiata* CANU and BASSLER, North American Early Tertiary Bryozoa. Bull. 106, U. S. National Museum, p. 295. pl. 41, figs. 14-18.

Measurements.—Aperture $\begin{cases} ha = 0.06 \text{ mm.} \\ la = 0.08 \text{ mm.} \end{cases}$

Zooecia $\begin{cases} Lz = 0.50 \text{ mm.} \\ lz = 0.42 \text{ mm.} \end{cases}$

Variations.—The measurements are quite variable, those we give being the greatest. There are five distal spines. The zooecial deformations are frequent and quite great. The operculum closes the ovicell. In front of the aperture there is a small mucro with a minute pore on each side conforming to the figures of Smitt. This is the distinctive characteristic of this form, which is very rare. It is somewhat larger than the form *innominata* Couch, 1844. It does not correspond altogether to *Puellina radiata* as Norman, 1909, limited it, for this author indicates the inconstant presence of a lunate pore before the aperture.

Biology.—Our specimens encrust corals. They were in reproduction and fixation May 1, 1884.

Occurrence.—*Albatross* Station D. 2169, off Habana, Cuba; 23° 10′ 28″ N.; 82° 20′ 27″ W.; 78 fms.; coral.
Fowey Light, 15 miles south of Miami, Fla.; 40 fms.
Pliocene: Minnitimmi Creek, Bocas Island, Almirante Bay, Panama.

PUELLINA INNOMINATA Couch, 1844

Plate 14, Figure 2

1873. *Cribrilina innominata* SMITT, Floridan Bryozoa. Kongl. Svenska Vetenskaps-Akademiens, Handlingar, vol. 11, p. 22, pl. 5, figs. 109, 110.

Measurements.—Aperture $\begin{cases} ha = 0.06 \text{ mm.} \\ la = 0.04 \text{ mm.} \end{cases}$

Zooecia $\begin{cases} Lz = 0.30\text{–}0.36 \text{ mm.} \\ lz = 0.30 \text{ mm.} \end{cases}$

Variations.—This form is the more frequent; it offers the same aspects as specimens from the Philippines but with smaller dimensions. It is well characterized by its median pore placed in the vicinity of the aperture and by the beautiful lateral tuberosities which surround each zooecium like a necklace. The median pore is often invisible and buried in the peristome. Frequently the lateral tuberosities are much attenuated and the costules much less calcified. The interzooecial avicularium is frequent, very long, acuminated, and salient in front of the zooecial plane.

According to Norman, 1909, this form differs from the typical form only in its much smaller dimensions, its more salient costules, and in its less acuminate avicularium. Smitt, 1872, placed here all the specimens ornamented with a lunate pore. The variations of the two forms being quite large, it is really impossible to distinguish them specifically, and we therefore follow the opinion of Waters.

The operculum closes the ovicell. The costules are covered by the ectocyst. On the interior the costules are not visible. Only the lumen pores, radially arranged, appear as tremopores.

Biology.—Our specimens encrust nullipores, dead shells, and corals. The living specimens were in reproduction March 15, 1885.

We have shown in our work on the Philippine Bryozoa that this species is in reproduction continuously during the entire year.

Occurrence.—*Albatross* Station D. 2320, north of Cuba; 23° 10′ 39″ N.; 82° 18′ 48″ W.; 130 fms.; fine coral.

Albatross Station D. 2405, Gulf of Mexico; 28° 45′ 00″ N.; 85° 02′ 00″ W.; 30 fms.; gray sand, broken coral.

Albatross Station D. 2639, Straits of Florida; 25° 04′ 50″ N.; 80° 15′ 10″ W.; 56 fms.; coral sand.

Albatross Station D. 2672, Atlantic, east of Georgia; 31° 31′ 00″ N.; 79° 05′ 00″ W.; 277 fms.; coarse brown sand.

PUELLINA FLORIDANA Smitt, 1873

Plate 14, Figures 3–7; text Figure 11*b*

1873. *Cribrilina figularis* Smitt, Floridan Bryozoa. Kongl. Svenska Vetenskaps-Akademiens, Handlingar, vol. 11, p. 23, pl. 5, fig. 112.

1873. *Cribrilina figularis* var. *floridana* Smitt, Kongl. Svenska Vetenskaps-Akademiens, Handlingar, p. 23, pl. 5, fig. 111.

?1879. *Lepralia elegantissima* Seguenza, Le formazioni terziarie della Provincia di Reggio (Calabria), Reale Accademia dei Lincei, Memoria della di Science, etc., ser. 3, vol. 6, p. 83, pl. 8, fig. 11.

?1901. *Cribrilina* (*Figularia*) *elegantissima* Neviani, Briozoi neogenici della Calabrie. Paleontographia Italica, vol. 6, p. 173, (sep. 59), pl. 1, fig. 28.

1914. *Cribrilina floridana* Osburn, Bryozoa of the Tortugas Islands. Publication Carnegie Institution, Washington, No. 182, p. 195.

Our specimen was living but not ovicelled. It corresponds to Figure 112 of Smitt.

Measurements.—Aperture $\begin{cases} ha = 0.07 \text{ mm.} \\ la = 0.10\text{–}0.13 \text{ mm.} \\ 0.15 \text{ mm. (after Smitt).} \end{cases}$

Zooecia $\begin{cases} Lz = 0.42\text{–}0.46 \text{ mm.} \\ lz = 0.36 \text{ mm.} \end{cases}$

There are about six pairs of dietellae. In transparency the costules are indistinct and the lumen pores are very numerous; the median line of suture is visible; the lunate pore is often surmounted by a kind of very narrow rimule (indicated on fig. 111 of Smitt). On the interior the costules are not visible. The semicircular operculum is well chitinized and of a brownish color (Osburn). We figure it and it is bordered with a thick sclerite.

We are the third observers of this species. Nevertheless, its structure is not yet well known, for the specimens found are very rare and incomplete. They encrust shells and corals.

Occurrence.—*Albatross* Station D. 2405, Gulf of Mexico; 28° 45′ 00″ N.; 85° 02′ 00″ W.; 30 fms.; gray sand, broken coral.

Florida, 47, 58 meters (Smitt); Tortugas, 8–34 meters (Osburn).

Genus FIGULARIA Jullien, 1885

FIGULARIA (?) AMPLA, new species

Plate 14, Figure 8; text Figure 11c

Description.—The zoarium encrusts shells. The zooecia are distinct, separated by a deep furrow, *very large* and little elongated, elliptical; the frontal is very convex and formed of six pairs of very broad costules, adjacent; the costules are separated by very small linear lacunae attached to a median and salient suture line. An elliptical line of lacunae a little larger outline on the frontal an elegant elliptical diagram. The aperture is large, a little transverse; two small lateral indentations separate a large semielliptic anter from a small concave poster. The ovicell is large, smooth, carinated, hyperstomial, opened by a very narrow slit.

Measurements.—Aperture $\begin{cases} ha = 0.26 \text{ mm.} \\ la = 0.30 \text{ mm.} \end{cases}$

Zooecia $\begin{cases} Lz = 1.5 \text{ mm.} \\ lz = 1.0 \text{ mm.} \end{cases}$

Structure.—The operculum is yellow and very chitinous; it probably closes the ovicell, but we have not been able to make direct observation. Our two specimens are without the ectocyst. We have not seen the internal ectocyst. Our conclusions on the structure of this beautiful species are then very insufficient and we are not able to class it accurately. It is by the simple exterior aspect of the frontal that we introduce it doubtfully and provisionally into the genus *Figularia*.

Occurrence.—*Albatross* Station D. 2167, off Habana, Cuba; 23° 10′ 40″ N.; 82° 20′ 30″ W.; 201 fms.; coral.

Holotype.—Cat. No. 7494, U.S.N.M.

Family HIPPOTHOIDAE Levinsen, 1909

Genus HIPPOTHOA (Lamouroux, 1821) Hincks, 1880

HIPPOTHOA EBURNEA Smitt, 1873

1873. *Gemellipora eburnea* SMITT, Floridan Bryozoa. Kongl. Svenska Vetenskaps-Akademiens Handlingar, vol. 11, no. 4, p. 35, pl. 9, fig. 178 (not pl. 7, fig. 152–156).

Measurements.—Aperture $\begin{cases} ha = 0.06 \text{ mm.} \\ la = 0.04 \text{ mm.} \end{cases}$

Zooecia $\begin{cases} Lz = 0.40 \text{ mm.} \\ lz = 0.14\text{–}0.16 \text{ mm.} \end{cases}$

Variations.—The length of the zooecium is quite variable; with the caudal portion it often measures 0.60–0.70 mm., but it may be elongated much more and double this length.

This is a very fragile species and, although it is not rare, it is difficult to find a well-preserved zoarium for the frontal is often broken. It chooses, moreover, for its development, sheltered places, the interior of dead shells, the inferior face of Cellepores, the base of arborescent corals, the folds of nullipores, etc.

One must not confuse this species with the creeping portions of *Pasythea eburnea* Smitt, 1872. We can not explain Smitt's confusion, for this species has neither the same dimensions nor the same apertural form.

Occurrence.—*Albatross* Station D. 2317, north of Cuba; 24° 25′ 45″ N.; 81° 46′ 45″ W.; 45 fms.; coral.

Albatross Station D. 2362, east of Yucatan; 22° 08′ 30″ N.; 86° 53′ 30″ W.; 25 fms.; coral sand.

Albatross Station D. 2405, Gulf of Mexico; 28° 45′ 00″ N.; 85° 02′ 00″ W.; 30 fms.; gray sand, broken coral.

Albatross Station D. 2672, Atlantic, east of Georgia; 31° 31′ 00″ N.; 79° 05′ 00″ W.; 277 fms.; coarse brown sand.

Florida, 194 meters (Smitt).

HIPPOTHOA DIVARICATA Lamouroux, 1821

Plate 28, Figure 7

1918. *Hippothoa divaricata* WATERS, Some collections of the Littoral Marine Fauna of the Cape Verde Islands. Journal Linnean Society, Zoology, vol. 34, p. 20 (Synonymy).

This cosmopolitan species has been noted at only one locality in our Gulf of Mexico dredgings. Miss Jelly's catalogue and Water's work cited above give its complete bibliography.

Occurrence.—*Albatross* Station D. 2650, Bahama Islands; 23° 34′ 30″ N.; 76° 34′ 00″ W.; 369 fms.

Plesiotype.—Cat. No. 7523, U.S.N.M.

Genus TRYPOSTEGA Levinsen, 1909

TRYPOSTEGA VENUSTA Norman, 1864

Plate 8, Figures 5, 6; text Figure 11*e*

1920. *Trypostega venusta* CANU and BASSLER, North American Early Tertiary Bryozoa. Bull. 106, U. S. National Museum, p. 330, pl. 85, fig. 15, 16. (Bibliography and geographic distribution.)

Measurements.—Zooecia (distant from border) $\begin{cases} Lz = 0.40 \text{ mm.} \\ lz = 0.26 \text{ mm.} \end{cases}$

Aperture $\begin{cases} ha = 0.10 \text{ mm.} \\ la = 0.06 \text{ mm.} \end{cases}$

Marginal zooecia $\begin{cases} Lz = 0.50\text{–}0.60 \text{ mm.} \\ lz = 0.30 \text{ mm.} \end{cases}$

Aperture $\begin{cases} ha = 0.10 \text{ mm.} \\ la = 0.06 \text{ mm.} \end{cases}$

Variations.—In our bibliography of 1920 we omitted the variety *inornata* Smitt, 1872 (not Gabb and Horn). We are now convinced that this is indeed the same species in spite of the difference in size; in fact, the species is quite variable in its micrometric dimensions, the marginal zooecia of the large colonies being much larger than the others. The operculum presents the same variations; it closes the ovicell.

Biology.—The specimens encrust bryozoa (*Steganoporella*, *Stylopoma*), shells, corals (*Oculina*), hydroids, and nullipores; they prefer smooth surfaces. They are light colored, but the operculum is slightly yellow. Our specimens were in reproduction and fixation from January to March; it is probable that they reproduce throughout the year.

This species is indifferent to bathymetric variations, but it prefers depths from 10 to 100 meters. It has been observed in the Atlantic as far as the fiftieth parallel.

Occurrence.—*Albatross* Station D. 2167, off Habana, Cuba; 23° 10′ 40″ N.; 82° 20′ 30″ W.; 201 fms.; coral.
Albatross Station D. 2334, north of Cuba; 23° 10′ 42″ N.; 82° 18′ 24″ W.; 67 fms.; white coral.
Albatross Station D. 2639, Straits of Florida; 25° 04′ 50″ N.; 80° 15′ 10″ W.; 56 fms.; coral sand.
Albatross Station D. 2405, Gulf of Mexico; 28° 45′ 00″ N.; 85° 02′ 00″ W.; 30 fms.; grey sand, broken coral.
Florida, 41–97 meters (Smitt); Tortugas, 8–24 meters (Osburn).

Plesiotypes.—Cat. Nos. 7608, 7609, U.S.N.M.

Family PETRALIIDAE Levinsen, 1909

Genus PETRALIELLA Canu and Bassler, 1927

PETRALIELLA BISINUATA Smitt, 1873

Plate 16, Figures 1–5; Plate 33, Figure 4; text Figures 12*a–h*

1873. *Escharella bisinuata* SMITT, Floridan Bryozoa. Kongl. Svenska Vetenskaps-Akademiens Handlingar, vol. 11, p. 59, pl. 12, fig. 229.
1909. *Petralia bisinuata* LEVINSEN, Studies on the Cheilostomatous Bryozoa, pp. 350, 351.
1914. *Petralia bisinuata* OSBURN, Bryozoa of the Tortugas Islands. Publication Carnegie Institution, Washington, No. 182, p. 217.

Measurements.—Aperture $\begin{cases} ha = 0.24\text{–}0.25 \text{ mm.} \\ la = 0.26 \text{ mm.} \end{cases}$

Zooecia $\begin{cases} Lz = 0.90\text{–}1.15 \text{ mm.} \\ lz = 0.50\text{–}0.55 \text{ mm.} \end{cases}$

Variations.—Smitt spoke only of a single avicularium; there are generally two on our specimens; rarely are they equal, one being larger than the other; these are the zooecial avicularia. Rarely there are two avicularia on the shield; then there are no longer any large avicularia. This irregularity is disconcerting and does not permit us to judge the function of these small organs.

The cribriform area is a rather deep concavity surrounded by a peristome, closed by the ectoyst, where there are no radicells and placed below the aperture. It is frequently accompanied by one or two smaller radicular pores. The frontal structure is that of a tremocyst.

This is a rare species of which we were able to prepare the complete operculum. It is often detached from the compensatrix, but frequently the chitinization stops at the axis of rotation. The opercula of the ovicelled zooecia are a little larger. The chitinized band which surrounds the operculum is generally narrow, but it can become enlarged as in the genus *Petralia*.

The radicells form a true passageway between the colonies and the algal substratum; they are fragile, hollow, terminated in a brush.

The mandibles are very thin and transparent. The zoarium is unilamellar, very often cylindrical, for it encrusts algae. It may also creep over nullipores (Smitt).

Biology.—The color in life is a bright vermillion (Osburn). The calcareous skeleton is much less pigmented than the ectocyst. The operculm is light colored. The giant species have not much vitality.

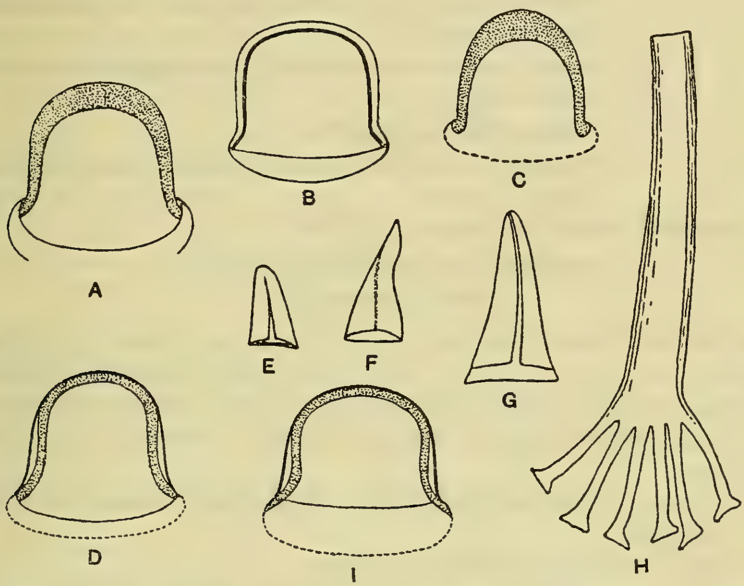

FIG. 12.—GENUS PETRALIELLA, NEW GENUS. *A–I.* PETRALIELLA BISINUATA SMITT, 1873. *A.* OPERCULUM, × 85, WITH BROAD, CHITINIZED MARGINAL BAND. *B.* ANOTHER OPERCULUM, × 85, WITH NARROW MARGINAL BAND. *C.* ANOTHER FORM OF OPERCULUM, × 85. *D.* OPERCULUM, × 85, IN WHICH THE PROXIMAL ARTICULATION WITH THE COMPENSATRIX IS VISIBLE. *E, F, G.* THREE MANDIBLES, × 85. *H.* RADICEL OF THIS SPECIES, × 85. *I.* PETRALIELLA MARGINATA, NEW SPECIES. OPERCULUM, × 85, WITH NARROW MARGINAL BAND

For example, on the same alga a larva of *Cellepora* was fixed near a *Petraliella* larva; the two colonies are well developed at first, but the *Cellepora* stopped the *Petraliella* and became superposed upon it. Likewise in the interior of a tube of *Petraliella* a larva of *Smittina trispinosa* was affixed; it developed normally in pursuing completely the radicular system which did not disturb it at all. When they are useless by death or putrefaction of the substratum, the radicells disappear; also the interior face serves as a refuge for small parasitic species such as *Hippothoa*, which find here an excellent refuge to shelter their extreme fragility. We have made the same observations on *Petraliella vorax*, new species, of the Philippines, where we were able to determine the same parasites.

Our living specimens were in reproduction January 30 and March 19, 1885. Up to the present the species has been dredged only from depths of water below 42 meters.

Occurrence.—*Albatross* Station D. 2362, east of Yucatan; 22° 08′ 30″ N.; 86° 53′ 30″ W.; 25 fms.; coral sand.
Albatross Station D. 2363, east of Yucatan; 22° 07′ 30″ N.; 87° 06′ 00″ W.; 21 fms.; coral.
Albatross Station D. 2414, Gulf of Mexico; 25° 04′ 30″ N.; 82° 59′ 15″ W.; 26 fms.; fine white sand, broken shells.
Florida, 14–30 meters (Smitt); Tortugas, 16–29 meters (Osburn).
Albatross Station D. 2405.
Pliocene: Minnitimmi Creek, Bocas Island, Almirante Bay, Panama.

Plesiotypes.—Cat. No. 7568, U.S.N.M.

PETRALIELLA BISINUATA GRANDIS, new variety

Plate 33, Figures 5, 6

In this new variety the aperture is larger and measures 0.30 mm. in width (and not 0.20 mm.). The avicularia are larger and measure 0.15 mm. in length instead of 0.12 mm. The inferior face shows the same small radicular pores which we have observed on the typical specimens.

Occurrence.—Pliocene: Minnitimmi Creek, Bocas Island, Almirante Bay, Panama.

Holotype.—Cat. No. 70851, U.S.N.M.

PETRALIELLA MARGINATA, new species

Plate 16, Figures 6–11; text Figure 12*i*

Description.—The zoarium is free, unilamellar, formed of more or less expanded fronds. The zooecia are distinct, separated by a *salient thread*, large, elongated, rectangular; the shield is incomplete and is not developed above the aperture; it is broad inferiorily and bears laterally two small avicularia; the frontal is flat, perforated by large tremopores, often coalescent, and ornamented laterally with short interareolar costules. The aperture is semicircular, somewhat elongated or a little transverse; two very short cardelles, placed very low, separate a very large anter from a very small poster; the proximal border is straight and finely serrate. The ovicell is very large, globular, with minute perforations; it is hyperstomial, buried in the distal zooecium closed by the operculum and bordered by a thin thread. The large avicularium is placed laterally in the neighborhood of the aperture below a small aptertural avicularium; it is oblique, triangular, very elongated, with unguiculate beak and provided with a pivot. The inner face of the zoarium bears distally on each zooecium a large orbicular cribriform area closed by the ectocyst. It is a radicular septule.

Measurements.—Aperture $\begin{cases} ha = 0.22\text{–}0.25 \text{ mm.} \\ la = 0.25 \text{ mm.} \end{cases}$

Zooecia $\begin{cases} Lz = 1.00 \text{ mm.} \\ lz = 0.65\text{–}0.70 \text{ mm.} \end{cases}$

Structure.—The operculum is light colored and bell-shaped. The marginal band is very narrow; the proximal border is indecisive, for it is attached to the compensatrix. We are obliged, in order to figure it, to indicate only the line of rotation. Like the aperture, the operculum is elongated or transverse.

In the interior the two cardelles are quite visible; they correspond exactly to the axis of rotation of the operculum, which also represents only the portion covering the anter. The tremopores are quite visible and numerous.

The dorsal admirably shows by transparency the structure of the cribriform area. The latter appears as a large multiporous septule. The pores are unequal in size and variable in number (10 to 20). Exteriorily there is a concavity closed by the ectocyst and from which large radicells sometime spring.

The ovicell is not of the same nature as the frontal. This feature is, moreover, one of the family characters. In the Escharellidae, for example, the ovicell is developed between the olocyst and the pleurocyst or tremocyst of the distal zooecium. Here, on the contrary, the ovicell has special walls; the distal zooecium is completely calcified when it is formed. The operculum does not close the ovicell throughout its life, but in opening it permits the passage of the eggs in closing exactly the orifice of the ovicell. However, on our dissected specimens we are not positively certain of the exactness of this observation.

Variations.—The small apertural avicularia are very constant. They are elliptical, but their orientation is quite variable. They must exercise the function of the oral glands which do not exist in this family. The large avicularium is zooecial; its presence is inconstant and its dimensions are variable. When one of the small apertural avicularia becomes very large, the large avicularium does not develop.

The zoarium often has the form of a hollow horn. The radicells are rarely present on the interior face. The latter is almost always incrusted by small species of bryozoa and notably by *Gemellipora eburnea* Smitt, 1872, which thus finds safe shelter to protect its especially fragile zoarium.

The separating thread of the cells is constant but it is very salient and quite visible on the old, strongly calcified zooecia.

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Affinities.—This species resembles very much *Petraliella chuakensis* Waters, 1913, and we at first identified it so. However, it differs in its much smaller micrometric measurements ($la = 0.25$ mm. and not 0.32 mm.), in the presence of two small apertural avicularia, in the occurrence of a thread separating the cells, in the presence of short interareolar costules, and in the much more finely denticulated proximal border of the aperture. It resembles also *Petraliella dorsiporosa* Busk, 1884, figured by Harmer, 1900, but differs from it in a much larger zooecial avicularium, in the presence of interareolar costules, in the serrate proximal border of the aperture, and in a single cribriform area to each zooecium on the inner face.

Biology.—Our specimens were in reproduction and fixation January 30 and March 19, 1885.

Occurrence.—*Albatross* Station D. 2366, Gulf of Mexico, off Yucatan; 22° 28′ 00″ N.; 87° 02′ 00″ W.; 43m.

Albatross Station D. 2405, Gulf of Mexico; 28° 45′ 00″ N.; 85° 02′ 00″ W.; 30 fms.; gray sand, broken coral.

Albatross Station D. 2414, Gulf of Mexico; 25° 04′ 30″ N.; 82° 59′ 15″ W.; 26 fms.; fine white sand, broken shells.

Cotypes.—Cat. No. 7569, U.S.N.M.

Genus COLEOPORA Canu and Bassler, 1927

COLEOPORA GRANULOSA, new species

Plate 33, Figure 9

Description.—The zoarium is incrusting. The zooecia are large, distinct, separated by a very thin thread, somewhat elongated, swollen; the frontal is convex and formed of a granular tremocyst; the peristomie is salient, free, cylindrical; the peristome is thin. The aperture is suborbicular.

Measurements.—Aperture $\begin{cases} ha = 0.20 \text{ mm.} \\ la = 0.25 \text{ mm.} \end{cases}$

Zooecia $\begin{cases} Lz = 1.15-1.25 \text{ mm.} \\ lz = 0.75-0.85 \text{ mm.} \end{cases}$

Affinities.—The peristome shows distinctly the tremocyst and the subadjacent olocyst; on certain cells the tremocyst overlaps the olocyst and on others the olocyst is visible.

This species approaches very closely *Coleopora minutipora* Canu and Bassler from the Philippines, but its micrometric dimensions are much smaller and its frontal granules are larger and more apparent. The genus *Coleopora* is equatorial. It is probable that it is represented in the Gulf of Mexico.

Occurrence.—Pliocene: Minnitimmi Creek, Bocas Island, Almirante Bay, Panama.

Holotype.—Cat. No. 70834, U.S.N.M.

Family GALEOPSIDAE Jullien, 1903

Genus GALEOPSIS Jullien, 1903

The ovicell is hyperstomial. The aperture has two cardelles. The peristomie is enlarged. The spiramen is very large and salient. The frontal is a tremocyst. The operculum bears two lateral bands. Avicularia.

Genotype.—*Galeopsis pupa* Jullien, 1903.

Range.—Cretaceous (Maastrichtian)—Recent.

Historical.—The genus *Galeopsis* was introduced into the nomenclature by Jullien, 1903, for two species with large spiramen—*G. rabidus* and *G. pupa* which he had discovered. He recognized that the spiramen was a tube opening in the peristomie above the operculum and he explained its physiologic function. Lacking material, he was not able to elucidate the structure of the new genus. Our definition of 1923 is therefore uncertain. At this time, conforming to the rules of nomenclature, we chose as the genotype the first species cited (*G. rabidus*). In our materials from the Philippines, we have had the fortune to discover some new species of Galeopsidae and to make a detailed study of them. We can now explain the structure of these animals and give better generic definitions.

First our selected genotype (*G. rabidus*) from its structure belongs in reality to *Gigantopora*, Ridley, 1881. To preserve the name the second species (*G. pupa*) should be regarded as the type of the genus *Galeopsis*. In consequence we here revise our definition of 1920.

Affinities.—As now limited the genus *Galeopsis* is very close to *Gephyrophora* Busk, 1884, and Waters, 1908, did not hesitate to unite them. The opercula, not being perfectly identical, we believe the two genera should be maintained at least provisionally. *Galeopsis* differs from *Gephyphora* in the presence of cardelles, in the absence of a sinus to the aperture, and in the presence of two lateral bands to the operculum, indicating a different muscular system.

The determination of fossil specimens is very difficult and it can be done only by dissection of the peristomie. The recent species are as follows, showing it is an equatorial genus solely:

Galeopsis pupa Jullien, 1903, Pacific (Philippines, Gambier).

Galeopsis mutabilis Canu and Bassler ms., Philippines.

Galeopsis brevicapitata Canu and Bassler ms., China Sea.

Genus STENOPSIS Canu and Bassler, 1927

The ovicell is hyperstomial. The aperture is rounded-quadrangular, without cardelles. The peristomie is elongated. The spiramen is broad and salient. The frontal is a tuberose tremocyst. The operculum is thin, semielliptical, and without muscular attachments. Avicularia.

Genotype.—*Stenopsis* (*Porina*) *fenestrata* Smitt, 1873.

Range.—Eocene (Jacksonian)—Recent.

The known species are as follows:

Stenopsis (Porina) fenestrata Smitt, 1873, Gulf of Mexico.

Stenopsis unirostris Canu and Bassler ms., Sulu Sea.

Stenopsis cylindrica, new name (=*Gigantopora fenestrata* Waters 1908), Red Sea.

Stenopsis (*Galeopsis*) *longicollis* Canu and Bassler, 1920, Jacksonian.

Stenopsis (*Galeopsis*) *cyclops* Canu and Bassler, 1920, Jacksonian.

Stenopsis (*Porina*) *tuberculosa* Maplestone, 1902, Miocene.

This is an equatorial genus. The ovicell opens into the peristomie.

Affinities.—*Stenopsis* differs from *Galeopsis* Jullien, 1903, in the absence of cardelles and in its opercula without bands or points. It differs from *Gigantopora* Ridley, 1881, which it resembles in general aspect, in the presence of a granular tremocyst. It differs from *Gephyrophora* Busk, 1884, in its longer peristomie and in the absence of rimule and points to the operculum.

STENOPSIS FENESTRATA Smitt, 1873

Plate 14, Figures 9, 10; text Figure 11*d*

1873. *Hippothoa fenestrata* Smitt, Floridan Bryozoa. Kongl. Svenska Vetenskaps-Akademiens, Handlingar, vol. 11, p. 47, pl. 6, fig. 112.
(Not *Gigantopora fenestrata* Waters, 1908.)

Measurements.—Aperture $\begin{cases} ha = 0.10 \text{ mm.} \\ la = 0.12 \text{ mm.} \end{cases}$

Spiramen $\begin{cases} h = 0.10 \text{ mm.} \\ l = 0.12 \text{ mm.} \end{cases}$

Zooecia $\begin{cases} Lz = 0.90\text{–}1.00 \text{ mm.} \\ lz = 0.35\text{-}0.40 \text{ mm.} \end{cases}$

Structure.—The aperture is semielliptical; its exact form is aptly defined as "rounded-quadrangular" by Smitt; it is visible at the bottom of the peristomie, which must be broken in order to render it clearly visible. The operculum has the same form and its proximal border is slightly concave; it bears neither muscular attachments nor ornaments; it is thin and fragile.

The peristome is thin, orbicular, very long, not covered by the tremocyst. It bears laterally a single triangular, thin avicularium, with the beak above.

The spiramen is placed at the base of the peristomie; it is salient and in the form of a lunar crescent with a distal concavity; its dimensions are exactly those of the aperture. The ovicell is globular and opens into the peristomie.

Affinities.—Waters, 1908, determined under this name a different species from the Red Sea and for which we have proposed the name of *S. cylindrica* because of its zooecial aspect. *Stenopsis fenestrata* differs from it in its long peristomie, in the great distance between the spiramen and the peristomice, in the presence of frontal granulations and a single avicularium, in its greater micrometric dimensions, and in its crescentic spiramen. It is much larger than *Stenopsis unirostris* Canu and Bassler which we have discovered in the Philippines. Our specimens creep over serpulae and nullipores. They were in reproduction in March, 1885.

Occurrence.—*Albatross* Station D. 2405, Gulf of Mexico; 28° 45′ 00″ N.; 85° 02′ 00″ W.; 30 fms.; gray sand, broken coral.

Plesiotypes.—Cat. No. 7599, U.S.N.M.

Family SCLERODOMIDAE Levinsen, 1909

Genus SEMIHASWELLIA Canu and Bassler, 1917

SEMIHASWELLIA SINUOSA, new species

Plate 15, Figures 1–4

Description.—The zoarium is articulated, the segments are long (10 mm.), subcylindrical, *sinuous*, with the zooecia on one face only; the anterior face bears tremopores arranged at the bottom of longitudinal, irregular, shallow sulci, and small, round, widely spaced avicularia. The zooecia are little distinct, much elongated; the frontal is convex and formed of a tremocyst with tubules the orifices of which are arranged at the bottom of longitudinal shallow sulci. The ascopore is small, round, placed on the median axis and at the base of the peristomie; the latter is somewhat salient and terminated by a fringed and orbicular peristome. The ovicell is globular, arranged laterally and opening into the peristomie. The base of articulation (basis ramae) is formed by a frontolateral eminence pierced by a large central pore surrounded by smaller pores; the flexible fibers are issued not only from the central pore but also from the small neighboring tremopores.

Measurements.—Zooecia $\begin{cases} Lz=0.50 \text{ mm.; diameter of peristome, } 0.12 \text{ mm.} \\ lz=0.25 \text{ mm.; diameter of segments, } 0.50 \text{ mm.} \end{cases}$

Structure.—In longitudinal section the zooecial walls are very thick; the tubules are very wide, although their orifice is very small, the ascopore is wide somewhat oblique, opening in the interior into the peristomie at the level of the operculum.

The ovicell is very remarkable and unique; instead of being arranged distally as in the genotype, it is placed laterally between the peristome and the ascopore. We have not, unfortunately, enough specimens to make a section of the ovicell and verify if it is a dissymetric peristomial ovicell or an ordinary hyperstomial ovicell.

Affinities.—The genotype *Semihaswellia proboscidea* Waters, 1889, has been dredged at a great depth around St. Thomas (West Indies). The presence of other species of the same genus in the Gulf of Mexico is then quite natural. We note, in fact, no essential difference between the two species. However, *Semihaswellia sinuosa* differs from *H. proboscidea* in its articulated zoarium (and not branched) and in its lateral, not distal ovicell.

Among the fossils from the Jacksonian we have found a smaller species, *Semihaswellia exilis* Canu and Bassler, 1920, in which we have been able to explain the structure. The anologies with the present species are evident and permit us to deduce from it that the large hollow apophysis is in reality a base of articulation and that the colony was articulated as a base of the figured segment proves. (Fig. 22, pl. 66.)

As all these species are quite rare and their study is quite incomplete, the task of the paleontologist is very difficult. *Semihaswellia proboscidea* Waters, 1889, has been found in the pteropod ooze at 729 meters of depth.

Occurrence.—*Albatross* Station D. 2392, Gulf of Mexico; 28° 47′ 30″ N.; 87° 27′ 00″ W.; 724 fms.; brown gray mud.

Cotypes.—Cat. No. 7591, U.S.N.M.

Genus TESSARADOMA Norman, 1868

TESSARADOMA GRACILE Sars, 1863

Plate 15, Figure 5; Plate 28, Figure 6

1873. *Tessaradoma boreale* Smitt, Floridan Bryozoa. Kongl. Svenska Vetenskaps-Akademiens Handlingar, vol. 11, p. 32, pl. 6, figs 143–145.
1903. *Tessaradoma gracile* Jullien, Bryozoaires de l'*Hirondelle.* Resultats des Campagnes scientifiques du Prince de Monaca, p. 74, pl. 3, fig. 4, and pl. 14, fig. 2. (Bibliography,)
1907. *Tessaradoma borealis* Calvet, Bryozoaires. Expedition Scientifique *Travailleur* et *Talisman*, p. 405.
1912. *Tessaradoma gracile* Nordgaard, Revision av universitetsmusets samling av norske Bryozoer. Kgl. norske Videnskaber Selskabs, Skriften, p. 20.
1918. *Tessaradoma gracile* Nordgaard, Bryozoa from the Arctic region. Tromso Museums Aarshefter, vol. 40, p. 53 (numerous localities cited, temperature).

It is difficult to recognize the true micrometric characteristics of this species. The measurements taken from the figures of the authors are extraordinarily divergent as may be noted from the following examples:

	Canu collection (North Atlantic)	Smitt, 1867	Smitt, 1873	Hincks, 1880		Jullien, 1903	D. 2117
				Fig. 5	Fig. 4		
	Millimeters	*Millimeters*	*Millimeters*	*Millimeters*	*Millimeters*	*Millimeters*	*Millimeters*
Diameter of peristome	0.16	0.18-0.20	0.18	0.14	0.10	0.10	0.25
Length	.90	1.20	1.28	.70	.40	.40	1.50-1.60
Width	.60	.60	.60	.33	.24	.22	.75-.90

The measurements observed on our specimens are the largest. They appear to constitute a variety. In their ornamentation they approach especially the figures of Smitt, 1873, and of Jullien, 1903. Smitt states that the species is very common in the Gulf of Mexico.

Occurrence.—*Albatross* Station D. 2117, Caribbean Sea; 15° 24′ 40″ N.; 63° 31′ 30″ W.; 683 fms.; yellow mud, fine sand; D. 2753, Lesser Antilles.

Geographic distribution.—Atlantic: From Spitzberg to Cape Verde Islands from 300 to 3,700 meters.

Plesiotypes.—Cat. No. 7605, U.S.N.M.

Family ESCHARELLIDAE Levinsen, 1909

Subfamily SCHIZOPORELLAE Canu and Bassler, 1917

Genus BUFFONELLARIA Canu and Bassler, 1927

The ovicell is hyperstomial and not closed by the operculum. The frontal is an olocyst with vein-like markings. There is a small oral avicularium.

Genotype.—*Hippothoa divergens typica* Smitt, 1873. Recent.

This genus differs from *Buffonella* Jullien, 1888, only in the movement of the operculum which closes the ovicell. We know three equatorial species of this genus—*Buffonellaria divergens* Smitt, 1872; *B. reticulata*, new species, from the Gulf of Mexico; and *B. loculifera* Canu and Bassler from the Philippines.

Relations between the oral avicularia and the function of the operculum in the Escharellidae are shown by the fact that when there is no oral avicularium present the operculum closes the ovicell, and when there is an oral avicularium the operculum does not close the ovicell. This is not a special phenomenon in *Buffonellaria* for it is general in all the Escharellidae *Buffonella*, *Lacerna*, *Dakaria*, *Schizomavella*, *Hippoponella*, and *Houzeauina* do not have oral avicularia and their operculum closes the ovicell. On the contrary, *Buffonellaria*, *Gemelliporella*, *Schizopodrella*, *Hippomenella*, *Hippozeugosella*, *Peristomella*, and *Romancheina* have two oral avicularia and their operculum does not close their ovicell. We have incomplete data on other genera of the family, especially when they are fossil; finally, certain of them such as *Hippoporina* are perhaps poorly classified.

In the uncertain family, Galeopsidae the same phenomenon is observable; *Haswellia* has no avicularia and its operculum closes the ovicell. On the contrary *Galeopsis* and *Gephyrophora* provided with avicularia do not have their operculum closing the ovicell. Very probably the genera of this family should be united to the Escharellidae.

In the Smittinidae and the Reteporidae, the operculum does not close the ovicell and there are no oral avicularia present, but in these two families there are oral glands.

We have always supposed that the zooecial avicularia have a physiologic function when they are constant. This new study completely confirms this supposition. But we do not yet know exactly how this function is exercised and if it is always the same.

We may again note how fruitful the physiologic classification is and how great are the results obtained by its use. Thanks to it, these small animals have already revealed many secrets of their complicated biology.

BUFFONELLARIA DIVERGENS Smitt, 1873

Plate 8, Figures 7, 8; text Figure 13*a*

1873. *Hippothoa divergens typica* SMITT, Floridan Bryozoa. Kongl. Svenska Vetenskaps-Akademiens Handlingar, vol. 11, no. 4, p. 47, pl. 9, fig. 179.

Measurements.—Aperture $\begin{cases} ha = 0.09 \text{ mm.} \\ la = 0.10\text{–}0.12 \text{ mm.} \end{cases}$

Zooecia $\begin{cases} Lz = 0.65 \text{ mm.} \\ lz = 0.45\text{–}0.55 \text{ mm.} \end{cases}$

Structure.—The ovicell is very fragile, placed on the distal zooecium, and opened very widely above the operculum and without any relationship with it. It is smooth and convex. The operculum is suborbicular with two lucidae at the place of the condyles of articulation; the two muscular attachments are removed from the margin and placed rather high.

FIG. 13.—OPERCULA OF BUFFONELLARIA. *A*. B. DIVERGENS SMITT, 1873. *B*. B. RETICULATA, NEW SPECIES

The frontal, seen by transparency, shows the radial threads characteristic of *Buffonellaria*. This structure is very different from that of *Hippothoa* and can not be confused with it. There is generally only a small oral avicularium.

Affinities.—It is in error that Hincks, 1880, Norman, 1909, and Osburn, 1914, have referred this species to *Stephanosella biaperta* Michelin, 1848. Not only it has not the same form of operculum, but the structure of the ovicell is very different; finally, the frontal is an olocyst with nerve-like threads and not a tremocyst with small pores. We have not found specimens corresponding to Smitt's Figure 177 (forma *laxa*).

Biology.—Our specimens encrust Cellepores, hydroids, and corals. They were in reproduction in May, 1884, and January, 1885. This species has been found only in deep waters.

Occurrence.—*Albatross* Station D. 2167, off Habana, Cuba; 23° 10′ 40″ N.; 82° 20′ 30″ W.; 201 fms.; coral.
Albatross Station D. 2320, north of Cuba; 23° 10′ 39″ N.; 82° 19′ 48″ W.; 130 fms.; fine coral.
Florida, 218 meters (Smitt).

Plesiotypes.—Cat. No. 7459, U.S.N.M.

BUFFONELLARIA RETICULATA, new species

Plate 8, Figure 4, text Figure 13*b*

Description.—The zoarium encrusts nullipores and shells. The zooecia are indistinct; the frontal bears salient *reticulations* which divide it into small irregular compartments. The aperture is buried at the bottom of an infundibuliform peristomie; its proximal border bears a rounded and deep sinus; the peristome is very salient, thin, nodular, and bears a kind of small avicularium. The ovicell is globular and decorated with two orbicular areas symmetrically arranged; it is hyperstomial and is not closed by the operculum.

Measurements.—Apertura $\begin{cases} ha = 0.14 \text{ mm.} \\ la = 0.12 \text{ mm.} \end{cases}$

Zooecia $\begin{cases} Lz = 0.40\text{–}0.50 \text{ mm.} \\ lz = 0.30 \text{ mm.} \end{cases}$

Structure.—This is a bizarre species the structure of which has for a time appeared enigmatic; we have finally concluded that the frontal reticulations result from the thickening of the olocystal veins characteristic of *Buffonellaria;* the young zooecia are deprived of them. The small oral avicularium is rather constant; it appears elliptic, but on our dried specimens we have not observed the direction of its mandible.

The operculum is similar to that of *Buffonellaria divergens* and bears also two lucidae corresponding to the two condyles of articulation. The dimensions are rather variable.

The exterior aspect of the aperture is deceiving, for it is not in rapport with the true form of the operculum, the rimule of the latter being much wider than the proximal sinus of the aperture.

The ovicell bears a system of nervelike threads like the frontal, but they are less salient and the principal ones limit the two perforated lateral areas.

Biology.—Our living specimens were in reproduction March 15, 1885. Several of them encrust both sides of shell fragments. This is a rather frequent phenomenon that is difficult to explain otherwise than by the floating of the substratum.

Occurrence.—*Albatross* Station D. 2405, Gulf of Mexico; 28° 45′ 00″ N.; 85° 02′ 00″ W; 30 fms.; gray sand, broken coral.

Holotype.—Cat. No. 7460, U.S.N.M.

Genus GEMELLIPORELLA Canu and Bassler, 1920

The ovicell is hyperstomial and not closed by the operculum. The frontal is an olocyst bordered by areolar pores and covered by a granular pleurocyst. There are oral avicularia.

Genotype.—*Gemelliporella vorax* Canu and Bassler, 1923.

Range.—Miocene—Recent.

Gemelliporella asper and *G. vorax* Canu and Bassler, 1923, belong to this genus. In 1923 we were deceived by the aspect of the aperture of the fossil specimens, but an examination of the recent specimens enables us to correct this false interpretation.

GEMELLIPORELLA ASPER Canu and Bassler 1923

Plate 10, Figure 1

1923. *Gemelliporella asper* Canu and Bassler, North American Later Tertiary and Quaternary Bryozoa. Bull. 125, U. S. National Museum, p. 110, pl. 18, figs. 5, 6.

Measurements.—Aperture $\begin{cases} ha=0.12\text{–}0.15 \text{ mm.} \\ la=0.08\text{–}0.10 \text{ mm.} \end{cases}$

Zooecia $\begin{cases} Lz=0.50 \text{ mm.} \\ lz=0.40\text{–}0.45 \text{ mm.} \end{cases}$

Structure.—Like the frontal, the ovicell is formed by an olocyst surmounted by a pleurocyst, but the latter is incomplete and leaves in front a small semicircular cicatrix. The small oral avicularium is elliptical and little salient; the large zooecial avicularium is arranged laterally; it is salient and its mandible is wide and horny; the pivot bears a very characteristic distal tooth. The areolar pores are large and scattered from each other.

Our recent specimens are somewhat less calcified than the fossils. Their large avicularium is much smaller than that in specimens from the Miocene but it is equal to that of the Pliocene examples.

Biology.—The great development of the avicularia seems to indicate rather calm waters. Our recent specimens encrust nullipores; the fossils encrusted oysters.

Occurrence.—*Albatross* Station D. 2322, north of Cuba; 23° 10′ 54″ N.; 82° 17′ 45″ W.; 115 fms.; coral.

Geologic distribution.—Miocene and Pliocene of Florida and South Carolina.

Plesiotype.—Cat. No. 7533, U.S.N.M.

Genus STYLOPOMA Levinsen, 1909

Levinsen, 1909, published his doubt as to the validity of this genus and even suppressed it. According to his ideas, the passage of the eggs is a function which each species operates differently and according to circumstances. We have always thought that this is an important function which is of generic importance. We violate this principle sometimes, but it is only in genera in which the species are rare and in order not to change the nomenclature uselessly. This is not the case in the genus *Stylopoma*, in which we already know the following seven species.

Stylopoma spongites Pallas, 1766, Miocene—Recent.

Stylopoma minuta Canu and Bassler, 1923, Miocene (Jamaica).

Stylopoma magniporosa Canu and Bassler, 1923, Miocene (Santo Domingo).

Stylopoma projecta Canu and Bassler, 1923, Pleistocene (Panama).

Stylopoma distorta, new species, Recent (Philippines).

Stylopoma parviporosa, new species, Recent (Philippines).

Stylopoma grandis, new species, Recent (Philippines).

This is an equatorial genus but it has been observed in the larger oceans such as the Atlantic, Indian, and Pacific. We have not yet found it in the Southern Hemisphere.

STYLOPOMA SPONGITES Pallas, 1766

Plate 10, Figures 8–10; Plate 32, Figure 9, text Figure 14

1918. *Schizoporella spongites* WATERS, Bryozoa of the Cape Verde Islands. Journal Linnean Society, Zoology, vol. 34, p. 16, pl. 2, figs. 10–13.

1923. *Stylopoma spongites* CANU and BASSLER, North American Later, Tertiary and Quaternary Bryozoa. Bull. 125, U. S. National Museum, p. 102, pl. 17, figs. 1–12. (Bibliography, geographic distribution.)

Measurements.—Aperture $\begin{cases} ha = 0.10 \text{ mm. (without sinus).} \\ la = 0.12\text{–}0.15 \text{ mm.} \end{cases}$

Zooecia $\begin{cases} Lz = 0.50 \text{ mm.} \\ lz = 0.35 \text{ mm. (variable).} \end{cases}$

Variations.—Smitt in 1873, Waters in 1918, and ourselves in 1923 have indicated the great zooecial variations of this species. The colonial variations are also numerous; the zoaria can be observed in spongy masses, often very large, in multilamellar hemescharian colonies, in uni or multilamellar encrusting surfaces, and in unilamellar cylindrical forms. Furthermore, in the waters off Florida we have observed magnificent bilamellar dendroid colonies of free or anastomosing, very regular, compressed fronds. This is a very capricious animal which can adapt itself to all the biologic conditions possible; but this faculty of adaptation is always accompanied by correlative variations.

Structure.—On the interior the tremopores are very small and at a magnification of 20 diameters they are visible only by transparency. There are no condyles to the aperture. The operculum is very thin and quite fragile; the proximal rimule is subtriangular and it is much wider than the apertural sinus which is thin and linear. The form appears quite variable, for that which we figure is a little different from the opercula figured by Levinson, 1909, and by Waters, 1918.

We have never observed the apertural denticles described by Waters, 1918. We believe that his specimen from Manaar is of another species.

Biology.—The larva scarcely chooses its substratum for it is affixed to shells, bryozoa, corals, sponges, rocks, and fronds of small algae. However, we have not yet observed colonies on nullipores. "The color varies from translucent white or yellow to bright brick red" (Osburn).

This is a very fecund species, the frequency of specimens and the abundance of ovicells being the immediate manifestations. This fecundity has increased in time, for the ovicells of the fossil specimens are generally smaller than the ovicells of the recent specimens. Reproduction was observed during the first three months of the year.

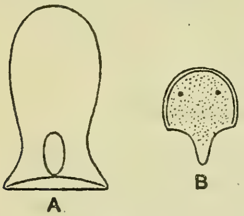

FIG 14.—STYLOPOMA SPONGITES PALLAS, 1766. *A.* MANDIBLE OF AN INTERZOOECIAL AVICULARIUM. *B.* OPERCULUM

An ordinary polypide constructs the zooecium. It degenerates and is replaced by a female polypide which constructs the ovicell above the distal zooecium and the aperture. It is deprived of tentacles which could not emerge through the special orifice of the ovicell. The passage of the eggs is thus assured in an absolute fashion. The escape of the larvae operates as in other species by the rupture of the membrane which closes the ovicell.

Occurrence.—*Albatross* Station D. 2319, north of Cuba; 23° 10′ 37″ N.; 82° 20′ 06″ W.; 143 fms.; gray coral.

Albatross Station D. 2320, north of Cuba; 23° 10′ 39″ N.; 82° 18′ 48″ W.; 130 fms.; fine coral.

Albatross Station D. 2405, Gulf of Mexico; 28° 45′ 00″ N.; 85° 02′ 00″ W.; 30 fms.; gray sand, broken coral.

Florida, 21–56 meters (Smitt); Tortugas, 5–29 meters (Osburn).

Pliocene: Minnitimmi Creek, Bocas Island, Almirante Bay, Panama.

Caribbean Sea, St. Thomas and St. John (Levinsen); Bermuda (Verrill); Cape Verde Islands, 16 meters (Waters), and perhaps Ceylon (Thornely) and Malacca (Levinsen).

Geologic distribution.—Upper Miocene of Virginia to Florida; Pliocene of Florida; Pleistocene of South Carolina, Florida, and Panama.

Plesiotypes.—Cat. Nos. 7600, 70861, U.S.N.M.

Genus SCHIZOPODRELLA Canu and Bassler, 1917

SCHIZOPODRELLA INCRASSATA, new species

Plate 9, Figures 1–4

?1923. *Gemelliporella vorax* CANU and BASSLER part, North American Later Tertiary and Quaternary Bryozoa. Bull. 125, U. S. National Museum, p. 111, pl. 19, fig. 1.

Description.—The zoarium encrusts algae, or more often develops into bilamellar fronds, dichotomous and compressed laterally. The young zooecia only are distinct, elongated, convex, all the others are indistinct with thick frontal and with irregularly arranged avicularia; the frontal is formed by an olocyst perforated by very small pores surmounted by a very thick tremocyst with large scattered pores. The ovicell of the young zooecia is globular and of the other zooecia is little visible, not salient, embedded in the calcified wall of the tremocyst; it is finely porous. Two small avicularia are arranged symmetrically on each side of the apertural sinus; a large zooecial avicularium, orbicular and salient, is distributed irregularly on the old zooecia.

Measurements.—Aperture $\begin{cases} ha = 0.10 \text{ mm.} \\ la = 0.06\text{–}0.08 \text{ mm.} \end{cases}$

Young zooecia $\begin{cases} Lz = 0.40 \text{ mm.} \\ lz = 0.30 \text{ mm.} \end{cases}$

Structure.—This species is very difficult to study because of its irregularity and its structure is visible only on preparations. Even on the young zooecia the tremopores are not apparent. They appear, on the contrary, very clearly on the interior especially on preparations examined by transparency. The muscular attachments of the operculum are placed far from the edge and toward the superior part.

It is probable that Figure 1, on plate 19 of our 1923 work, which we have considered as a variety of *Gemelliporella vorax*, really belongs to the present species. Our specimens were in reproduction March 19, 1885.

Occurrence.—*Albatross* Station D. 2405, Gulf of Mexico; 28° 45′ 00″ N.; 85° 02′ 00″ W.; 30 fms.; gray sand, broken coral (bilamellar).

Albatross Station D. 2639, Straits of Florida; 25° 04′ 50″ N.; 80° 15′ 10″ W.; 56 fms.; coral sand (unilamellar). ? Pliocene of South Carolina.

Holotype.—Cat. No. 7585, U.S.N.M.

SCHIZOPODRELLA FLORIDANA Osburn, 1914

Plate 10, Figures 4–6; text Figure 15 *d, e*

1914. *Schizoporella floridana* OSBURN, Bryozoa of the Tortugas Islands, Florida. Publication Carnegie Institution, Washington, no. 182, p. 205, figs. 17, 18.

1923. *Schizopodrella floridana* CANU and BASSLER, North American Later Tertiary and Quaternary Bryozoa. Bull. 125, U. S. National Museum, p. 106, pl. 16, figs. 11–15.

Measurements.—Aperture $\begin{cases} ha = 0.17\text{–}0.20 \text{ mm.} \\ la = 0.15 \text{ mm.} \end{cases}$

Zooecia $\begin{cases} Lz = 0.85\text{–}90 \text{ mm.} \\ lz = \text{variable.} \end{cases}$

Structure.—In 1923 we figured a group of marginal zooecia oriented and deprived of the large frontal avicularium. The other zooecia are arranged in every way; they bear an enormous, very salient avicularium which has furnished us the mandible. This lack of orientation explains the irregularities of our section of 1923; it approaches, however, that Waters figured, 1918, for *Schizoporella viridis* and in which the arrangement indicated the independence of the superposed lamellae in the multilamellar colonies.

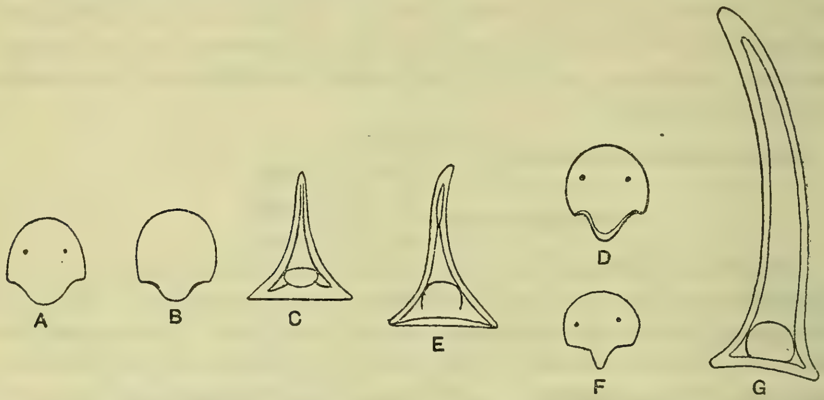

FIG. 15.—GENUS SCHIZOPODRELLA CANU AND BASSLER, 1917. *A–C.* SCHIZOPODRELLA PUNGENS, NEW SPECIES. *A, B.* TWO OPERCULA, × 85. *C.* MANDIBLE, × 85. *D, E.* SCHIZOPODRELLA FLORIDANA OSBURN, 1914. *D.* OPERCULUM. *E.* MANDIBLE OF A LARGE AVICULARIUM. *F, G.* SCHIZOPODRELLA FALCIFERA, NEW SPECIES. *F.* OPERCULUM. *G.* MANDIBLE OF LARGE INTERZOOECIAL AVICULARIUM

The operculum is light colored. It has no peculiarities of form. On the interior the tremopores are not visible at an enlargement of ×20, but they are apparent by transparency; there are no condyles for the articulation of the operculum.

Biology.—The colonies form voluminous masses attaining the size of the fist, according to the number of superposed lamellae. The latter curve around and surround a small stony fragment; sometimes the substratum is an algal frond and it is necessary that the colony be very light in spite of its large volume. "The color ranges from pure white to dark purplish and red" (Osburn). The frontal ectocyst is alone colored; the interior of the zooecia as well as all the calcareous skeleton is not colored.

Only the young marginal zooecia have the aspect shown in Osburn's figure. The other cells are unoriented, the oral avicularium is lacking or is much reduced and the large frontal avicularium is often wanting.

Our living specimens were in reproduction January 30, 1884.

Occurrence.—*Albatross* Station D. 2363, east of Yucatan; 22° 07′ 30″ N.; 87° 06′ 00″ W.; 21 fms.; white coral rock.

Geologic distribution.—Miocene of North Carolina and Florida.

Plesiotypes.—Cat. No. 7582, U.S.N.M.

SCHIZOPODRELLA FALCIFERA, new species

Plate 10, Figures 2, 3; text Figure 15 *f*, *g*

Description.—The zoarium encrusts Cellepores. The zooecia are distinct, separated by a shallow furrow, rectangular; the frontal is a tremocyst with small pores and is little convex. The aperture is placed eccentrically, rarely in the zooecial median axis. It is suborbicular with a rather deep proximal, triangular sinus. A small avicularium is placed at the side of the aperture; it is very thin and elongated. On the zoarial surface appears sporadically a large, very elongated somewhat falciform avicularium placed on a salient eminence.

Measurements.—Aperture $\begin{cases} ha = 0.15 \text{ mm.} \\ la = 0.15 \text{ mm.} \end{cases}$

Zooecia $\begin{cases} Lz = 0.45\text{–}0.50 \text{ mm.} \\ lz = 0.30\text{–}0.35 \text{ mm.} \end{cases}$

Affinities.—The operculum is of the *Schizopodrella* type; the two muscular attachments are removed from the border.

This species resembles *Schizopodrella longirostris* Hincks, 1886, in the often eccentric position of its aperture but differs from it in the very different form of its zoarial avicularium which covers two or three zooecia. Our specimen was in reproduction January 30, 1905.

Occurrence.—*Albatross* Station D. 2365, east of Yucatan; 22° 18′ 00″ N.; 87° 04′ 00″ W.; 24 fms.; white rock coral.

Holotype.—Cat. No. 7583, U.S.N.M.

SCHIZOPODRELLA PUNGENS, new species

Plate 27, Figures 5–12; text Figure 15 *a–c*

Description.—The zoarium encrusts shells or soft algae at their bifurcation. It is uni or multi lamellar. The zooecia are distinct, separated by a deep furrow, elongated, elliptical; the frontal is convex and formed by a granular tremocyst with large pores. It is ornamented with a more or less salient umbo placed on the median axis in the vicinity of the apertura. The apertura is somewhat elongated; the anter is large and semicircular; the poster is small, distinct, with a broad rounded rimule; the peristome is thin, salient, furnished with very short spines. The oral avicularium is thin, triangular, with very *salient* beak; it is placed obliquely, adjacent to the poster and on one side only. The ovicell is large globular, porous, covering a large portion of the distal zooecium.

Measurements.—Apertura $\begin{cases} ha = 0.14\text{–}0.15 \text{ mm.} \\ la = 0.12 \text{ mm.} \end{cases}$

Zooecia $\begin{cases} Lz = 0.60\text{–}0.75 \text{ mm.} \\ lz = 0.30\text{–}0.40 \text{ mm.} \end{cases}$

Variations.—The colonies have generally the aspect of hollow tubes of a half centimeter in diameter, irregularly ramified, and of a length measuring as much as 3 centimeters. These tubes are never ancestrular. One of these colonies still had its base fixed on a small shell and then developed, forming an arborescent ensemble. Although living, as no trace of the alga was observed at the center of the tubes, we suppose that the latter was very fragile and naturally was destroyed during cleaning of the specimens.

The avicularia are the most variable organs. Their beak is very salient and at times perpendicular to the apertural plane. On certain zooecia they are placed exactly on the frontal. They are generally oriented obliquely toward the top of the colony, but this orientation varies considerably according to the irregularity of the substratum and of the budding; rarely the point is oriented toward the base. Their length varies from one branch to another (0.20 mm. to 0.30 mm). Whatever the orientation or size may be, the mandible is always lowered on the rimule.

The zooecia of the external lamella are very often irregularly oriented. The size of the frontal mucro is equally variable.

Affinities.—This new species differs from *Schizopodrella isabelleana* Smitt, 1873, in its elongated and nontransverse aperture, in the presence of a frontal mucro, and in its larger avicularia.

The projections on the zoarial surface made by the umbo and by the avicularia give it a prickly aspect which enables the species to be rather easily distinguished.

On specimens boiled in Javelle water the aperture shows the same features as in *Schizopodrella isabelleana*; on each side of the rimule there are two very small secondary indentations.

Biology.—The avicularia are not zooecial but they are indeed oral avicularia not only because their occurrence is constant but also because the mandible in opening comes always in immediate contact with the rimule. Their function remains mysterious but it appears in connection with the hydrostatic system.

The larva fixes itself on dead shells which the colony surrounds in developing their many lamellae. If the shell is small the ensemble must be very light and buoyant. But the colonies develop with much more ease on shells already covered with algae or with radicles. They encrust the latter, forming the curious tubes described previously. These tubes are frequently separated from the primitive shell and form floating masses.

Occurrence.—Gulf of Mexico, Cedar Keys, Florida. *Albatross* Station D. 2362, east of Yucatan; 22° 8′ 30″ N.; 86° 53′ 30″ W.; 25 fms.; coral sand.

Cotypes.—Cat. No. 7586, U.S.N.M.

SCHIZOPODRELLA ISABELLEANA Smitt, 1873

Plate 27, Figures 1–4

1873. *Hippothoa isabelleana* SMITT, Floridan Bryozoa. Kongl. Svenska Vetenskaps-Akademiens Handlingar, vol. 10, p. 44, pl. 8, figs. 166–168 (not D'Orbigny, 1835).

Measurements.—Aperture $\begin{cases} ha = 0.10\text{–}0.12 \text{ mm.} \\ la = 0.13\text{–}0.14 \text{ mm.} \end{cases}$

Zooecia $\begin{cases} Lz = 0.50\text{–}0.60 \text{ mm.} \\ lz = 0.30\text{–}0.45 \text{ mm.} \end{cases}$

Structure.—The colonies are multilamellar; they encrust algae at their bifurcation and have the aspect of irregularly ramified hollow tubes. The transverse section is not at all that of the Cellepores and Figure 167 of Smitt is perfectly exact.

The zooecia are rhomboidal or irregular; they are not always well oriented. The ectocyst is rather thick but the tremopores are quite visible by transparency.

The details of the aperture are quite visible, especially on specimens boiled in Javelle water, and they are identical with those of *Schizopodrella pungens*. The poster bears two very small indentations placed symmetrically on each side of the rimule. This character does not exist in the other species of the genus. The aperture is always somewhat transverse.

The ovicell is porous like the frontal and is never closed by the operculum; it is quite globular, placed on the distal zooecium, which it covers about half.

On the inferior face of the zoarial lamellae the zooecia have a structure analogous to that which Barroso in 1918 and 1921 observed on *Schizopodrella unicornis* Johnston, 1847. The proximal border of each cell is ornamented with four to six very long denticles quite visible by transparency on our figure. Barroso, 1918, figured them viewed from the interior, and he remarks:

> En el angulo que forman la pared de la base y la parte inferior de las zoecias existen uno surcos, siete de ordinario, separados par pequeñas costillas que están como reforzando la union de los dos paredes; no puede apieciarse claramente en los citados surcos perforación, locual las daria significacion de poros de communicación interzoeciales.[9]

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[9] Barroso, Bol. real Sociedad Espanola de Historia Natural, vol. 18, p. 409 (Sep. 2) (1918).

Affinities.—The determination of this species is not always easy, for it may be confused with two other species of the same general aspect and with analogous dimensions. It differs from *Stylopoma spongites* Pallas, 1766, in the nature of its ovicell which does not hide the aperture, and in its much larger apertural rimule. It differs from *Schizopodrella pungens*, new species, in the absence of an umbo on the frontal and in its transverse and nonelongated aperture. It is not *Escharina isabelleana* D'Orbigny, 1839, in which the avicularium is placed at the side of the anter and in which the affinities according to Waters, 1906, are rather with *Schizopodrella unicornis* Johnston, 1847.

Biology.—Our colonies were bluish; this is perhaps what Smitt wished to express in writing that his were of purplish blue tint. They were ovicelled, but as we have not seen the ancestrula it is probable that this was not the month of the escape of the larva and of the fixation.

The avicularia have generally a very salient beak oriented obliquely toward the superior part of the zooecia. Their presence is constant. They are often adjacent to the poster, never the anter. We think that they are oral and that their presence is to supply some internal function of which we are unfortunately ignorant. In the other species of this genus the avicularia are frequently two in number, symmetrically placed on each side of the aperture; it would be convenient then to place *Schizopodrella pungens* and *S. isabelleana* in a special section.

The colonies fixed on algae belong to the category of floating bryozoa. They have not necessarily lived at the place where they were dredged and they do not therefore furnish exact bathymetric data.

Occurrence.—St. Thomas, Virgin Islands, West Indies; Florida, 27 meters (?) (Smitt).
Pliocene: Minnitimmi Creek, Bocas Island, Almirante Bay, northwest Panama.

Plesiotypes.—Cat. No. 7584, U.S.N.M.

Genus GEMELLIPORA Smitt, 1873 (part)

GEMELILPORA GLABRA Smitt, 1873

Plate 12, Figures 1–7; text Figure 16

1885. *Gemellipora glabra* BUSK, Bryozoa of the *Challenger*. Report Scientific Results Voyage *Challenger*, vol. 10, p. 176, pl. 25, fig. 3.

1873. *Gemellipora glabra* SMITT, Floridan Bryozoa. Kongl. Svenska Vetenskaps Akademiens, Handlingar, vol. 11, p. 37, pl. 11, figs. 207–210

Measurements.—Aperture $\begin{cases} ha = 0.18 \text{ mm.} \\ la = 0.12 \text{ mm.} \end{cases}$

Zooecia $\begin{cases} Lz = 1.1 \text{ mm.} \\ lz = 0.5 \text{ mm.} \end{cases}$

Structure.—The zoarium is formed of dichotomous, cylindrical branches borne by a slightly expanded discoidal base. It is entirely covered over by a thin ectocyst, allowing all the tuberosities and the tremopores of the skeleton to be visible. The latter are small and numerous. The zooecia are indistinct except at the extremity of the branches. The ovicell is salient, globular, almost entirely covered by tremopores; a median cicatrix permits the inferior olocyst to be seen.

In longitudinal section the zoarial walls are very thick and perforated by very numerous tubular tremopores. The transverse section shows six zooecia; the peristome is ornamented by two longitudinal lines of granules.

The operculum is large, oval, with the two small lateral denticles characteristic of the genus; its decoration is rather variable.

FIG. 16.—GEMELLIPORA GLABRA SMITT, 1873. *A*, *B*. TWO ASPECTS OF THE OPERCULUM, × 85

Affinities.—The zoarium of *Gemellipora punctata* Canu and Bassler, 1923, is identical but the present species differs from it in its smaller and more scattered apertures.

Biology.—Our specimens were in reproduction. It is an equatorial species and from shallow water.

Occurrence.—*Albatross* Station D. 2405, Gulf of Mexico; 28° 45′ 00″ N.; 85° 02′ 00″ W.; 30 fms.; gray sand, broken coral.

Albatross Station D. 2639, Straits of Florida; 25° 04′ 50″ N.; 80° 15′ 10″ W.; 56 fms.; coral sand.

Fowey Light, 15 miles south of Miami, Fla.; 40 fms.

Florida, 90 meters (Smitt). Atlantic: Bahia, 16–48 meters; John Adams Bank (Busk).

Plesiotypes.—Cat. No. 7501, 7502, U.S.N.M.

GEMELLIPORA (?) LIMBATA Smitt, 1873

1873. *Gemellipora limbata* SMITT, Floridan Bryozoa. Kongl. Svenska Vetenskaps-Akademiens Handlingar, vol. 11, p. 40, pl. 11, figs. 212–214.

We have found some zooecia of this remarkable monoserial species. They were dead and we have not been able to make a close study of them. We have preserved Smitt's generic name, although the species appears to us to belong to the genus *Lagenipora*.

The diameter of the apertura is 0.09 mm. The frontal is smooth or areolated.

Biology.—The zoarium encrusts Cellepores (Smitt), shells, or nullipores. It is a species of great depths.

Occurrence.—*Albatross* Station D. 2152, 2½ miles northwest of Habana Light; 387 fms.; coral.

Albatross Station D. 2320, north of Cuba; 23° 10′ 39″ N.; 82° 18′ 48″ W.; 130 fms.; fine coral.

Florida, 763 meters (Smitt).

Genus GEMELLIPORIDRA Canu and Bassler, 1927

The ovicell is hyperstomial and is always closed by the operculum. The frontal and the ovicell are covered by tremopores. The aperture bears two small lateral indentations separating a very large suborbicular anter from a very small concave poster. The operculum bears two lateral marks corresponding to oral indentations and two linear muscular attachments. There are two oral avicularia irregularly arranged on each side of the aperture. The complete colonies are multilamellar, and the zooecia are then badly oriented.

Genotype.—*Gemelliporidra typica* Canu and Bassler, 1927. Recent.

Range.—Pleistocene. Recent.

The other known species are:

Gemelliporidra aculeata, new species, Recent, Gulf of Mexico.

Gemelliporidra magniporosa, new species, Recent, Gulf of Mexico.

Gemelliporidra (*Cyclicopora*) *multilamellosa* Canu and Bassler, 1923, Pleistocene, Panama Canal Zone.

This genus is very close to *Gemellipora* Smitt, 1873, in the form of the operculum and of the aperture in which the lateral indentations serve for the insertion of two corresponding denticles on the operculum. It differs in a wider, rounded poster and in its larger, rectangular zooecia poorly oriented (celleporine structure of Smitt).

As in *Hippodiplosella*, there are two linear bands on the operculum. *Gemelliporidra* differs from this genus in the absence of cardelles, in the presence of two indentations in the aperture, in two lateral denticles on the operculum, and in the muscular attachments much less clear and more irregular. The genus is known only in the Tropical Zone of the Atlantic.

GEMELLIPORIDRA TYPICA Canu and Bassler, 1927

Plate 11, Figures 1–4, text Figures 17 *a–c*

1927. *Gemelliporidra typica* Canu and Bassler, Classification Cheilostomatous Bryozoa. Proc. U. S. Nat. Mus., vol. 69, p. 7, pl. 1, fig. 9.

Description.—The zoarium is uni or multi lamellar. The zooecia are large, rectangular, distinct, separated by a salient thread, oriented in all directions, little elongated; the frontal is convex, formed of a perforated olocyst surmounted by a granular tremocyst in which the lateral pores are much larger. The aperture is suborbicular and provided with two lateral indentations separating a very large anter from a concave and sinuous poster. The ovicell is globular and disposed between the olocyst and the tremocyst of the distal zooecium. On each side of the aperture there is a triangular avicularium with pivot, obliquely arranged, with the beak adjacent to the peristome and directed towards the median zooecial axis.

Measurements.—Aperture $\begin{cases} ha = 0.22 \text{ mm.} \\ la = 0.19 \text{ mm.} \end{cases}$

Zooecia $\begin{cases} Lz = 1.10 \text{ mm.} \\ lz = 0.90 \text{ mm.} \end{cases}$

Structure.—The width of the aperture varies from 0.15 to 0.28 mm. The form is orbicular, a little elongated or transverse. On the transverse aperture two very small lateral indentations are visible as in *Gemellipora,* but it is an exterior aspect occasioned by the presence of two small cardelles. Moreover, this form is not constant and the corresponding opercula are of two kinds—one is regular, the other has a small lateral constriction. The opercular muscles are attached to two lateral bands very close to the border.

The ovicell is buried on the distal zooecium and developed between its olocyst and its tremocyst; it is of the same structure as the frontal; it is relatively small and closed by the operculum. On each side of the aperture there is a transverse thread jointed to the salient thread separating the zooecia. These threads do not limit the zooecia distally, although the aperture appears in a terminal projection; in the interior the aperture is removed from the distal border.

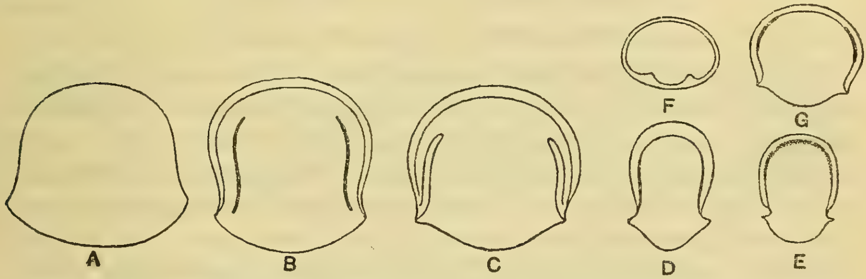

FIG. 17.—OPERCULA OF GEMELLIPORIDRA CANU AND BASSLER, 1927. *A-C.* GEMELLIPORIDRA TYPICA CANU AND BASSLER, 1927. ORDINARY, ELONGATE AND TRANSVERSE OPERCULA, × 85. *D, E.* GEMELLIPORIDRA MAGNIPOROSA, NEW SPECIES. TWO OPERCULA SHOWING VARIATION, × 85. *F. G.* GEMELLIPORIDRA ACULEATA, NEW SPECIES. *F.* RARE FORM OF OPERCULUM. *G.* ORDINARY OPERCULUM WITH THE THICK PART OF INNER LINE INDICATING THE INSERTION OF THE OPERCULAR MUSCLES

The frontal is a granular tremocyst; the lateral tremopores are large, the others are very small.

As in all the multilamellar species, the orientation of the zooecia is not constant; sporadically inverted zooecia develop and disarrange the primitive orientation.

The avicularium is placed laterally in the vicinity of the aperture. It is long, triangular, acuminated, provided with a pivot; its beak is directed toward the top and toward the median axis of the zooecium. As it is not constant, its function is only accessory; it does not replace an essential organ of the zooecium itself. In spite of its position, we consider it as a zoarial avicularium of oxygenation. On several of our specimens it changes its position and becomes transverse.

The micrometric measurements are quite inconstant and vary from single to double, but the general structure remains always the same. The transverse section indicates that the zooecia of the superposed lamellae arranged in rows and not in quincunx.

Biology.—This species forms large, free colonies, but the lamellae are superposed only on one side. It is incrusted by small species of bryozoa. It appears to prefer the great depths. The dredgings of the *Albatross* showed it to have been in reproduction from January to May.

Occurrence.—*Albatross* Station D. 2167, off Havana, Cuba; 23° 10′ 40″ N; 82° 20′ 30″ W.; 201 fms.; coral.
Albatross Station D. 2319, north of Cuba; 23° 10′ 37″ N.; 82° 20′ 06″ W; 143 fms.; gray coral.
Albatross Station D. 2330, north of Cuba; 23° 10′ 48″ N.; 82° 19′ 15″ W; 121 fms.; gray coral.
Pleistocene: Panama Canal Zone.

Cotypes.—Cat. Nos. 7505, 7506, U.S.N.M.

GEMELLIPORIDRA ACULEATA, new species

Plate 9, Figure 5; text Figure 17 *f*, *g*

Description.—The zoarium encrusts shells. The zooecia are distinct, separated by a deep furrow, elongated, elliptical, or subrectangular on the zoarial margin; the frontal is convex, covered by a granular tremocyst with very small pores. The aperture is orbicular or somewhat transverse; the cardelles are small; the peristome is a little salient, granular, and formed by the tremocyst. The ovicell is globular, salient, closed by the operculum. Sporadically there are avicularian zooeciules bearing a long slender mandible in the form of a *needle;* they are always primoserial.

Measurements.—Aperture $\begin{cases} ha = 0.12\text{–}0.15 \text{ mm.} \\ la = 0.15 \text{ mm.} \end{cases}$

Zooecia $\begin{cases} Lz = 0.65 \text{ mm.} \\ lz = 0.40 \text{ mm.} \end{cases}$

Zooeciules $\begin{cases} Lz = 0.55 \text{ mm.} \\ lz = 0.25 \text{ mm.} \end{cases}$

Affinities.—This species is very well characterized by its avicularian zooeciules which are always primoserial. We have found two kinds of opercula; the more transverse belong apparently to the ovicelled zooecia; the others are surrounded by a marginal band on which the opercular muscles are laterally inserted. Our two specimens were dredged alive.

Occurrence.—Fowey Light, 15 miles south of Miami, Fla.; 40 fms.

Holotype.—Cat. No. 7507, U.S.N.M.

GEMELLIPORIDRA MAGNIPOROSA Canu and Bassler, 1923

Plate 11, Figures 5–11, text Figure 17 *d*, *e*

1923. *Schizoporella magniporosa* Canu and Bassler, North American Later Tertiary and Quaternary Bryozoa. Bull. 125, U. S. National Museum, p. 95, pl. 45, figs. 1, 2.

Measurements.—Aperture $\begin{cases} ha = 0.16 \text{ mm.} \\ la = 0.12 \text{ mm.} \end{cases}$

Zooecia $\begin{cases} Lz = 0.60 \text{ mm.} \\ lz = 0.40 \text{ mm. (variable).} \end{cases}$

Structure.—We discovered this species in the Pleistocene of Panama, but on the fossil specimens we were unable to discern the true nature of the aperture; the operculum is that of a *Gemellipora* but somewhat attenuated and less oval; the ornament on it is variable. The zooecia are not always regularly oriented. Inverse zooecia are formed sporadically and completely disarrange the regularity of the budding. We have observed this phenomenon in many genera but we are ignorant of its cause. For species with celleporine structure Smitt, 1867, created the genus *Herentia*, but this name has not been admitted into nomenclature because of great diversity of the species.

The zooecia are generally separated by a salient thread. The two small oral avicularia are triangular, with pointed and very salient beak in front of the zooecial plane; they are very difficult to illustrate. They are constant, but sometimes one of them is lacking. The ovicell appears on the normally oriented zooecia; it is globular, closed by the operculum and covered by large tremopores like the frontal.

The dimensions are quite variable especially in width. The determination of isolated specimens is quite difficult.

Biology.—The colonies encrust bryozoa, shells, or grains of sand joined together. Many lamellae are often superposed. The formation of inversed zooecia is, morever, absolutely connected with the plurilamellar phase, for we have observed it in other species of very different genera. The architecture of the bryozoa is so complicated that it often escaped our comprehension.

Our specimens were in reproduction from January to April.

Occurrence.—*Albatross* Station D. 2157, Gulf of Mexico, off Habana; 23° 10′ 04″ N.; 82° 21′ 07″ W.; 29 fms.

Albatross Station D. 2169, off Habana, Cuba; 23° 10′ 28″ N.; 82° 20′ 27″ W.; 78 fms.; coral.

Albatross Station D. 2362, east of Yucatan; 22° 08′ 30″ N.; 86° 53° 30″ W.; 25 fms.; coral sand.

Pleistocene of Panama (Canu and Bassler).

Plesiotypes.—Cat. Nos. 7503, 7504, U.S.N.M.

GEMELLIPORIDRA MULTILAMELLOSA Canu and Bassler, 1923

1923. *Cyclicopora multilamellosa* CANU and BASSLER, North American Later Tertiary and Quaternary Bryozoa. Bull. 125, U. S. National Museum; p. 138, pl. 46, figs. 3–6.

This interesting fossil species is somewhat smaller than *Gemelliporidra typica* and differs still more in its small and transverse aperture and in its much longer avicularia, with the beak always oriented toward the base of the zooecium.

We were unable to establish the true structure of this species on the fossil specimens previously studied, but the discovery of three recent species now permits us to incorporate it in the genus *Gemelliporidra.*

Occurrence.—Pleistocene: Mount Hope, Panama Canal Zone.
Pliocene: Minnitimmi Creek, Bocas Island, Almirante Bay, Panama.

Subfamily HIPPOPORAE Canu and Bassler, 1917

Genus HIPPOPORINA Neviani, 1895

HIPPOPORINA CLEIDOSTOMA Smitt, 1873

Plate 9, Figure 7; Plate 32, Figure 5; text Figure 18

1873. *Lepralia cleidostoma* SMITT, Floridan Bryozoa. Kongl. Svenska Vetenskaps-Akademiens Handlinger, vol. 11, p. 62, pl. 11, figs. 217–219. Not Waters, 1899, Norman, 1909.

Measurements.—Aperture $\begin{cases} ha = 0.14 \text{ mm.} \\ la = 0.10 \text{ mm.} \end{cases}$

Zooecia $\begin{cases} Lz = 0.40\text{–}0.50 \text{ mm.} \\ lz = 0.24\text{–}0.30 \text{ mm.} \end{cases}$

Affinities.—This species is not at all *Hippoporina porcellana,* Busk, 1860, found at Madeira and studied successfully by Waters, 1899,

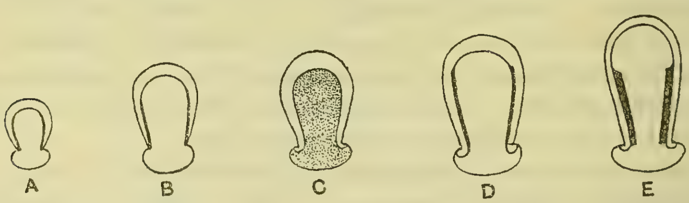

FIG. 18.—HIPPOPORINA CLEIDOSTOMA SMITT, 1873. *A–E.* DIFFERENT FORMS OF THE OPERCULUM WHICH IS MUCH CHITINIZED

and Norman, 1909. It differs from it in its more elongated zooecia, in its larger and more elongated operculum, and in its aperture much less removed from the distal border of the cell. This error of synonymy obliges us to revise our text Figure 114 of 1920.

The zooecia are very small in the vicinity of the ancestrula and increase regularly up to the border of the colony. The aperture is subject to the same phenomenon so that opercula of all the sizes can be found. We have figured some of them. In comparing them with those of Waters, 1899, it is easy to note that they have neither the same proportions nor the same size and that they belong to a perfectly distinct species. The zoarial avicularium is rather rare; we have, however, observed it twice on the ancestrula. The operculum does not close the ovicell.

Biology.—The colonies are rarely unilamellar and free; they generally encrust shells, Cellepores, corals, and hydroids; three specimens were plurilamellar; but this celleporoid structure is very rare. "The color of the colony is shining white, either pure or with a bluish tinge" (Smitt). Our living specimens were in reproduction in May–April, 1885. This is one of the more common species of the Gulf of Mexico. It will be easy to dredge living specimens to study the larva, which appears to us poorly classed in the Escharellidae and its great bathymetric range should correspond to a larger geologic distribution. Kirkpatrick believed he had discovered it in China, but he did not figure his specimens. The species discovered in Japan by Ortmann, 1890, and in Queen Charlotte Island by Hincks, 1884, appear to approach more *Hippoporina porcellana* Busk, 1860.

Occurrence.—*Albatross* Station D. 2167, off Habana, Cuba; 23° 10′ 40″ N.; 82° 20′ 30″ W.; 201 fms.; coral.

Albatross Station D. 2365, east of Yucatan; 22° 18′ 00″ N.; 87° 04′ 00″ W.; 24 fms.; white rock coral.

Albatross Station D. 2405, Gulf of Mexico; 28° 45′ 00″ N.; 85° 02′ 00″ W.; 30 fms.; gray sand, broken coral.

Albatross Station D. 2639, Straits of Flordia; 25° 04′ 50″ N.; 70° 53′ 00″ W.; 133 fms.; green sand.

Plesiotypes.—Cat. Nos. 7517, 7518, U.S.N.M.

Fowey Light, 15 miles south of Miami, Fla.; 40 fms.

Florida, 48–194 meters (Smitt).

Pliocene: Minnitimmi Creek, Bocas Island, Almirante Bay, Panama.

Genus HIPPADENELLA Canu and Bassler, 1917

HIPPADENELLA FLORIDANA, new species

Plate 9, Figure 8; text Figure 19*a*

Description.—The zoarium creeps over chitinous sponges. The zooecia are distinct, separated by a deep furrow, elongated, elliptical, more or less broad; the frontal is very convex, bordered by areolar pores, covered with a pleurocyst; the avicularian chamber is small, convex, little salient, median. The aperture is suborbicular, two short and broad cardelles separating a large anter from a small poster, with proximal concave border; the peristome is very thin and very little salient. The ovicell is large, globular, placed on the distal zooecium.

Measurements.—Aperture $\begin{cases} ha = 0.18 \text{ mm.} \\ la = 0.18 \text{ mm.} \end{cases}$

Zooecia $\begin{cases} Lz = 0.90\text{–}1.00 \text{ mm.} \\ lz = 0.35\text{–}0.50 \text{ mm.} \end{cases}$

Structure.—Two specimens only have been found, the smaller of which was destroyed in the preparation of the operculum. The latter is wide suborbicular; the proximal border is slightly sinous, the muscular attachments are long and very little removed from the border. This is the typical operculum of the Hippoporae. On our dry specimen we have not been able to verify exactly if the operculum closes the ovicell. The ectocyst is very thin.

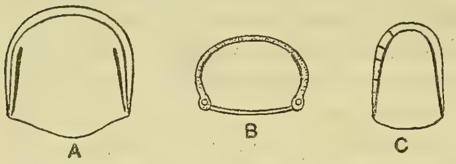

FIG. 19.—OPERCULA, × 85. *A.* HIPPADENELLA FLORIDANA, NEW SPECIES. *B.* HIPPODIPLOSIA PERTUSA ESPER, 1894. THE THICKENED PORTION OF THE INNER LINE INDICATES THE PLACE OF THE OPERCULAR MUSCLES. *C.* HIPPOMENELLA RUBRA, NEW SPECIES

Occurrence.—Cedar Keys, Fla.

Holotype.—Cat. No. 7525, U.S.N.M.

Genus HIPPODIPLOSIA Canu, 1916

HIPPODIPLOSIA PERTUSA Esper, 1794

Plate 9, Figure 6; Plate 32, Figure 10; text Figure 19*b*

1873. *Escharella pertusa* SMITT, Floridan Bryozoa. Kongl. Svenska Vetenskaps-Akademiens Handlingar, vol. 11, p. 55.
1880. *Lepralia pertusa* HINCKS, British Marine Polyzoa, p. 305, pl. 43, figs. 4, 5.
1881. *Lepralia pertusa* JULLIEN, List des Bryozoaires à Etretat. Bulletin Société Zoologique de France, vol. 5, p. 11.
1896. *Hippoporina pertusa* NEVIANI, Corellarii e Briozoi neogenici di sardegna. Bolletina della Societá, geologica Italiana, vol. 15, p. 15.
1896. *Lepralia pertusa* HENNIG, Bryozoer fran Westgrönland. Kongl. Vetenskaps-Akademiens Forhandlingar, vol. 53, p. 358.
1902. *Lepralia pertusa* CALVET, Bryozoaires marins des côtes de Corse. Travaux Institut de Zoologie Université Montpellier, ser. 2, mem. No. 12, p. 26.
1902. *Lepralia pertusa* CALVET, Bryozoaires marins de la region de Cette. Travaux Institut Zoologie Université Montpellier, ser. 2, mem. No. 11, p. 51.
1903. *Lepralia pertusa* JULLIEN and CALVET, Bryozoaires provenant des campagnes del' *Hirondelle.* Resultats du Campagnes Scientifiques du Prince de Monaco, fasc. 23, p. 69, fig. 134.
1905. *Eschara nordlandica* NORDGAARD, Hydrographical and biological investigations in Norwegian fiords, p. 167, pl. 4, fig. 32–35 (fide Nordgaard).

1906. *Eschara nordlandica* NORDGAARD, Bryozoa from the second *Fram* Expedition, 1898–1902. Report second Norwegian Expedition *Fram*, p. 22.

1912. *Lepralia pertusa* OSBURN, Bryozoa of the Woods Hole Region. Bull. Bureau of Fisheries, vol. 30, p. 241, pl. 26, fig. 56.

1918. *Hippoporina pertusa* NORDGAARD, Bryozoa from the Arctic regions. Tromso Museums Aarshefter, vol. 40, p. 59.

1919. *Hipporina pertusa* OSBURN, Bryozoa of the Crocker Land Expedition. Bulletin American Museum Natural History, vol. 16, p. 611.

Measurements.—Aperture $\begin{cases} ha = 0.14\text{–}0.18 \text{ mm.} \\ la = 0.18\text{–}0.20 \text{ mm.} \end{cases}$

Zooecia $\begin{cases} Lz = 0.60\text{–}0.70 \text{ mm} \\ lz = 0.40\text{–}0.50 \text{ mm} \end{cases}$

Structure.—The frontal is formed by an olocyst surmounted by a tremocyst with small pores; the latter is incomplete in the vicinity of the aperture so that the subjacent olocyst is visible in the proximal portion of the aperture; the peristome limits the tremocyst and not the aperture and it is more or less expanded.

The ovicell is developed between the olocyst and the pleurocyst of the distal zooecium in which it is embedded. The operculum closes the ovicell; it is semielliptical, transverse. The muscles are attached to a lateral point of an inner peripheral band somewhat thickened on the sides. The operculum does not resemble that which Nordgaard, 1905, illustrated for his *Eschara nordlandica.* The zooecia are little convex and separated by a salient thread.

Affinities.—The older bibliography of this species is rather confused; for the geographic distribution it is prudent to rely only upon determinations made after the publication of the more exact figures of Hincks, 1880. We do not see any great difference from *Flustra mangnevilleana* Savigny-Audouin, 1828. According to Smitt, the apertural width of the latter is 0.23 mm. and, according to the published figures, the zooecia are more convex, not separated by a salient thread, and the cardelles are more salient and placed a little higher. We have been able to compare directly our specimens from Habana with those of Le Croisic (France).

Biology.—The species appears to be in reproduction almost all the year. It grows on algae as well as on solid bodies; but it fixes itself very rarely on siliceous pebbles. Its bathymetric range is rather large but it prefers the more shallow waters. It is rarely observed below 100 meters; one time on the Newfoundland Banks it was dredged at 155 meters of depth. It characterizes the Temperate Zone and does not extend beyond the Tropic of Cancer or the Polar Circle. Its presence in the Pacific is still doubtful. The determination of the fossils must be revised; however, it appears to begin in the European Miocene.

Occurrence.—*Albatross* Station D. 2362, east of Yucatan; 22° 08′ 30″ N.; 86° 53′ 30″ W.; 25 fms.; coral sand.
Florida, 97 meters (Smith).
Pliocene: Minnitimmi Creek, Bocus Island, Almirante Bay, Panama.

Geographic distribution.—Northern Atlantic: Europe from the mouth of the Loire to Spitsberg. America; Florida and Greenland. Mediterranean.

Plesiotype.—Cat. No. 7521, U.S.N.M.

Genus HIPPOMENELLA Canu Bassler, 1917

HIPPOMENELLA RUBRA, new species

Plate 10, Figure 7; text Figure 19c

Description.—The zoarium is unilamellar and creeps over algae; it is a beautiful glistening red. The zooecia are distinct, separated by a deep furrow, elongated, ovoid, swollen; the frontal is convex, ornamented by a double range of areolar pores and by small granules. The aperture is large, elongated, elliptical; the peristome is salient and formed by the tremocyst; it bears six to eight large hollow spines; it is enlarged and expanded in its proximal portion. The ovicell is large, globular, buried in the distal zooecium, closed by the operculum; it is bordered with areolar pores ornamented with costules converging toward a proximal tuberosity. The avicularia are implanted in the vicinity of the peristome; they are long, thin, triangular, tapering; their beak is directed exteriorily and turned toward the base.

Measurements.—Aperture $\begin{cases} ha = 0.15\text{–}0.18 \text{ mm.} \\ lz = 0.13\text{–}0.15 \text{ mm.} \end{cases}$

Zooecia $\begin{cases} Lz = 0.70\text{–}0.75 \text{ mm.} \\ lz = 0.60 \text{ mm.} \end{cases}$

Affinities.—The ancestrula is very small, its frontal is very short. The ancestrular zooecia are smaller than the marginal zooecia and are deprived of avicularia. The avicularia are inconstant and often absent; we consider them as zoarial.

Hippothoa mucronata Smitt, 1873, is a species very close, perhaps identical, having the same frontal, same ovicell, the same spines, and the same color. Our species differs from it only in the presence of the avicularia and in the tuberosity of the ovicell placed lower and not in the middle.

This species differs from *Lepralia mucronelliformis* Waters, 1899, from Madeira in its smaller dimensions, a larger aperture, and two more spines on the peristome.

The discovery of this species in the Gulf of Mexico is important, for it permits the recognition of the true characters of the genus

Hippomenella abundant in the American Eocene. It is, unfortunately, very rare.

Biology.—Our specimen was dredged living and was in reproduction and fixation March 15, 1885.

Occurrence.—*Albatross* Station D. 2405, Gulf of Mexico; 28° 45′ 00″ N.; 85° 02′ 00″ W.; 30 fms.; gray sand, broken coral.

Holotype.—Cat. No. 7516, U.S.N.M.

Genus LEPRALIA Johnston, 1847

LEPRALIA PALLIOLATA, new species

Plate 12, Figure 11; text Figure 20*d*

Description.—The zoarium encrusts fragments of shells; the zooecia are distinct, separated by a deep furrow, elongated, elliptical; the frontal is quite convex, smooth, formed of two superposed calcareous lamellae. The aperture is small and formed of a large semicircular anter separated by two cardelles from a wider poster with concave proximal border. The ovicell is hyperstomial, never closed by the operculum, globular, smooth; it is formed by two calcareous lamellae of which the superior one is incomplete and limits a small frontal cicatrix. The ancestrula is very small. There is a small avicularium in front of the aperture.

Measurements.—Aperture $\begin{cases} ha = 0.09 \text{ mm.} \\ la = 0.08 \text{ mm.} \end{cases}$

Zooecia $\begin{cases} Lz = 0.50 \text{ mm.} \\ lz = 0.30 \text{ mm.} \end{cases}$

Structure.—The structure of this charming specimen is unusual. The aperture as well as the small avicularia perforates the interior lamella of the frontal. The exterior lamella almost entirely covers the frontal without burying the avicularium, bears spines, and forms on the adult zooecia a kind of false peristome at the bottom of which the aperture and the avicularium are placed. The zooecium appears thus to be covered with a kind of *small mantle*. The structure of the ovicell is identical; the exterior lamella is incomplete and forms a small linear frontal cicatrix.

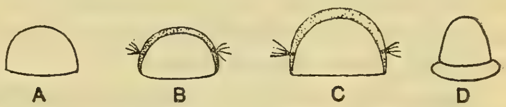

FIG. 20.—OPERCULA OF MICROPORELLA. *A*. MICROPORELLA CILIATA LINNAEUS, 1758. *B*, *C*. MICROPORELLA AMPLA, NEW SPECIES. *D*. LEPRALIA PALLIOLATA, NEW SPECIES. OPERCULUM, × 85

It is very difficult to classify this species. The presence of the oral avicularium and the vanna larger than the porta are characters nonexistent in *Hippoporina*. Moreover, we are ignorant of the structure of the interior lamella. We have found only three specimens of this species, one of which has served in the preparation of the operculum; we are not able then to continue the study. The operculum is divided into two parts and bears no muscular attachments.

Occurrence.—*Albatross* Station D. 2639, Straits of Florida; 25° 04′ 50″ N.; 80° 15′ 10″ W.; 56 fms.; coral sand.

Holotype.—Cat. No. 7537, U.S.N.M.

LEPRALIA FISSURATA, new species.

Plate 33, Figure 1

Description.—The zoarium encrusts shells. The zooecia are distinct, separated by a furrow, elongated, elliptical; the frontal is convex, perforated by large tremopores scattered and separated by large salient granulations. The aperture is elliptical, very little elongated; two small cardelles separate a large anter from a much smaller poster; the peristome is thin, nonsalient. The ovicell is large, globular, smooth, buried on the distal zooecium, hyperstomial; it bears a long longitudinal *fissure*, very irregular in width. One or two small avicularia are arranged in the vicinity of the poster.

Measurements.—Aperture $\begin{cases} ha = 0.15 \text{ mm.} \\ la = 0.12 \text{ mm.} \end{cases}$

Zooecia $\begin{cases} Lz = 0.40\text{–}0.47 \text{ mm.} \\ lz = 0.35\text{–}0.40 \text{ mm.} \end{cases}$

Affinities.—At first sight this species appears to be a *Lepraliella* but it differs however in its nondeltoid ovicellarian fissure and often formed by two simple pores united by a fissure. This structure is very remarkable and it is very difficult to interpret it on the fossils.

The ovicell appears to be independent of the cell into which it does not open. Moreover, it is deprived of the usual transverse slit by which the larvae can escape. We can then only admit that the longitudinal fissure serves for this latter function. But this is only a supposition and the examination of recent specimens only can confirm it. We leave the species then in the old genus *Lepralia*, awaiting better observations.

Occurrence.—Pliocene: Minnitimmi Creek, Bocas Island, Almirante Bay, Northwest Panama.

Holotype.—Cat. No. 70846, U.S.N.M.

Subfamily MICROPORELLAE Canu and Bassler, 1917

Genus MICROPORELLA Hincks, 1877

MICROPORELLA CILIATA Linnaeus, 1759

Text Figure 20*a*

1914. *Microporella ciliata* OSBURN, Bryozoa of the Tortugas Islands. Publication Carnegie Institution, Washington, No. 182, p. 208. (Regional bibliography.)

1923. *Microporella ciliata* CANU and BASSLER, North American Later Tertiary and Quaternary Bryozoa. Bull. 125, U. S. National Museum, p. 119, pl. 20, figs. 1–6, pl. 36, figs. 4, 5. (Recent bibliography and geologic distribution.)

Measurements.—Aperture $\begin{cases} ha = 0.08 \text{ mm.} \\ la = 0.10\text{–}0.14 \text{ mm.} \end{cases}$

Zooecia $\begin{cases} Lz = 0.50 \text{ mm.} \\ lz = 0.32 \text{ mm.} \end{cases}$

The zooecial width frequently attains 0.40 mm. and there are two avicularia symmetrically arranged.

Biology.—Our specimens encrust nullipores, shells, bryozoa, and corals. They were almost all living and in reproduction or fixation. One time only have we seen the ectocyst slightly pigmented with green.

The period of reproduction appears very long, but we have not yet enough data concerning it. Moreover, this species is quite cosmopolitan and the notes published on it are so numerous that its biology could be learned.

Occurrence.—Fowey Light, 15 miles south of Miami, Fla.; 40 fms.
Albatross Station D. 2405, Gulf of Mexico; 28° 45′ 00″ N.; 85° 02′ 00″ W.; 30 fms.; gray sand, broken coral.
Albatross Station D. 2639, Straits of Florida; 25° 04′ 50″ N.; 80° 15′ 10″ W.; 56 fms.; coral sand.
Tortugas, 8–29 meters (Osburn); Florida, 11–97 meters (Smitt).

MICROPORELLA AMPLA, new species

Plate 12, Figures 8–10; text Figure 20*b*, *c*

Description.—The zoarium encrusts nullipores. The zooecia are distinct, separated by a deep furrow, little elongated, hexagonal, very broad and large; the frontal is convex and finely granular; the ascopore is small, round, marginated. The aperture is small, semi-elliptical; the peristome is little salient and bears five or six spines. The ovicell is small, globular, fringed around the orifice. The avicularia are arranged symmetrically on each side of the aperture; they are small, triangular; their mandible is directed upward and toward the median axis of the distal zooecium.

Measurements.—Aperture $\begin{cases} ha = 0.10 \text{ mm.} \\ la = 0.12 \text{ mm.} \end{cases}$

Zooecia $\begin{cases} Lz = 0.70\text{–}0.74 \text{ mm.} \\ lz = 0.50 \text{ mm.} \end{cases}$

This species is very well characterized by its large dimensions and its small avicularia. The variations in width on the same colony are extraordinary, as may be noted on our figures. The colony measured 6 square centimeters of surface. It was in reproduction. The operculum is bordered by a thick sclerite.

Occurrence.—*Albatross* Station D. 2152, 2½ miles northwest of Habana Light; 387 fms.; coral.

Holotype.—Cat. No. 7557, U.S.N.M.

MICROPORELLA NORMANI, new name.

Plate 34, Figure 5

1909. *Microporella coronata* NORMAN, The Polyzoa of Madeira. Journal Linnean Society Zoology, vol. 30, p. 297, pl. 39, fig. 4.

Measurements.—Aperture $\begin{cases} ha = 0.08 \text{ mm.} \\ la = 0.15 \text{ mm.} \end{cases}$

Zooecia $\begin{cases} Lz = 0.65\text{–}0.75 \text{ mm.} \\ lz = 0.40\text{–}0.55 \text{ mm.} \end{cases}$

Affinities.—According to Waters, 1908, *Microporella coronata* Audouin, 1826, is a smaller species in which the dimensions are, aperture = 0.08 by 0.12 mm. and zooecia = 0.56 by 0.36 mm. Norman's figure indicates only the broad cells; our specimens contain a mixture of broad and long cells, but we have not seen other differences.

This species is well characterized by its large avicularia almost adjacent to the aperture. It is very close to *Microporella californica* Busk, 1856, in the ensemble of its measurements and in its general characters. It differs from it only in the absence of a frontal gibbosity, in its somewhat shorter zooecia, in slightly broader aperture, and in its smaller avicularia.

Waters identified these three species with that of Audouin, 1826. This is possible, for they have very much the same exterior aspect, but we prefer, however, to separate them as the materials for comparison in our possession are not sufficient.

Occurrence.—Recent: Madeira. Pliocene: Minnitimmi Creek, Bocas Island, Almirante Bay, northwest Panama.

Cotypes.—Cat. No. 70849, U.S.N.M.

Genus FENESTRULINA Jullien, 1888

FENESTRULINA MALUSI Savigny-Audouin, 1826

1923. *Fenestrulina malusi* CANU and BASSLER, North American Later Tertiary and Quaternary Bryozoa. Bull. 125, U. S. National Museum, p. 118, pl. 36, figs. 2, 3. (Bibliography, geologic, and geographic distribution.)

In our work of 1923 we wrote: "It is remarkable that this very cosmopolitan species has never been observed in the western Atlantic as fossil as well as recent." Since then we have been fortunate enough to discover two ovicelled specimens living on *Stylopoma spongites* in the waters of Florida.

Occurrence.—*Albatross* Station D. 2405, Gulf of Mexico; 28° 45′ 00″ N.; 85° 02′ 00″ W.; 30 fms.; gray sand, broken coral.

Family TUBUCELLARIIDAE Busk, 1884

Genus TUBUCELLARIA D'Orbigny, 1852

TUBUCELLARIA CEREOIDES Ellis and Solander, 1786

Plate 15, Figure 6; Plate 33, Figure 7

1907. *Tubucellaria cereoides* WATERS, Tubucellaria: its species and ovicells. Linnean Society's Journal Zoology, vol. 30, p. 129, pl. 15, figs. 8, 9, 15, 16. (Bibliography, geographic and geologic distribution.)
1914. *Tubucellaria cereoides* OSBURN, Bryozoa of the Tortugas Islands. Publication Carnegie Institution, Washington, No. 182, p. 203.
1917. *Tubucellaria cereoides* CANU, Les Bryozoaires fossiles des terrains du Sud-Ouest de la France, XI, Rupelien. Bulletin Société geologique France (7 ser. 4), vol. 17, p. 357 (characteristics).

This very cosmopolitan species has not yet been discovered in the western Atlantic on the American shores. Osburn, 1914, discovered one segment at Tortugas. We have been fortunate to discover three segments at Fowey Light. We give a photograph of one of them in order to show that we are not deceived in our determination.

The bushy zoaria of *Tubucellaria cereoides* are often attached to algae and the depth at which the segments are found is not of very great bathymetric value.

Occurrence.—Fowey Light, 15 miles south of Miami, Fla.; 40 fms.
Tortugas, 24 meters (Osburn).
Pliocene: Minnitimmi Creek, Bocas Island, Almirante Bay, Panama.

Plesiotypes.—Cat. No. 7607, U.S.N.M.

Family SMITTINIDAE Levinsen, 1909

Genus CYSTISELLA Canu and Bassler, 1917

CYSTISELLA AMERICANA, new species

Plate 15, Figures 7, 8

Description.—The zoarium is free and bilamellar. The zooecia are distinct, separated by a deep furrow, elongated, subcylidrical; the frontal is quite convex, smooth, entirely covered by the frontal avicularium which bears a large triangular callosity. The aperture is semicircular. The ovicell is globular, very fragile. The orifice of the avicularium is placed on the proximal border of the aperture and in a plane perpendicular to it.

Measurements.—Aperture $\begin{cases} ha = 0.10 \text{ mm.} \\ la = 0.12 \text{ mm.} \end{cases}$

Zooecia $\begin{cases} Lz = 0.80 \text{ mm.} \\ lz = 0.30\text{–}0.35 \text{ mm.} \end{cases}$

The known recent species of the genus *Cystisella* are northern. The discovery of a fossil species in the Midwayan of Alabama with a subtropical fauna causes us to anticipate a much larger geographic distribution. We have been fortunate to discover the figured specimen in the Gulf of Mexico near New Orleans.

This new species differs from *C. saccata* Busk, 1856, in its smaller apertural dimensions, in the absence of two proximal pores in the avicularium cavity, in the shorter zooecium (0.80 mm. and not 1.10 mm.), and in the frontal avicularium occupying all the zooecial width.

We gave a summary in 1920 (p. 480, fig. 135) of our anatomical knowledge of this remarkable genus.

Occurrence.—*Albatross* Station D. 2387, Gulf of Mexico; 29° 24′ 00″ N.; 88° 04′ 00″ W.; 32 fms.; sand, gravel, broken shells.

Holotype.—Cat. No. 7479, U.S.N.M.

Genus SMITTINA Norman, 1903

SMITTINA TRISPINOSA SPATHULATA Smitt, 1873

Plate 15, Figures 9–13; text Figure 21

1873. *Escharella jacotina* var. *spathulata* SMITT, Floridan Bryozoa. Kongl. Svenska Vetenskaps-Akademiens Handlingar, vol. 10, p. 59. pl. 10, figs. 199, 200.

1914. *Smittina trispinosa* OSBURN, Bryozoa of the Tortugas Islands. Publication Carnegie Institution, Washington, No. 182, p. 208. (Local bibliography.)

Structure.—Our specimens creep over shells or sometimes are free and unilamellar. Never are they arranged on large flat surfaces, so that their photography is quite difficult. They belong to the variety *spathulata* and we have not observed any other varieties, even the other variations described in the same latitudes by Osburn in 1912 and 1914. This variety is itself very irregular. We have figured the most characteristic opercula and mandibles.

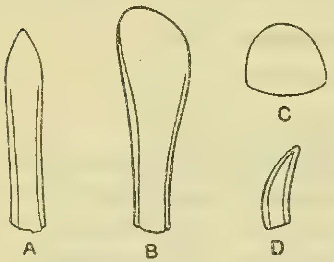

FIG. 21.—SMITTINA SPATHULATA SMITT, 1873. *A, B.* MANDIBLES OF LARGE AVICULARIA, × 85. *C.* OPERCULUM, × 85. *D.* MANDIBLE OF SMALL AVICULARIUM, × 85

The lyrule and the cardelles are placed on the proximal border of the aperture; they are placed *above* the operculum and remain visible on the specimens with ectocyst. The frontal is granulated at the center and surrounded by many rows of areolar pores. The latter are not visible at the interior, which is perfectly smooth at a magnification of 25 diameters. A thick pleurocyst covers the olocyst.

The ovicell develops between the olocyst and the pleurocyst of the distal zooecium and shows all the characters of the frontal. This characteristic as well as the absence of an avicularium in the sinus of the peristomie would cause us to place this species in the genus *Mucronella,* although this change would still not satisfy scientific exactness. *Smittina trispinosa* is a very cosmopolitan species which possesses powerful means of adaptation, a knowledge of which will reveal its very instructive biology. In our Philippine monograph we have tried to begin this work by putting some order in all the known varieties. In spite of the contrary opinion of Smitt, the variety *spathulata* is special to the Gulf of Mexico. The variety *spathulata* of MacGillivray and Kirkpatrick from Torres Strait differs notably in the position and form of the large avicularia.

Occurrence (var. *spathulata* only).—

Fowey Light, 15 miles south of Miami, Fla., 40 fms.

Albatross Station D. 2362, east of Yucatan; 22° 08′ 30″ N.; 86° 53′ 30″ W.; 25 fms.; coral sand.

Albatross Station D. 2365, east of Yucatan; 22° 18′ 00″ N.; 87° 04′ 00″ W.; 24 fms.; white rock coral.

Plesiotypes.—Cat. No. 7594, U.S.N.M.

SMITTINA ECHINATA, new species

Plate 28, Figures 2, 3

Description.—The zoarium is hollow, cylindrical, surrounding the delicate radicells of algae. It emits in every direction short conical or flabelliform branches forming an ensemble with the spiny aspect of *Echinocava.* The zooecia are distinct, separated by a furrow, short, elliptical; the frontal is convex and formed by a granular pleurocyst surmounting the olocyst; it is bordered with large areolar pores. The apertura is elliptical, orbicular, or transverse; it contains a small flat lyrule and two very small, very fragile cardelles. The oral avicularium is small and triangular with the beak oriented toward the top; it is placed to the right or to the left of the proximal border of the apertura. The ovicell is large, globular, perforated by some large pores. The pleurocyst does not cover it entirely and leaves a large circular area.

Measurements.—Apertura $\begin{cases} ha = 0.10 \text{ mm.} \\ la = 0.10 \text{ mm.} \end{cases}$

Zooecium $\begin{cases} Lz = 0.35 \text{ mm.} \\ lz = 0.20 \text{ mm.} \end{cases}$

Affinities.—This species is extremely fertile, for on our specimens almost all of the zooecia are ovicelled. The peristone is thin and salient and is little visible on the ovicelled zooecia. The small zooecial dimensions and its curious colonies characterize this species very well.

Biology.—The most fruitful species are not necessarily the most common. *Smittina echinata* is a good example of this, for only a few specimens have been found. The innumerable larvae are probably an easy prey for many marine organisms.

Occurrence.—Cedar Keys, Fla.

Cotypes.—Cat. No. 7596, U.S.N.M.

SMITTINA LABELLUM, new species

Plate 17, Figures 6–10; text Figures 22 *a*, *g*, *h*

Description.—The zoarium encrusts small fragments of shells and corals and often consists of two superposed lamellae. The zooecia are distinct, separated by a salient thread, somewhat elongated, irregularly rectangular; the frontal is finely granular, bordered by scattered areolar pores, convex, formed of a tremocyst with very small pores (visible only under strong magnification). The apertura is small, suborbicular; a small lyrule and two minute cardelles are placed at the bottom of the peristomie; the peristome is thin, very salient, and bears two distal spines, two large lateral notched lips, and a proximal indentation forming a pseudorimule. The ovicell is large, globular, not as broad as the zooecia, adorned with a frontal area, finely granular. The frontal of the zooecia bears avicularia of variable size, oriented diversely with semicircular or spathulate mandibles.

Measurements.—Apertura $\begin{cases} ha = 0.10 \text{ mm.} (?). \\ la = 0.10 \text{ mm.} \end{cases}$

Zooecium $\begin{cases} Lz = 0.60\text{–}0.80 \text{ mm.} \\ lz = 0.50\text{–}0.60 \text{ mm.} \end{cases}$

Diameter of the ovicell = 0.35 mm.

Length of the large avicularia = 0.35 mm.

Variations.—Irregularity is the rule here, for no zooecium resembles its neighbor. The development of the apertural lips is very inconstant; they are very large in the protected portions; the exposed portions of the colony are deprived of them, but the peristome always exhibits two indentations—a proximal one in the pseudorimule and a distal one for the two spines. Certain zooecia have no avicularia; others have two or three; their form, position, orientation, and size are difficult of accurate description. Often a small triangular avicularium is adjacent to one of the peristomial lips; it is not clearly visible because of its position perpendicular to the zooecial plane.

Exteriorily the frontal does not appear perforated, and this species could be placed in the genus *Smittina* as we have defined it. However, in a special preparation it appears perforated by very small tremopores when they are examined at a suitable magnification

(× 85); their diameter is in the neighborhood of six-thousandths of a millimeter (0.006 mm.)

Affinities.—This species differs from *Smittina trispinosa* Johnston, 1838, in its larger dimensions, in the presence of two oral spines, and in the greater diameter (0.35 mm.) of its ovicell. It differs from *Smittina tripora* Canu and Bassler of the Philippines in the absence of two rather constant peristomial avicularia and in the presence of a large frontal avicularium.

The *S. trispinosa* group is very disconcerting in its zooecial irregularity and its false tremocyst. We were inclined to form a special genus for it, but we do not yet see any physiologic function which could differentiate it from other *Smittina*. However, it is a homogeneous group to the trained eye of the specialist. *Smittia collaris*, variety Waters, 1883, a fossil of the Miocene at Muddy Creek, Australia, is another species of the same group in which a small tongue sometimes replaces the distal spines.

Biology.—Our specimens were living and ovicelled January 19, 1885. The great irregularity of the avicularia is difficult to understand. It is difficult to admit that chance and fantasy are the only reasons for their presence; they are not ornaments but they are indeed special organs always in activity. Their appearance seems to be in connection with an immediate necessity, but essentially variable and changing, that each cell contributes to the profit of the colony. There is then an undoubted instinct, almost a kind of reasoning, permitting an adaption more easily to its environment.

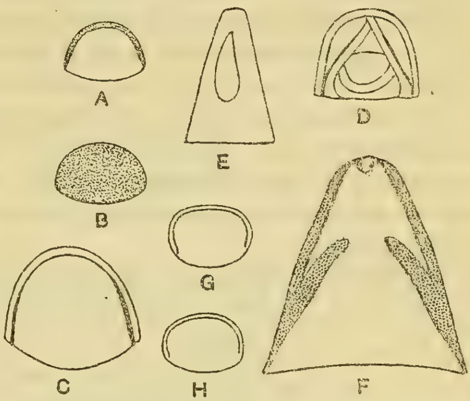

FIG. 22.—FAMILY SMITTINIDAE. *A*. SMITTINA LABELLUM, NEW SPECIES. OPERCULUM, × 85 DOUBTFULLY REFERRED HERE. *B*. UMBONULA UNDULATA, NEW SPECIES. OPERCULUM, × 85. *C, D*. PALMICELLARIA AVICULIFERA, NEW SPECIES. *C*. OPERCULUM, × 85. *D*. MANDIBLE, × 250. *E, F*. RHAMPHOSTOMELLA MAGNIROSTRIS, NEW SPECIES, *E*. MANDIBLE, × 85. *F*. LARGE MANDIBLE, × 85. *G, H*. SMITTINA LABELLUM, NEW SPECIES. TWO OPERCULA, × 85

Occurrence.—*Albatross* Station D. 2339; 23° 10′ 40″ N.; 82° 20′ 15″ W.; 191 fms.

Albatross Station D. 2639, Straits of Florida; 25° 04′ 50″ N.; 80° 15′ 10″ W.; 56 fms.; coral sand.

Florida, 21 and 71 meters (Smitt); Tortugas, low water, 20 meters (Osburn).

Cotypes.—Cat. No. 7560, U.S.N.M.

Genus MUCRONELLA Hincks, 1880

MUCRONELLA EGYPTIACA Waters, 1909

Plate 17, Figures 1–5

1909. *Smittia egyptiaca* WATERS, Bryozoa from the Red Sea. Linnean Society's Journal, Zoology, vol. 31, p. 157, pl. 15, fig. 6, 9.

Measurements.—Aperture $\begin{cases} ha = 0.10\text{–}0.12 \text{ mm.} \\ la = 0.12 \text{ mm.} \end{cases}$

Zooecia $\begin{cases} Lz = 0.40\text{–}0.60 \text{ mm.} \\ lz = 0.40 \text{ mm.} \end{cases}$

Affinities.—The colonies encrust probably small ramified algae; they have the aspect of small, hollow bifurcated tubes of 5 mm. diameter. Because of this particular form the zooecia have variable micrometric measurements; our photographs represent the most regular cells.

The lyrule is broad and little salient; the small cardelles are almost on the transverse median axis of the aperture. The mucro is little salient. The small oral avicularium is very inconstant.

We have seen no essential differences from Water's species. If the cells appear more regular, the same colony bears others absolutely analogous to those illustrated by this author. In their ensemble, the micrometric measurements are identical. Our specimens were living and ovicelled.

Occurrence.—*Albatross* Station D. 2389, Gulf of Mexico; 29° 28′ 00″ N.; 87° 56′ 00″ W.; 27 fms.; gray sand, broken shells.

Red Sea; Khor Dongola; Engineer Island; Ras el Millau, Sinai Coast (Waters).

Plesiotypes.—Cat. No. 7561, U.S.N.M.

Genus PALMICELLARIA Alder, 1864

PALMICELLARIA AVICULIFERA, new species

Plate 17, Figures 14–16; text Figure 22 *c, d*

Description.—The zoarium encrusts grains of hard clay. The zooecia are distinct, separated by a deep furrow, large, cylindrical; the frontal is smooth, very convex, surrounded by very small scattered areolar pores. The aperture is semielliptical and transverse, with a slightly concave proximal border; it is placed at the bottom of a deep peristomie; the peristome is thick, very salient; it bears a very salient round avicularium, without pivot, and four or five other smaller avicularia irregularly placed. The ovicell is large, globular, somewhat transverse, opening widely in the peristomie above the operculum.

Measurements.—Aperture (interior) $\begin{cases} ha = 0.15\text{–}0.20 \text{ mm.} \\ la = 0.20\text{–}0.25 \text{ mm.} \end{cases}$

Zooecia (interior) $\begin{cases} Lz = 0.70\text{–}0.80 \text{ mm.} \\ lz = 0.40\text{–}0.50 \text{ mm.} \end{cases}$

Structure.—The operculum is very thin, bell-shaped; two long lateral bands placed very near the border serve as attachments for the muscles. The operculum and the mandible of the small peristomial avicularia have the aspect of those of *Porella.*

Affinities.—In the list of species of *Palmicellaria* which we published in 1923, we forgot a beautiful species from the English Crag, *Palmicellaria* (*Lepralia*) *bicornis* Busk, 1859. Our American species approaches it very closely but differs from it in its somewhat larger micrometric dimensions, in its larger and more salient ovicell, and in the presence of more than two accessory peristomial avicularia. Our specimens were in reproduction April 12, 1886.

Occurrence.—*Albatross* Station D. 2650, Bahama Islands; 23° 34′ 30″ N.; 76° 34′ 00″ W.; 369 fms.; coral sand, white ooze.

Cotypes.—Cat. No. 7565, U.S.N.M.

Genus UMBONULA Hincks, 1880

UMBONULA UNDULATA, new species

Plate 17, Figures 11–13; text Figure 22*b*

Description.—The zoarium is free, bilamellar with undulated fronds. The zooecia are distinct, separated by a furrow, elliptical, somewhat elongated; the frontal is very convex, decorated by four or five pairs of large costules oriented toward a small avicularian umbo which covers the lyrule. The aperture is semielliptical, transverse, with rounded lateral angles; it is placed at the bottom of a short peristomie; the peristomice is transverse or elongated. The ovicell is globular, smooth, or costulated.

Measurements.—Aperture $\begin{cases} ha = 0.12 \text{ mm.} \\ la = 0.10 \text{ mm.} \end{cases}$

Zooecia $\begin{cases} Lz = 0.50\text{–}0.60 \text{ mm.} \\ lz = 0.25 \text{ mm.} \end{cases}$

Variations.—The avicularian umbo is not constant; it is often replaced by a sinus of the peristome at the bottom of which the lyrule is visible. The operculm is thickened, chitinous, golden yellow; it is semielliptical and the proximal border is straight or convex. The ovicells are very numerous on the colony and yet the species is very rare; the larvae probably do not know how to choose their substratum.

The peristomice is much larger than the aperture; it opens the locella in which the operculm operates and which serves as a passage for the larvae.

Occurrence.—Cedar Keys, Fla.

Holotype.—Cat. No. 7610, U.S.N.M.

Genus RHAMPHOSTOMELLA Lorenz, 1886

RHAMPHOSTOMELLA MAGNIROSTRIS, new species

Plate 19, Figures 5–7; text Figure 22 *e*, *f*

Description.—The zoarium is free, uni, or bi lamellar; the fronds are very irregular. The zooecia are little distinct, separated by a furrow, elongated, elliptical; the frontal is convex, bordered with areolar pores and ornamented with irregular costules. The aperture is large, elliptical, transverse, or suborbicular; the proximal border bears a wide lyrule placed eccentrically; the avicularian umbo is salient, arranged obliquely and partially covering the aperture. The ovicell is large, globular, formed of two calcareous lamellae and ornamented with punctations.

Measurements.—Aperture $\begin{cases} ha = 0.25 \text{ mm.} \\ la = 0.22 \text{ mm.} \end{cases}$

Zooecia $\begin{cases} Lz = 0.75 \text{ mm.} \\ lz = 0.40 \text{ mm.} \end{cases}$

Variations.—The much calcified zooecia present fantastic forms; strong salient threads unite the ovicells, the frontal becomes concave, the lyrule disappears, the avicularian umbo is lacking, and it is replaced sporadically by an *enormous avicularium* with a large triangular mandible.

Affinities.—The genus *Rhamphostomella* is very common in the recent northern seas. Its presence in the Priabonian of the Vicentin, Italy, in the Jacksonian of the two Carolinas and of Georgia and in the Vicksburgian of Alabama proves that it can inhabit the warmer waters and approach the equatorial zone. Its presence in Florida confirms this observation deduced from paleontology.

In the form of its elliptical operculum this new species approaches *Rhamphostomella costata* Lorenz, 1886, but differs from it in its free zoarium and its smaller and more irregular costules. It approaches more *Rhamphostomella bilaminata* Hincks, 1877, dredged more to the north in the American waters but differs from it in its large lyrule and in the presence of its large sporadic avicularia. The operculum is very thick, elliptical, little resembling the form of the aperture. Its margins are thin.

Occurrence.—Cedar Keys, Fla.

Cotypes.—Cat. No. 7579, U.S.N.M.

Genus BRYOCRYPTELLA Cossmann, 1906

BRYOCRYPTELLA CONVEXA, new species

Plate 28, Figure 8

Description.—The zoarium encrusts fragments of shells. The zooecia are distinct, separated by a deep furrow, elongated, fusiform, very convex. The frontal is formed by an olocyst surmounted by a detachable pleurocyst and is surrounded by large areolar pores. The avicularian cavity forms a salient boss surrounded by five or six pores. The apertura is semicircular, without lyrule or cardelles. The avicularium is round, cylindrical, opening into the peristomie perpendicularly to the operculum. The ovicell is large, globular; the pleurocyst is often incomplete and then limits a circular area.

Measurements.—Aperture $\begin{cases} ha = 0.13 \text{ mm.} \\ la = 0.15\text{–}0.20 \text{ mm.} \end{cases}$

Zooecium $\begin{cases} Lz = 0.85\text{–}1.00 \text{ mm.} \\ lz = 0.40\text{–}0.60 \text{ mm.} \end{cases}$

Affinities.—The zooecial measurements are rather variable; the width increases when the length diminishes. The zooecial structure is absolutely identical with that of *Bryocryptella torquata* Jullien, 1903, from the Gulf of Gascogny, but the present species differs in its incrusting instead of arborescent colony. The structure of the ovicell being identical with that of the zooecial frontal, we can not class the genus in the family Escharellidae. Moreover, Jullien classed it in the family of Lepraliidae. Our specimens were dead and deprived of their chitinous appendages.

Occurrence.—*Albatross* Station D. 2650, Bahamas, 595 meters.

Holotype.—Cat. No. 7463, U.S.N.M.

BRYOCRYPTELLA RETICULATA, new species

Plate 18, Figures 1–3

?1873. *Retepora reticulata* Smitt, Floridan Bryozoa. Kongl. Svenska Vetenskaps-Akademiens Handlingar, vol. 11, p. 69, pl. 13, figs. 242, 244.

Description.—The zoarium is free, *reticulated,* with wide meshes; the branches are formed by two longitudinal rows of cells. The zooecia are little distinct, very elongated, with finely granular surface. The peristomice is suborbicular; the apertura located at the bottom of a deep peristomie is not visible. A small avicularium is lodged in the proximal portion of the peristomie. The ovicell is very convex; its contours are indecisive; it opens into the peristomie.

Measurements.—Peristomice, Diameter, 0.15–0.20 mm.

Zooecia $\begin{cases} Lz = 0.70\text{–}0.80 \text{ mm.} \\ lz = ? \end{cases}$

Affinities.—The indistinct zooecia and the reticulated zoarium distinguish this species clearly from *Bryocryptella torquata* Jullien, 1903, and from *Bryocryptella koehleri* Calvet, 1896. Very probably *Reticulipora reticulata* Smitt, 1872, is the same species. However, Smitt figured a longitudinal slit on the ovicell and some vibices on the dorsal which we have not observed on our specimen.

Biology.—The two known species of this genus live in deep waters of the Gulf of Gascogny. *Bryocryptella reticulata* descends still lower.

Occurrence.—*Albatross* Station D. 2343, north of Cuba; 23° 11′ 35″ N.; 82° 19′ 25″ W.; 279 fms.; fine coral.
? Havana, 437 meters (Smitt).

Cotypes.—Cat. No. 7464, U.S.N.M.

Family RETEPORIDAE Smitt, 1867

Genus RETEPORA Imperato, 1599

RETEPORA MARSUPIATA Smitt, 1873

Plate 18, Figures 7–13; text Figure 23 *a*

1873. *Retepora marsupiata* Smitt, Floridan Bryozoa. Kongl. Svenska Vetenskaps-Akademiens Handlingar, vol. 11, p. 67, pl. 13, figs. 245–254.
1904. *Retepora marsupiata* Osburn, Bryozoa of the Tortugas Islands. Publication Carnegie Institution, Washington, No. 182, p. 200.

We have observed very few specimens of this beautiful species. They resemble especially Figures 252 and 253 of Smitt, and do not bear avicularia. However, the latter appear on some rare cells and we do not doubt that Smitt's observations are perfectly correct. We doubt much, on the contrary, the exactitude of the synonymy indicated by Smitt and Osburn.

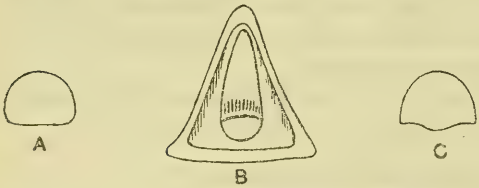

Fig. 23.—Appendages of Reteporidae. *A.* Retepora marsupiata Smitt, 1873. Operculum, × 85. *B, C.* Schizellozoon elongatum, new species. *B.* Mandible of a frontal avicularium, × 85. *C.* Operculum, × 85

In our monograph on the bryozoa of the Philippines we have given a long study on the biology of the Retepores.

The operculum is thick, light colored, semicircular.

Biology.—Our specimens were in reproduction from January to March. "The color is a delicate pink" (Osburn). The bathymetric distribution of this species is very great.

Occurrence.—*Albatross* Station D. 2117, Caribbean Sea; 15° 24′ 40″ N.; 63° 31′ 30″ W.; 683 fms.; yellow mud, fine sand.
Albatross Station D. 2411, Gulf of Mexico; 26° 33′ 30″ N.; 83° 15′ 30″ W.; 27 fms.; fine white sand, black specks.
Florida, 16–424 meters (Smitt); Tortugas, 16–29 meters (Osburn).

Plesiotypes.—Cat. No. 7577, U.S.N.M.

Genus SCHIZELLOZOON Canu and Bassler, 1917[4]

SCHIZELLOZOON ELONGATUM, new species

Plate 19, Figures 1–4; text Figure 23 *b*, *c*

Description.—The zoarium is bushy and reticulated; the branches have two or three longitudinal ranges of zooecia; the fenestrae are very long, very large, generally much wider than the branches. The dorsal is quite convex, finely granular; the vibices are very salient and form two rows of losanges irregularly alternating; two or three small orbicular avicularia appear on each losange. The zooecia are distinct, separated by a salient thread, elongated, very large, subhexagonal; the frontal is convex, very finely granular. The apertura is suborbicular, buried at the bottom of the peristomie, with a very broad proximal rimule. The peristomie is thin, salient, expanded, notched; in its proximal part is a reteporidian pore opening into the peristomie. The ovicell is convex, much elongated, adorned with a large longitudinal slit. The frontal bears two very small orbicular avicularia and sporadically a large, very salient, triangular acuminate avicularium with mandible turned toward the base.

Measurements.—Apertura $\begin{cases} ha = ? \\ la = 0.12\text{–}0.13 \text{ mm.} \end{cases}$

Zooecium $\begin{cases} Lz = 0.85\text{–}1.00 \text{ mm.} \\ lz = 0.60\text{–}0.70 \text{ mm.} \end{cases}$

Maximum length of fenestrae, 8.00 mm.

Diameter of branches, 1.5 mm.

Affinities.—The opercula were altered or absent on our specimens; we have not been able to make a good preparation and we have given only an approximate one. The large mandibles are triangular, much thickened, marginated, with a large proximal lucida.

Only *Retepora wallichiana* Hincks, 1877, of the northern seas can be compared to the present species in the length of its fenestrae. It differs in its wider and more robust branches and in its large ovicellarian indentation.

Occurrence.—*Albatross* Station D. 2666; 30° 47′ 30″ N.; 79° 49′ 00″ W.; 270 fms.

Cotypes.—Cat. No. 7587, U.S.N.M.

Genus RHYNCHOZOON Hincks, 1891

RHYNCHOZOON CORNIGER, new species

Plate 34, Figure 6

Description.—The zoarium encrusts nullipores. The zooecia are distinct, separated by a furrow, much more elongated at the periphery than at the center of the colony. The frontal is convex, smooth, surrounded by large areolar pores. It bears above the aperture a very salient avicularium umbo and two smaller pedunculate cylindrical avicularia. The aperture is elliptical, transverse; the proximal rimule is very broad and of little depth. The ovicell is large, convex, formed of two calcareous pellicules of which the superior is incomplete and limits a large irregular frontal area.

Measurements.—Aperture $\begin{cases} ha = 0.07 \text{ mm.} \\ la = 0.10 \text{ mm.} \end{cases}$

Zooecia (marginal) $\begin{cases} Lz = 0.50 \text{ mm.} \\ lz = 0.35 \text{ mm.} \end{cases}$

Affinities.—This new species differs from *Rhynchozoon vaughani* Canu and Bassler, 1923, from the Miocene at Bowden, Jamaica, in its much smaller dimensions. It differs from *Rhynchozoon levigatum* Canu and Bassler, 1923, from the Pleistocene at Mount Hope, Panama, in the presence of two small pedunculate avicularia.

Occurrence.—Pliocene: Minnitimmi Creek, Bocas Island, Almirante Bay, Panama.

Holotype.—Cat. No. 70854, U.S.N.M.

Genus RETEPORELLA Busk, 1884

RETEPORELLA PROMINENS, new species

Plate 18, Figures 4–6

Description.—The zoarium is free, arborescent; the branches are compressed, elliptical in section, dichotomous, formed of four longitudinal rows of cells. The zooecia are indistinct but slightly outlined by the vibices arranged in lozenge-shaped areas. The frontal is flat, finely granular. The peristomie is very *salient*, tubulose; the peristome is thick, orbicular, slashed. In the peristomie there is a small crown of very short and numerous spicules. The ovicell bears a longitudinal fissure; it is marginated. On the dorsal the vibices are arranged transversely; in the species thus outlined there are one or two very small rounded avicularia.

Measurements.—Diameter of peristome = 0.13–0.20 mm.
Diameter of peristomice = 0.12 mm.
Length of peristomie = 0.15–0.20 mm.
Zooecia $\begin{cases} Lz = 0.75\text{–}0.85 \text{ mm.} \\ lz = 0.35 \text{ mm.} \end{cases}$

We are not able to determine the true form of the aperture nor that of the operculum. We have then classed this species in the zoarial genus *Reteporella* Busk, 1884, which remains as before a genus for uncertain species of this group.

Occurrence.—*Albatross* Station D. 2354, east of Yucatan; 20° 59′ 30″ N.; 86° 23′ 45″ W.; 130 fms.; coral.

Holotype.—Cat. No. 7578, U.S.N.M.

Family STOMACHETOSELLIDAE Canu and Bassler, 1917

Genus CIGCLISULA Canu and Bassler, 1927

CIGCLISULA SERRULATA Smitt, 1873

Plate 20, Figures 1–14; text Figure 24

1873. *Porina serrulata* SMITT, Floridan Bryozoa. Kongl. Svenska Vetenskaps-Akademiens Handlingar, vol. 11, p. 27, pl. 5, figs. 116–125.

Measurements.—Peristomice $\begin{cases} hp = 0.10\text{–}0.12 \text{ mm.} \\ lp = 0.10\text{–}0.12 \text{ mm.} \end{cases}$

Zooecia (interior) $\begin{cases} Lz = 0.60\text{–}0.65 \text{ mm.} \\ lz = 0.25\text{–}0.30 \text{ mm.} \end{cases}$

Structure and variations.—The zoarium is bilamellar; the fronds are narrow and bifurcate like the horns of a deer. The base is circular, little expanded, concave; it appears, therefore, to attach itself to small algae.

The marginal zooecia are distinct, elongated, covered with tubular tremopores; the peristome is very salient, irregularly crenulated. They are transformed sometimes into large spatulate avicularia. The terminal zooecia of the fronds have also the same aspect. All the axial zooecia are indistinct and their frontal is ornamented with a complicated system of avicularia. The large spatulate avicularia give to the fronds the serrulate aspect characteristic of the species. They are inconstant and belong to the group of zoarial avicularia.

The ovicell is hyperstomial, opening into the peristomie above the operculum, developed between the olocyst and the tremocyst of the distal zooecium. It is not entirely covered over by the tremocyst; on its median longitudinal axis there is a narrow cribriform area formed by a double row of very short costules very variable in aspect. It is little apparent and immersed into the great thickness of the tremocyst.

The spiramen is very apparent on the young cells, on the marginal cells, and on the little calcified fronds. On the axial cells it is much less apparent and often difficult to observe. In longitudinal section it appears oblique and opens into the peristomie. According to Smitt, it is not covered by the ectocyst, which proves its hydrostatic function.

The small apertural avicularia are elliptical, with pivot, the beak turned toward the aperture. They are generally placed on the distal arch of the peristome. There is never more than one or two to a zooecium. Small analogous avicularia are developed sporadically on the frontal.

Large spatulate zooecial avicularia are placed obliquely on the frontal of all the axial zooecia; they are oval, variable in direction, the beak oriented toward the base. The distal orifice is small, oval, marginated. There is no proximal orifice, for the latter is closed by a small calcareous finely perforated membrane. In erecting themselves their mandible forces the water toward the aperture. Their presence is rather constant; however, certain rare groups of zooecia are deprived of them and the tremocyst appears as in the marginal zooecia.

Other rare groups of zooecia are covered by a sort of smooth pleurocyst on which one or two avicularia subsist. This is not proof of old age, as Smitt wrote, for the group that we figure was placed on a young frond above the ordinary axial zooecia.

The aperture was figured by Smitt as semielliptical. On our photographs it appears for the most part as suborbicular and a little transverse. It is, moreover, rarely apparent and always buried at the bottom of the tremocystal peristomie. The operculum is very fragile, very thin, and of the same form as the aperture.

On the interior the zooecia are rather regular, smooth (olocyst), with rather thick walls. The spiramen appears in the portion corresponding to the external peristomie. The place and the true form of the aperture is more evident on the lateral zooecia.

FIG. 24.—CIGCLISULA SERRULATA SMITT, 1877. *A, B.* OPERCULA, × 85

Affinities.—Schizoporella cribrifera Hincks, 1885, and *Schizoporella fisheri* Jullien, 1882, are ornamented with an analogous sievelike ovicell. They belong probably to the same family. Their aperture bears a proximal sinus which is lacking in *Cigclisula serrulata.*

This species differs very much from the genotype in the absence of the peristomial avicularia and in the form and nature of the operculum. It can in reality be considered as the type of a new genus of the same family, but as we know no closely allied species and as our information on the structure is still incomplete, we prefer to wait for a more complete study. This is the last representative of a family which was very important in the Gulf of Mexico of geologic time.

Occurrence.—Fowey Light, 15 miles south of Miami, Fla., 40 fms.
Albatross Station D. 2639, Straits of Florida; 25° 04′ 50″ N.; 80° 15′ 10″ W.; 56 fms.; coral sand.
Florida, 56–68 meters (Smitt).

Plesiotypes.—Cat. No. 7476, U.S.N.M.

Family ADEONIDAE Jullien, 1903

Genus ADEONA (Lamouroux, 1816) Levinsen, 1909

ADEONA PLAGIOPORA Smitt, 1873

Plate 23, Figures 4, 5

1873. *Porina plagiopora* SMITT, Floridian Bryozoa. Kongl. Svenska Vetenskeps-Akademiens Handlingar, vol. 11, p. 30, pl. 6, figs. 134, 135.

Measurements.—Peristomice $\begin{cases} hp = 0.08 \text{ mm.} \\ lp = 0.10 \text{ mm.} \end{cases}$

Zooecia $\begin{cases} Lz = 0.50\text{–}0.60 \text{ mm.} \\ lz = 0.30 \text{ mm.} \end{cases}$

Variations.—Our specimens are generally quite similiar to the figures of Smitt; we figure two variations—one around a gonoecium the other around the ancestrula.

Osburn, 1914 (p. 199), identified this species with *Adeona violacea* Johnston, 1847. He collected all the intermediate forms between the two species at the Tortugas, but on the contrary, our specimens do not have this variability, so that we have not been able to verify Osburn's synonymy. The ancestrula is small and reduced to the peristomie.

Occurrence.—Fowey Light, 15 miles south of Miami, Fla.; 40 fms.
Albatross Station D. 2319, north of Cuba; 23° 10′ 37″ N.; 82° 20′ 06″ W.; 143 fms.; gray coral.
Albatross Station D. 2324, north of Cuba; 23° 10′ 25″ N.; 82° 20′ 24″ W.; 33 fms.; coral.
Albatross Station D. 2405, Gulf of Mexico; 28° 45′ 00″ N.; 85° 02′ 00″ W.; 30 fms.; gray sand, broken coral.
Albatross Station D. 2639, Straits of Florida; 25° 04′ 50″ N.; 80° 15′ 10″ W.; 56 fms.; coral sand.
Florida, 97 meters (Smitt); Bermuda (Verrill).

Plesiotypes.—Cat. Nos. 7448, 7449, U.S.N.M.

Genus BRACEBRIDGIA MacGillivray, 1886

BRACEBRIDGIA SUBSULCATA Smitt, 1873

Plate 23, Figures 1–3; text Figure 25

1873. *Porina subsulcata* SMITT, Floridan Bryozoa. Kongl. Svenska Vetenskaps-Akademiens, Handlingar, vol. 11, p. 28, pl. 6, figs. 136–140.

1900. *Porina subsulcata* VERRILL, Tunicata and Molluscoida of the Bermudas. Trans. Connecticut Academy, vol. 10, p. 54.

1914. *Bracebridgia subsulcata* OSBURN, Bryozoa of the Tortugas Islands. Publication Carnegie Institution, Washington, No. 182, p. 199.

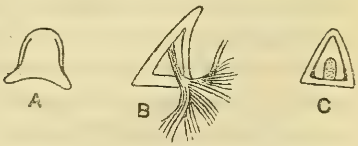

FIG. 25.—BRACEBRIDGIA SUBSULCATA SMITT, 1873. *A.* OPERCULUM, × 85. *B.* MANDIBLE WITH MUSCLES, × 85. *C.* MANDIBLE, × 85

Structure.—It is with hesitation that Osburn, 1914, placed this species in *Bracebridgia*, for he believed he recognized trace of an ascopore on the frontal. We have prepared several interiors and have observed no traces of the ascopore, as the olocyst is perfectly smooth without any perforation. This species is evidently a *Bracebridgia*.

The operculum is small, bell-shaped, with two lateral muscular attachments; it is attached inferiorily to the compensatrix without any trace of articulation. The mandible is triangular, dissymetric, unguiculated. The retractor muscle is very large, flabelliform, and formed of seven broad regular bundles.

The zoarium is much ramified; the fronds are dichotomous and develop like the horns of a deer.

Biology.—The color varies from yellowish pink to orange (Osburn). Our specimens are a yellowish gray. We have observed the expanded base.

Occurrence.—*Albatross* Station D. 2405, Gulf of Mexico; 28° 45′ 00″ N.; 85° 02′ 00″ W.; 30 fms.; gray sand, broken coral.

Fowey Light, 15 miles south of Miami, Fla.; 40 fms.

Tortugas, 16–19 meters (Osburn); Florida, 16–77 meters (Smitt) and 763 meters; Bermuda (Verrill).

Plesiotypes.—Cat. Nos. 7461, 7462, U.S.N.M.

Family HIPPOPODINIDAE Levinsen, 1909

Genus METRARABDOTOS Canu, 1914

METRARABDOTOS UNGUICULATUM, new species

Plate 23, Figures 6–9; text Figure 26

Description.—The zoarium is free, unilamellar, cylindrical, or conical. The zooecia are distinct, separated by a thread placed at the bottom of a furrow, large, much elongated, little broad; the frontal is convex, bordered laterally by areolar pores, formed of a pleurocyst with large granules. The aperture is transverse, semielliptical, little visible, arranged at the bottom of a peristomie. The peristomice is orbicular and provided with a proximal sinus; the peristome is thick and salient. At the side of the aperture and adjacent to the peristome there is a large falciform, long, thin, unguiculated avicularium with its convexity oriented toward the base of the zooecium and the beak toward the top. The ovicelled zooecia are much broader and bear two very small oral avicularia. The ovicell is enormous, endozooecial, convex, of the same structure as the frontal, and is ornamented with narrow, smooth, transverse callosities in the vicinity of its orifice.

Measurements.—Aperture (interior) $\begin{cases} ha = 0.10 \text{ mm.} \\ la = 0.20 \text{ mm.} \end{cases}$

Peristomice $\begin{cases} hp = 0.20 \text{ mm.} \\ lp = 0.15 \text{ mm.} \end{cases}$

Zooecia $\begin{cases} Lz = 1.00 \text{ mm.} \\ lz = 0.50 \text{ mm.} \end{cases}$

Variations.—As on all the giant species, the micrometric variations are quite variable. Our measurements are average, as there are some large and some smaller cells. The smaller cells are frequently deprived of avicularia.

The peristome is indented by a rimule spiramen but the ovicelled zooecia do not bear one and probably have no polypide. Our specimens, unfortunately not being preserved in alcohol, we have been unable to study their anatomy. On the interior there are parietal dietellae as in the Adeonidae. By transparency, there are large interareolar costules and a kind of lyrule often garnishes the spiramen sinus of the peristome. The ovicell bears two pores invisible exteriorily.

Two flabelliform muscular bundles move the mandible, which is strongly chitinized on the borders.

Biology.—The colony frequently encrusts radicells of algae which give to it its tubular appearance. They creep also on nullipores and on Serpulae and cover large surfaces. Many lamellae are sometimes superposed.

FIG. 26.—METRARABDOTOS UNGUICULATUM, NEW SPECIES. MANDIBLE, × 85, OF ORAL AVICULARIUM WITH TWO BUNDLES OF MUSCULAR FIBERS

The color is rose, reddish purple, or reddish violet.

Affinities.—At first glance this species may be confused with *Schizopodrella floridana* Osburn, 1914, but differs from it in its large endozooecial ovicell, in its pleurocystal and not tremocystal frontal, and in its avicularium with inferior (and not superior) concavity. Its large unguiculated avicularium differenciates it from all the other known species.

The genus *Metrarabdotos* is much developed in the American Miocene and Pliocene. We have described several very beautiful and vigorous species, but in which the fronds are always free and bilamellar.

The discovery of a recent well-developed species of this genus, much developed on both sides of the Atlantic during the long geologic periods, is very fortunate. When it is more studied, the paleontologist will understand better the life conditions of the ancient seas.

The genus *Metrarabdotos* is not really an equatorial genus. It lives in the vicinity of the Tropics but it does not go beyond this area.

Occurrence.—*Albatross* Station D. 2363, east of Yucatan; 22° 07′ 30″ N.; 87° 06′ 00″ W.; 21 fms.; white rock coral.

Albatross Station D. 2405, Gulf of Mexico; 28° 45′ 00″ N.; 85° 02′ 00″ W.; 30 fms.; gray sand, broken coral.

Albatross Station D. 2639, Straits of Florida; 25° 04′ 50″ N.; 80° 15′ 10″ W.; 56 fms.; coral sand.

Cotypes.—Cat. No. 7556, U.S.N.M.

Genus HIPPALIOSINA Canu, 1918

HIPPALIOSINA ROSTRIGERA Smitt, 1873

Text Figure 27

1873. *Escharella rostrigera* SMITT, Floridan Bryozoa. Kongl. Svenska Vetenskaps Akademiens, Handlingar, vol. 11, p. 57, pl. 10, figs. 203–205.

1914. *Lepralia rostrigera* OSBURN, Bryozoa of Tortugas Islands. Publication Carnegie Institution of Washington, No. 182, p. 211. (Not Waters, 1885, Jelly, 1889.)

1923. *Hippaliosina rostrigera* CANU, and BASSLER, North American Later Tertiary and Quaternary Bryozoa. Bull. 125, U. S. National Museum, p. 167, pl. 17, figs. 15–17.

Measurements.—Apertura $\begin{cases} ha=0.11 \text{ mm.} \\ la=0.10 \text{ mm.} \end{cases}$

Zooecia (ordinary) $\begin{cases} Lz=0.44\text{–}0.46 \text{ mm.} \\ lz=0.26 \text{ mm.} \end{cases}$

Aperture (ovicelled zooecia) $\begin{cases} ha=0.12 \text{ mm.} \\ la=0.14 \text{ mm.} \end{cases}$

Zooecia (ovicelled) $\begin{cases} Lz=0.60 \text{ mm.} \\ lz=0.30 \text{ mm.} \end{cases}$

Structure.—The opercula of the ordinary zooecia are of extraordinary irregularity and their ornamentation is very transparent and difficult to observe. The distal margin is thick and there are two lateral bands very close to the border. The mandibles are also very variable. Some are very short and others long and setiform. They are always unguiculate. The frontal seen by transparency shows the large areolar pores and the pleurocystal granules (sketched in black).

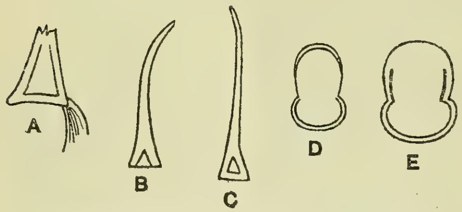

FIG. 27.—HIPPALIOSINA ROSTRIGERA SMITT, 1873. *A–C.* DIFFERENT FORMS OF THE SETIFORM MANDIBLE OF THE AVICULARIUM. *D, E.* OPERCULA, × 85

The natural history of the genus *Hippaliosina* is still very incomplete, for the larva and the anatomy are still awaiting description.

Biology.—Our specimens encrust Pectens and Nullipores while Osburn's examples grew on corals and shells. This species appears to prefer coral bottoms. It was in reproduction on March 15, 1885. Its longevity is very great, for we have discovered it in the Middle Miocene of Virginia. It has never left the Gulf of Mexico.

Occurrence.—*Albatross* Station D. 2319, north of Cuba; 23° 10′ 37″ N.; 82° 20′ 06″ W.; 143 fms.; gray coral.

Albatross Station D. 2405, Gulf of Mexico; 28° 45′ 00″ N.; 85° 02′ 00″W.; 30 fms.; gray sand; broken coral.

Florida, 56–69 meters (Smitt); Tortugas, 16–24 meters (Osburn).

Plesiotypes.—Cat. No. 7524, U.S.N.M.

Genus TREMOSCHIZODINA Duvergier, 1921

1921. *Tremoschizodina* DUVERGIER, Bryozoaires du Néogene de l'Aquitane. Actes de la Société Linneénne de Bordeaux, ser. 72, p. 36.

The ovicell is endozooecial. The aperture has a very broad proximal sinus. The frontal is a tremocyst surmounting a thin olocyst. The avicularium is parietal and very rare.

Genotype.—*Tremoschizodina pisciformis* Duvergier, 1921 (Miocene).

Range.—Miocene (Helvetian)—Recent.

This remarkable genus was discovered by Duvergier, in the Helvetian in the vicinity of Bordeaux, France. We have observed that *Gemellipora lata* Smitt, 1873, belongs to the same genus. Finally we discovered a magnificent and vigorous species in the Philippines, *Tremoschizodina crassa,* living in the Sulu Archipelago and in the China Sea.

This is an equatorial genus but passes somewhat beyond the line of the Tropics. The species appear to be extremely sensitive to cold and can not live at a temperature less than 9° C.

TREMOSCHIZODINA LATA Smitt, 1873

Plate 21, Figures 1, 2; text Figure 28

1873. *Gemellipora lata* SMITT, Floridan Bryozoa. Svenska Vetenskaps-Akademiens Handlingar vol. 11, p. 36, pl. 7, fig. 157.

Measurements.—Aperture $\begin{cases} ha = 0.16 \text{ mm.} \\ la = 0.13 \text{ mm.} \end{cases}$

Aperture (ovicelled) $\begin{cases} ha = 0.14 \text{ mm.} \\ la = 0.18 \text{ mm.} \end{cases}$

Zooecia $\begin{cases} Lz = 0.50 \text{ mm.} \\ lz = 0.36 \text{ mm.} \end{cases}$

Structure.—Smitt found only a single nonovicelled specimen. Fortunately, we have had the chance to discover the ovicell. It is endozooecial, small, and somewhat convex. This species must, therefore, be classed in the genus *Tremoschizodina* Duvergier, 1921.

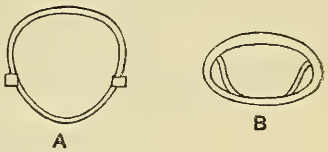

FIG. 28.—TREMOSCHIZODINA LATA SMITT, 1873. *A.* OPERCULUM OF ORDINARY ZOOECIA, × 85. *B.* OPERCULUM OF OVICELLED ZOOECIA, × 85

The apertura figured by Smitt is perfectly exact. That of the ovicelled zooecia is somewhat larger, elliptical, and transverse. The operculum is formed of two parts corresponding to the anter and poster and bordered interiorily by a sclerite on which the opercular muscles are probably attached; there is no other ornament visible. It is yellow colored and strongly chitinized. The axis of rotation is formed by two chitinous cardelles, a phenomenon rather rare in the Cheilostomata.

The frontal is formed of an olocyst surmounted by a detachable and very thin tremocyst. On the young zooecia the frontal forms a very pretty mosaic. At the center of each polygon there is a small tubular very oblique pore. In transparency, the tremopores are widely spaced. On the interior, the zooecial walls are very thin. The tremopores are very small and little visible.

Biology.—The zoarium encrusts dead shells, corals, nullipores, and bryozoa.

Our specimens are yellow colored. Smitts specimen "had a yellowish color, with the zooecial aperture, through their covering membrane and operculum of a darker greenish-yellow tint" (Smitt).

The specimens dredged alive were in reproduction March 15, 1885.

The colonies are always very small and we have not been able to study the avicularia.

Occurrence.—*Albatross* Station D. 2152, 2½ miles northwest of Habana Light; 387 fms.; coral.

Albatross Station D. 2405, Gulf of Mexico; 28° 45′ 00″ N.; 85° 02′ 00″ W.; 30 fms.; gray sand, broken coral.

Albatross Station D. 2639, Straits of Florida; 25° 04′ 50″ N.; 80° 15′ 10″ W.; 56 fms.; coral sand.

Fowey Light, 15 miles south of Miami, Fla.; 40 fms.

Florida, 110 meters (Smitt).

Plesiotype.—Cat. No. 7604, U.S.N.M.

TREMOSCHIZODINA ANATINA, new species

Plate 33, Figure 10

Description.—The zoarium is incrusting. The zooecia are distinct, separated by a deep furrow, elongated, subrectangular; the frontal is convex, striated transversely, perforated by very small and much scattered pores. The apertura is suborbicular or somewhat transverse; two small points separate the anter from a concave rimule, very broad and little distinct. There are large avicularia shaped like a *duck's beak* arranged sporadically between the zooecia.

Measurements.—Aperture $\begin{cases} ha = 0.15\text{–}0.17 \text{ mm.} \\ la = 0.17 \text{ mm.} \end{cases}$

Zooecia $\begin{cases} Lz = 0.75\text{–}0.85 \text{ mm.} \\ lz = 0.40\text{–}0.50 \text{ mm.} \end{cases}$

Avicularia $\begin{cases} Lav = 0.85 \text{ mm.} \\ lav = 0.25 \text{ mm.} \end{cases}$

Affinities.—This new species differs from the recent *Tremoschizodina lata* Smitt, 1873, in which the frontal and the aperture are identical in its larger dimensions and in the presence of a large interzooecial avicularium. *Tremoschizodina pisciformis* Duvergier, 1921, of the French Miocene (genotype) and the recent *Tremoschizodina crassa* Canu and Bassler from the Philippines have a frontal with tremopores and a zooecial avicularium. The form of the aperture of the first is clearly schizoporoid and somewhat different from the apertural form of the other species.

The genus *Tremoschizodina* is therefore not yet perfectly limited. Very few specimens have been found and we have not been able to make tangential sections necessary for a more complete study. It is a tropical genus.

Occurrence.—Pliocene: Minnitimmi Creek, Bocas Island, Almirante Bay, northwest Panama.

Holotype.—Cat. No. 70866, U.S.N.M.

Genus HIPPOPODINA Levinsen, 1909

HIPPOPODINA FEEGENSIS Busk, 1884

Plate 34, Figures 1, 2

1913. *Lepralia feegensis* WATERS, Bryozoa from Zanzibar. Proceedings Zoological Society, London, p. 514, pl. 70, figs. 21, 22. (Bibliography.) Not *Lepralia feegensis* MacGillivray.

Variations.—The operculum figured by Waters, 1913, indicates oral dimensions of 0.22 by 0.19 mm. The aperture figured by Levinsen, 1909, measures 0.18 to 0.20 mm. in diameter or 0.21 by 0.19 mm. The aperture on our specimen is 0.21 by 0.19 mm. or 0.25 by 0.22 mm.; it is, then, slightly larger. All the other characters are quite identical with those which can be observed on the excellent figures of Busk and of Levinsen. Our determination appears to us perfectly exact.

This is a tropical species observed from the African coast to the Philippine Islands in the Indian Ocean. Its presence has not yet been noted in the Gulf of Mexico, where it may perhaps be found some day. *Scrupocellaria retiformis* Smitt, 1872, has an analogous geographic distribution and we have noted its occurrence as a fossil in Panama and as a living species in the Gulf of Mexico.

Occurrence.—Pliocene: Minnitimmi Creek, Bocas Island, Almirante Bay, northwest Panama.

Geographic distribution.—Indian Ocean: Philippines, 29 meters (Busk); Hongkong, Sifu (Philipps); Manaar; Andamans; Cargados (Thornely); Wasin, British East Africa, 16 meters (Waters).

Plesiotype.—Cat. No. 70842, U.S.N.M.

Family CREPIDACANTHIDÆ Levinsen, 1909

Genus MASTIGOPHORA Hincks, 1880

MASTIGOPHORA PESANSERIS Smitt, 1873

Plate 21, Figure 9; Plate 34, Figure 4

1873. *Hippothoa pesanseris* SMITT, Floridan Bryozoa. Kongl. Svenska Vetenskaps-Akademiens, Handlingar, vol. 11, p. 43, pl. 7, figs. 159, 160.

1914. *Escharina pesanseris* OSBURN, Bryozoa of the Tortugas. Publication Carnegie Institution, Washington, No. 182, p. 207.

Measurements.—Aperture $\begin{cases} ha = 0.12 \text{ mm.} \\ la = 0.08\text{–}0.09 \text{ mm.} \end{cases}$

Zooecia $\begin{cases} Lz = 0.60\text{–}0.70 \text{ mm.} \\ lz = 0.50 \text{ mm.} \end{cases}$

Our specimens were dead when dredged; one of them was green. We have figured the best preserved.

This species is rather cosmopolitan. We rediscovered it in the Philippines and have indicated the principal variations.

Occurrence.—*Albatross* Station D. 2319, north of Cuba; 23° 10′ 37″ N.; 82° 20′ 06″ W.; 143 fms.; gray coral.
Albatross Station D. 2639, Straits of Florida; 25° 04′ 50″ N.; 80° 15′ 10″ W.; 56 fms.; coral sand.
Fowey Light, 15 miles south of Miami, Fla.; 40 fms.
Tortugas, 13 meters (Osburn), 68 meters (Smitt).
Pliocene, Minnitimmi Creek, Bocas Island, Almirante Bay, Panama.

Plesiotypes.—Cat. Nos. 7545, 7546, U.S.N.M.

MASTIGOPHORA POROSA Smitt, 1873

Plate 19, Figures 8, 9; text Figure 29

1873. *Hippothoa porosa* SMITT, Floridan Bryozoa. Kongl. Svenska Vetenskaps-Akademiens, Handlingar, vol. 11; p. 41, pl. 7, fig. 158.

Measurements.—Aperture $\begin{cases} ha = 0.10 \text{ mm.} \\ la = 0.14 \text{ mm.} \end{cases}$

Zooecia $\begin{cases} Lz = 0.70\text{–}0.80 \text{ mm.} \\ lz = 0.45\text{–}0.90 \text{ mm.} \end{cases}$

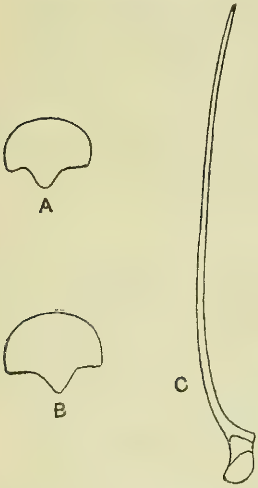

FIG. 29.—MASTIGOPHORA POROSA SMITT, 1873. *A*, *B*. SMALL AND LARGE OPERCULA, × 85. *C*. SETIFORM MANDIBLE, × 85

Structure.—Our colonies are small and rare in each locality. The operculum is thin with a broad triangular rimule. The mandible of the vibraculum is setiform and short; it moves obliquely. The ovicell is very short and of the same structure as the frontal.

Biology.—The specimens encrust nullipores, shells, and corals. They are yellow or old rose in color. They were in reproduction January 15, 1885.

Occurrence.—*Albatross* Station D. 2405, Gulf of Mexico; 28° 45′ 00″ N.; 85° 02′ 00″ W.; 30 fms.; grays and, broken coral.
Albatross Station D. 2639, Straits of Florida; 25° 04′ 50″ N.; 80° 15′ 10″ W.; 56 fms.; coral sand.
Fowey Light, 15 miles south of Miami, Fla.; 40 fms.
Florida, 64–113 meters (Smitt).
Blake Expedition, between Jamaica and Cuba; 18° 22′ N.; 89° 21′ W. (Norman, 1909).

Plesiotype.—Cat. No. 7547, U.S.N.M.

Genus CREPIDACANTHA Levinsen, 1909

CREPIDACANTHA SETIGERA Smitt, 1873

Plate 21, Figure 10

1873. *Hippothoa setigera* SMITT, Floridan Bryozoa. Kongl. Svenska Vetenskaps-Akademiens, Handlingar, vol. 11, p. 58, pl. 15, fig. 206.

Measurements.—Aperture $\begin{cases} ha=0.10 \text{ mm.} \\ la=0.08 \text{ mm.} \end{cases}$

Zooecia $\begin{cases} Lz=0.60 \text{ mm.} \\ lz=0.45\text{–}0.50 \text{ mm.} \end{cases}$

Affinities.—This species differs from *Crepidacantha grandis*, discovered by us in the Philippines, only in the absence of a small oral mucro and in the much smaller dimensions of the aperture. Very probably it is the same species.

Smitt discovered only one specimen deprived of its marginal spines but ornamented with its setiform mandibles somewhat shorter than the zooecia. Our specimen is still more incomplete. The comparison with other species is therefore necessarily difficult and uncertain. The colonies encrust fragments of shells.

Occurrence.—*Albatross* Station D. 2639, Straits of Florida; 25° 04′ 50″ N.; 80° 15′ 10″ W.; 56 fms; coral sand.
Tortugas Islands, 97 meters (Smitt)

Plesiotype.—Cat. No. 7827, U.S.N.M.

CREPIDACANTHA LONGISETA, new species

Plate 21, Figures 3, 4

Description.—The zoarium encrusts corals and hydroids. The zooecia are distinct, separated by a deep furrow, elongated, pyriform; the frontal is convex, smooth, or granular, bordered laterally by linear pores and by 11 very long marginal spines. The aperture is small, suborbicular, formed of a semicircular anter and a small concave poster separated by two very short cardelles; the peristome is broad, little salient, with a small mucro in its proximal part. The ovicell is large, globular, placed on the zooecium itself, closed by the operculum; the pleurocyst which covers the olocyst is incomplete and leaves a frontal area. On each side of the aperture there is a small avicularium; the setiform mandible is longer than the zooecium and very flexible.

Measurements.—Aperture $\begin{cases} ha=0.10 \text{ mm.} \\ la=0.10 \text{ mm.} \end{cases}$

Zooecia $\begin{cases} Lz=0.44 \text{ mm.} \\ lz=0.34 \text{ mm.} \end{cases}$

Affinities.—This new species differs from *Crepidacantha poissonii* Savigny-Audouin, 1826, in its avicularia placed on each side of the aperture and not below it. It differs from *Crepidacantha setigera* Smitt, 1873, in its smaller dimensions and its long retiform mandible.

Biology.—This species was in reproduction from the month of January to the month of May, according to the dredgings of the *Albatross.*

Occurrence.—*Albatross* Station D. 2167, off Habana, Cuba; 23° 10′ 40″ N.; 82° 20′ 30″ W.; 201 fms.; coral.

Albatross Station D. 2169, off Habana, Cuba; 23° 10′ 28″ N.; 82° 21′ 27″ W.; 78 fms.; coral.

Albatross Station D. 2334, north of Cuba; 23° 10′ 42″ N.; 82° 18′ 24″ W.; 67 fms.; white coral.

Holotype.—Cat. No. 7826, U.S.N.M.

CREPIDACANTHA POISSONII Savigny-Audouin, 1826

Plate 34, Figure 3

1826. *Flustra poissonii* Audouin, In Savigny's Description de l'Egypt. Histoire Naturelle, vol. 1, p. 10, fig. 5.
1880. *Lepralia kirchenpaueri* var. *teres* Hincks, Contribution history Marine Polyzoa. Annals and Magazine of Natural History, ser. 5, vol. 6, p. 77 (sep. 9), pl. 9, fig. 7.
1885. *Lepralia kirchenpaueri* var. *teres* Hincks, Contribution history Marine Polyzoa. Annals and Magazine of Natural History, ser. 5, vol. 15, p. 256 (sep. 166).
1899. *Lepralia poissonii* Waters, Bryozoa from Madeira. Journal Royal Microscopical Society, p. 16.
1909. *Lepralia poissonii* Norman, The Polyzoa of Madeira. Linnean Society's Journal-Zoology, vol. 30, p. 307, pl. 41, figs. 7, 8. Not Kirkpatrick, 1888; MacGillivray, 1882; Levinsen, 1909.

Under the name of *Lepralia poissonii*, the authors have manifestly confused many species and it is necessary to rename them. The specific characteristic is furnished by the position of the setiform avicularia, which are always removed from the aperture and placed much lower. In all the other species they are always placed at the side of the aperture, and if lower, on a level with the proximal border. There is no other synonymy than that which we indicate.

The specimens from the Red Sea have costulated ovicells; those from Madeira and from the Gulf of Mexico are smooth, without frontal area.

This interesting species is represented in the Pliocene deposits of Panama by a variation which presents no characters essentially different from the species.

The two vibracula are not placed symmetrically on the frontal.

Affinities.—*Crepidacantha* is a genus of the Tropics and of the southern part of the Temperate Zone. Many species are known. They are characterized by their micrometric dimensions and especially by the position of the two oral vibracula. In *Crepidacantha poissonii* these are always placed symmetrically below the aperture. The figures of Savigny and Norman agree perfectly in showing this essential character. On our fossil specimens from Panama the vibracula are rarely placed at the same height. Almost always there is one more removed from the aperture, but both are always below the aperture as in the type.

In the two other species from the Gulf of Mexico, *C. setigera* Smitt, 1873, and *C. longiseta,* new species, the vibracula are placed on each side of the aperture.

Occurrence.—Madeira, Hawaiian Islands, etc. (type form).
Pliocene: Minnitimmi Creek, Bocas Island, Almirante Bay, northwest Panama.

Holotype.—Cat. No. 70835, U.S.N.M.

Family PHYLACTELLIDAE Canu and Bassler, 1917

Genus LAGENIPORA Hincks, 1877

LAGENIPORA VERRUCOSA, new species

Plate 21, Figures 5–8

Description.—The zoarium encrusts shells, nullipores, corals, and hydroids; the zooecia are arranged in uniserial lines more or less ramified. The zooecia are long, lageniform; the frontal is convex, verrucose, and terminated by a long cylindrical smooth peristome. The aperture is orbicular and buried at the bottom of the peristome; the peristome is thin, entire, or notched. The ovicell is small, globular, opening into the peristome above the operculum.

Measurements.—Diameter of peristome = 0.20 mm.

$$\text{Zooecia}\begin{cases} Lz = 0.55 \text{ mm.} \\ lz = 0.30\text{–}0.35 \text{ mm.} \end{cases}$$

Structure.—This curious species is rather variable. There are some very verrucose zooecia and others which are almost smooth. The length of the peristome depends upon its position on its substratum. The branches are irregular in their divergence; they have a tendency to approach each other and the cells group themselves sometimes in the manner of cellepores, but without ever surmounting each other.

Affinities.—*Lagenipora edwardsi* Jullien, 1882, is also uniserial, but our species differs in its smaller zooecia and its long peristomes.

Biology.—This is a species of the coral bottoms and of submarine currents; it descends to rather great depths. It is fond of small round bodies for a substratum and it twists about them in all directions. The choice made by the larva is a beautiful manifestation of their instinct. The photography of the colonies thus fixed is very difficult.

Occurrence.—*Albatross* Station D. 2320, north of Cuba; 23° 10′ 39″ N.; 82° 18′ 48″ W.; 130 fms.; fine coral.
Albatross Station D. 2324, north of Cuba; 23° 10′ 25″ N.; 82° 20′ 24″ W.; 33 fms.; coral.
Albatross Station D. 2639, Straits of Florida; 25° 04′ 50″ N.; 80° 15′ 10″ W.; 56 fms.; coral sand.
Albatross Station D. 2319, north of Cuba; 23° 10′ 37″ N.; 82° 20′ 06″ W.; 143 fms.; gray coral.

Cotypes.—Cat. Nos. 7534, 7535, U.S.N.M.

Family CELLEPORIDAE Busk, 1852

Genus HIPPOPORIDRA Canu and Bassler, 1927

The ovicell is hyperstomial and bears a frontal area. The zooecia are accumulated; the frontal is surrounded by areolar pores and often bears small avicularia. The aperture is formed of an anter and a poster separated by two cardelles. The large interzooecial avicularia are acuminated.

Genotype.—*Hippoporidra* (*Cellepora*) *edax* Busk, 1859.

Range.—Miocene—Recent.

The known species of this genus are as follows:

Hippoporidra (*Cellepora*) *edax* Busk, 1859, recent, fossil.

Hippoporidra (*Lepralia*) *calcarea* Smitt, 1873, recent, fossil.

Hippoporidra (*Lepralia*) *maculata* Ulrich and Bassler, 1904, Miocene.

Hippoporidra (*Lepralia*) *parvula* Canu and Bassler, 1923, Miocene.

This is a very natural and homogeneous genus. The zooecia are very small, and their study especially in the fossils, is troublesome and difficult. It is very difficult to differentiate the species.

Two good figures of the genotype have been published, that of Hincks, 1880, a recent specimen, and that of Busk, 1859, representing a specimen from the English Crag (Pliocene). Both are incomplete but as zoologists we will consider especially that of Hincks. *Hippoporidra calcarea* Smitt, 1872, differs in the absence of small frontal avicularia and in a somewhat larger apertural width. *Hippoporidra maculata* Ulrich and Bassler, 1904, differs from *H. edax* in its large avicularium much less acuminate, in a somewhat larger apertural width, and in the presence of two areolar pores between the frontal costules. Finally *Hippoporidra parvula* Canu and Bassler, 1923, differs in its transverse aperture and in the presence of three or four small frontal avicularia.

All these species present curious phenomena of symbiosis.

The section which we gave in 1923 of *Hippoporidra maculata* proves that the genus belongs to the Celleporidae and not to the Escharellidae.

HIPPOPORIDRA EDAX Busk, 1859

Plate 22, Figures 1–4

1873. *Lepralia edax* SMITT, Floridan Bryozoa. Kongl. Svenska Vetenskaps-Akademiens Handlingar, vol. 11. p. 63.
1889. *Lepralia edax* JELLY, A synomymic Catalogue of Marine Bryozoa, p. 126. (Bibliography.)
1923. *Cellepora minuta* CANU and BASSLER, North American Later Tertiary and Quaternary Bryozoa. Bull. 125, U. S. National Museum, p. 182, pl. 25, figs. 10–13.

Measurements.—Apertural width = 0.06 mm.

Structure.—Hincks, 1880, in introducing *Hippoporidra calcarea* Smitt, 1873, into synonymy with *Hippoporidra edax* Busk, 1859, made an error which rendered also problematical the synonymy of Miss Jelly, 1889. Smitt (p. 64) has indicated the difference in writing that the essential characters of the present species is the presence "of a median umbo just proximally of the zooecial aperture."

On our specimens the umbo is particularly constant on the salient (superficial) zooecia; it is less apparent on the immersed (deep) zooecia.

The apertural width is exactly that indicated by Smitt.—0.06 mm. for the anter and 0.036 by 0.04 mm. for the poster. The frontal is a granular pleurocyst surrounded by a single line of areolar pores separated by short costules (as in Hinck's figure). The ovicell has an identical structure, but the pleurocyst is incomplete and leaves a very fragile olocystal area. The interzooecial avicularium is rather rare; it always accompanies the groups of deep zooecia; its general form is lozenge-shaped. The small frontal avicularium is always placed on the line of areolar pores, but it is frequently wanting.

The fossil form which we describe in 1923 under the name of *Cellepora minuta* belongs to the present species. It presents, however, some slight differences; the umbo is not constant and between the costules there are sometimes, as in the fossil forms from the English Pliocene figured by Busk, two or three areolar pores. The anter is frequently almost as wide as the poster. The large interzooecial avicularium has a form very similar to that of *Hippoporidra calcarea* but with smaller dimensions.

Biology.—The superb specimen that we have studied measures 6 cm. in length. It entirely covers a gastropod and emits two free and symmetrically arranged lateral branches. It is ovicelled (January 30, 1885). It is a case of symmetric symbiosis.

Smitt's specimen was only a small fragment of 4 mm. in length, "a little compressed, pointed of pumicose consistence." This is the reason the small frontal avicularium can not be observed.

We have always trouble in understanding the selective faculty of the larvae; the latter can not really choose their substratum of fixation; what is then the biochemical reaction which allows them to subsist only on shells of gastropods?

Occurrence.—*Albatross* Station D. 2363, east of Yucatan; 22° 07′ 30″ N.; 87° 06′ 00″ W.; 21 fms.; wh. r. coral.
Elbow Reef, Fla., 39 meters (Smitt).
Tertiary, Miocene: Wilmington, N. C., and Muldrows Mills, S. C. Pliocene: Waccamaw River, S. C.

Plesiotypes.—Cat. No. 7515, U.S.N.M.

HIPPOPORIDRA CALCAREA Smitt, 1873

Plate 22, Figures 5, 6; text Figure 30

1873. *Lepralia calcarea* SMITT, Floridan Bryozoa. Kongl. Svenska Vetenskaps Akademiens Handlingar, vol. 11, p. 63, pl. 11, figs. 220–223.
1914. *Lepralia edax* OSBURN, Bryozoa of the Tortugas Islands. Publication Carnegie Institution, No. 182, p. 212.

Structure.—The apertural width is from 0.08 to 0.09 mm.; there is no umbo on the frontal in agreement with Smitt's figure. The zoarial avicularia are very small and inconsistent; their absence is much more frequent than their presence.

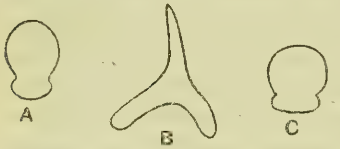

FIG. 30.—HIPPOPORIDRA CALCAREA SMITT, 1873. *A*. ORDINARY OPERCULUM, × 85. *B*. MANDIBLE OF AN INTERZOOECIAL AVICULARIUM, × 85. *C*. OPERCULUM OF OVICELLED ZOOECIUM, × 85

The operculum has a form very close to that of *Hippoporina;* we are not positively certain of the presence of muscular attachments. That of the ovicelled zooecia is much wider.

The area of the ovicell is not membraneous as Osburn described it in 1914. It is formed by a very fragile olocyst.

The mandible is star-shaped with three more or less elongated branches.

Affinities.—The specific differences from *Hippoporidra edax* Busk, 1859, are very slight. We do not yet know the chitinous appendages of the latter species, and we believe it prudent to keep the distinction made by Smitt. Too hasty conclusions as to synonymy are dangerous and lead the paleontologist to false stratigraphic conclusions.

Hippoporidra calcarea differs from *H. maculata* Ulrich and Bassler, 1904, in which the frontal is without an umbo, in the more acuminate form of the large interzooecial avicularium without a salient beak.

Biology.—Our colonies encrust gastropods. They emit free radial branches in which the development is in relation to the general equilibrium of the entire colony. They appear to be able to float and to be easily transported by currents. We have found some other fragments coming certainly from more complete colonies.

Our living specimens were ovicelled in March and April.

Occurrence.—Fowey Light, 15 miles south of Miami, Fla., 40 fms.
Albatross Station D. 2387, Gulf of Mexico; 29° 24′ 00″ N.; 88° 04′ 00″ W.; 32 fms.; sand, gravel, broken shells.
Albatross Station D. 2640, Straits of Florida; 25° 05′ 00″ N.; 80° 15′ 00″ W.; 56 fms.; coral sand.
Tortugas, 13–29 meters (Osburn); Florida, 79–127 meters (Smitt); Bermudas, shallow water (Verrill).

Plesiotype.—Cat. No. 7514, U.S.N.M.

Genus HIPPOTREMA Canu and Bassler, 1927

The ovicell is hyperstomial and is not closed by the operculum. The zooecia are piled upon each other in disorder; their frontal is perforated by tremopores. The aperture is formed by a large orbicular anter and by a short poster separated by two cardelles. The operculum does not have lateral linear attachments.

Genotype.—*Hippotrema* (*Lepralia*) *janthina* Smitt, 1873.

Range.—Recent.

This is the *C. janthina* group of Waters of which we have published a text figure.[10] The genus differs from *Hippoporidra* in the transformation of the pleurocyst into a tremocyst, in the different form of the poster, and in the absence of linear attachments to the operculum.

The only known species are:

Hippotrema (*Lepralia*) *janthina* Smitt, 1873, Florida.

Hippotrema (*Lepralia*) *rotundora* Norman, 1909, Madeira.

Waters, 1899, and Norman, 1909, are not in accord on the character of the second species.

HIPPOTREMA JANTHINA Smitt, 1873

1873. *Lepralia janthina* SMITT, Floridan Bryozoa. Kongl. Svenska Vetenskaps Akademiens, Handlingar, vol. 11, p. 63, pl. 11, figs. 224, 225.

1904. *Lepralia janthina* OSBURN, Bryozoa of the Tortugas Islands. Publication Carnegie Institution, Washington, No. 182, p. 213. (No Waters, 1899) (according to Norman).

Measurements.—Width of aperture =0.11 (Smitt) to 0.12 mm.

Structure.—The small avicularium is placed in the vicinity of the aperture; it is triangular and erected almost vertically. Contrary to the opinion of Osburn, there are interzooecial avicularia; they are long and thin; their presence is rather rare.

Biology.—Our living specimen encrusts *Stylopoma spongites;* it was in reproduction January 17, 1885.

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[10] Canu and Bassler, 1920, p. 615, fig. 185.

"The color is a deep blue black or violet" (Osburn). The margin of the aperture is usually of a little whitish tint in contrast with the black-bluish color of the zooecial wall (Smitt).

Occurrence.—*Albatross* Station D. 2320, north of Cuba; 23° 01′ 39″ N.; 82° 18′ 48″ W.; 130 fms.; fine coral.
Tortugas, 9 meters (Osburn); Florida, 21 meters (Smitt).

Plesiotype.—Cat. No. 7522, U.S.N.M.

Genus HOLOPORELLA Waters, 1909

HOLOPORELLA ALBIROSTRIS Smitt, 1873

Plate 22, Figures 10, 11; text Figure 31

1889. *Cellepora albirostris* Jelly, A Synonymic Catalogue of Marine Bryozoa, p. 45.
1914. *Holoporella albirostris* Osburn, Bryozoa of the Tortugas Islands. Publication Carnegie Institution, Washington, No. 182, p. 215.
1923. *Holoporella albirostris* Canu and Bassler, North American Later Tertiary and Quaternary Bryozoa. Bull. 125, United States National Museum, p. 174, pl. 7, figs. 9–14, pl. 32, figs. 6–10.

Measurements.—Diameter of the apertura, 0.14 mm.

Structure.—We have little to add to the natural history of this rather common species. The deep interzooecial avicularia are thin

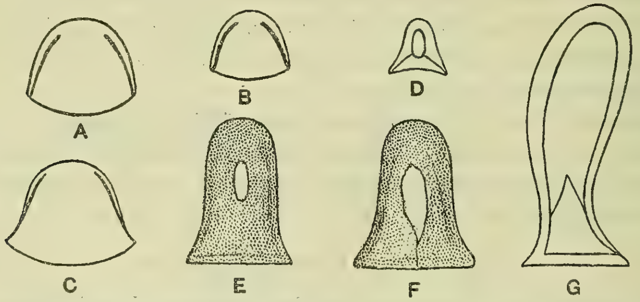

Fig. 31.—Holoporella albirostris Smitt, 1873. *A*, *B*. Two opercula, × 85, showing variations. *C*. Operculum of a superficial zooecium. *D*. Mandible of an oral avicularium. *E*, *F*. Two mandibles of the interzooecial avicularia showing variations of the lucida. *G*. Large mandible

and long. The superficial interzooecial avicularia appear as large salient tubes as broad as the zooecia. Our figure represents an ensemble of well-preserved zooecia and superficial avicularia. It is easy to understand that such a spinous and fragile structure is easily broken and that the determination of fossil specimens presents great difficulties.

The operculum is very thin, quite transparent, and its preparation is very delicate. Nevertheless we believe that the figures of Busk, 1885, are not altogether exact. We have distinctly recognized the two linear lateral attachments common to *Holoporella* but they are little removed from the border. Furthermore, the two lamellae which habitually constitute the operculum glide very easily on one another and it seems to us that the small lateral sinuosities figured by Busk have no other origin than irregular gliding in the preparations.

The interzooecial avicularia have mandibles more rigid and more easy to prepare. Our mandibles are very close to those of Busk; the central lucida is quite variable in form and in position.

On the interior face of the free colonies the zooecia are arranged in longitudinal bifurcated rows.

Biology.—"It is readily recognizable by its grayish-brown color with blackish-brown opercula in the zooecial and avicularian apertures against which the calcareous white projecting rostra show it." (Smitt.) Except in the youngest stages, the colony has a dark grayish or blackish color against which the white spines stand out in sharp contrast." (Osburn.)

Our colonies are generally free and tubular. They probably encrust thin algae. Sometimes encrusting shells and *Petralia.* Moreover, the species has been observed on corals and even on sponges. This species has been observed only in little depths of water. Its geographic distribution is great.

Occurrence.—*Albatross* Station D. 2405, Gulf of Mexico; 28° 45′ 00″ N.; 85° 02′ 00″ W.; 30 fms.; gray sand, broken coral.

Albatross Station D. 2639, Straits of Florida; 25° 04′ 50″ N.; 80° 15′ 10″ W.; 56 fms.; coral sand.

Tortugas, low water, 24 meters (Osburn); Florida, 41–56 meters (Smitt).

Geographic distribution.—Indian Ocean: Heard Island, 121 meters. Pacific: Shark Islands, Port Jackson, 13 meters; and Port Philips Heads, Australia.

Geologic distribution.—Miocene of Australia (Waters); Pliocene of New Zealand (Waters); Oligocene of Anguilla; Miocene of Jamaica; Pliocene of Florida.

Plesiotypes.—Cat. No. 7527, U.S.N.M.

HOLOPORELLA MAGNIFICA Osburn, 1914

Plate 24, Figures 7, 8; text Figure 32

1914. *Holoporella magnifica* OSBURN, Bryozoa from the Tortugas Islands. Publication Carnegie Institution, Washington, No. 182, p. 216, figs, 22, 23.

Measurements.—Aperture $\begin{cases} ha = 0.24\text{–}0.26 \text{ mm.} \\ la = 0.28\text{–}0.30 \text{ mm.} \end{cases}$

Structure.—Osburn did not give the chitinous appendages, so we have prepared them. The operculum bears laterally two very thick sclerites a little attenuated in the distal portion. The tentacular sheath is attached by two pairs of very thick muscles. The mandibles of the oral avicularia are semielliptical and strongly chitinized in their distal portion. The mandibles of the large interzooecial avicularia are very large, more or less rounded or somewhat acuminated. The muscular bundles are attached to them.

One of our colonies measures more than 20 square centimeters. It is tinted with brown.

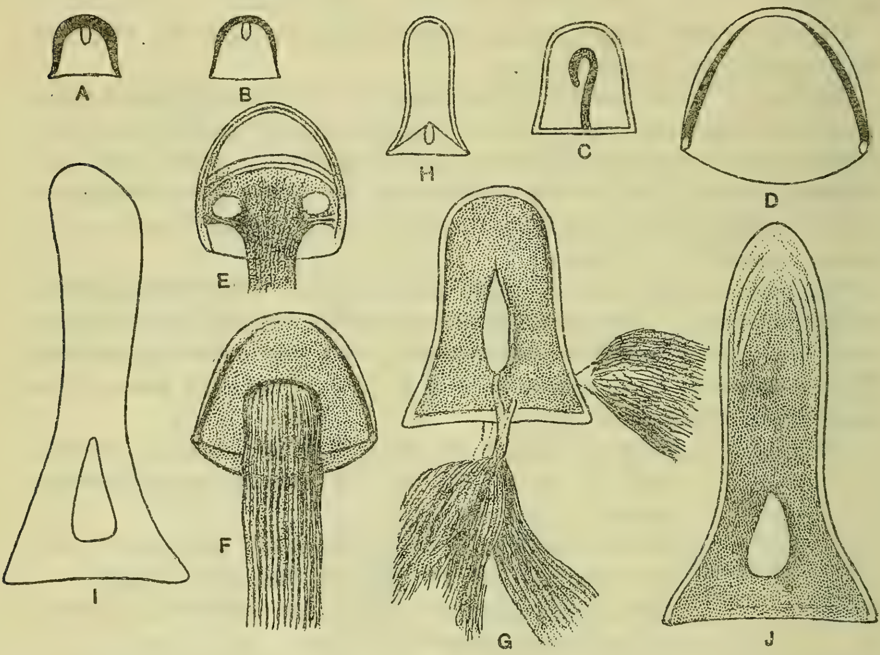

FIG. 32.—HOLOPORELLA MAGNIFICA OSBURN, 1914. *A*, *B*. MANDIBLE OF THE SMALL ZOOECIAL AVICULARIA, × 85. *C*. AN ORDINARY AVICULARIAN MANDIBLE. *D*. ISOLATED OPERCULUM. × 85. *E*. OPERCULUM, × 85, WITH ATTACHED TENTACULAR SHEATH. *F*. TENTACULAR SHEATH ATTACHED TO OPERCULUM, × 85. *G*. MANDIBLE OF AN INTERZOOECIAL AVICULARIUM WITH ITS TWO PAIRS OF ELEVATOR AND OCCLUSOR MUSCLES GROUPED IN SUPERPOSED BUNDLES. *H*. A SMALL AVICULARIUM, × 85. *I*, *J*. MANDIBLES OF LARGE INTERZOOECIAL AVICULARIA, × 85

Occurrence.—*Albatross* Station D. 2363, east of Yucatan; 22° 07′ 30″ N.; 87° 06′ 00″ W.; 21 fms.; white rock coral.

Albatross Station D. 2405, Gulf of Mexico; 28° 45′ 00″ N.; 85° 02′ 00″ W.; 30 fms.; gray sand, broken coral.

Tortugas, 16 meters; and Biscayne Key, Florida (Osburn).

Plesiotypes.—Cat. No. 75265, U.S.N.M.

HOLOPORELLA TURRITA Smitt, 1873

Text Figures 33 *c*, *d*

1873. *Lepralia turrita* SMITT, Floridan Bryozoa. Kongl. Svenska Vetenskaps Akademiens, Handlingar, vol. 11, p. 65, pl. 5, figs. 226–228.
1881. *Cellepora turrita* RIDLEY, Proc. Zoological Society, London, p. 55.
1890. *Lepralia turrita* KIRKPATRICK, Hydrozoa and Polyzoa from the China Sea. Annals and Magazine of Natural History, ser. 6, vol. 5, p. 16.
1914. *Holoporella turrita* OSBURN, Bryozoa of the Tortugas Islands. Publication Carnegie Institution, Washington, No. 182, p. 217.
1923. *Holoporella turrita* CANU and BASSLER, North American Later Tertiary and Quaternary Bryozoa. Bull. 125, U. S. National Museum, p. 179, pl. 46, fig. 1.

Measurements.—Aperture$\begin{cases} ha = 0.14.–0.18. \text{ mm.} \\ la = 0.18 \text{ mm.} \end{cases}$

Structure.—There are two sorts of opercula. The transverse ones appear to correspond to deep zooecia and the elongated ones to super-

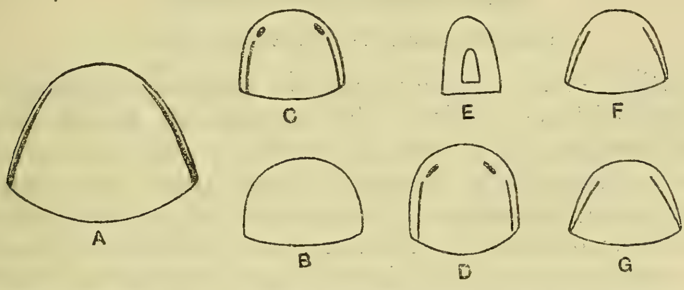

FIG. 33.—OPERCULA, × 85. *A*. HOLOPORELLA TUBULOSA, NEW SPECIES. *B*. HOLOPORELLA SUBALBA, NEW SPECIES. *C*, *D*. HOLOPORELLA TURRITA SMITT, 1873. *E–G*. HOLOPORELLA VAGANS BUSK, 1888. *E*. MANDIBLE. *F*, *G*. OPERCULA

ficial zooecia. We have made the same observation in specimens from the Philippine Islands. Our specimens do not have the interzooecial avicularia figured by Smitt and which we have observed in the Philippine examples. Their presence appears to be in relationship with the tranquillity of the waters.

Variations.—The number and the dimensions of the stout spines are alone variable; there are generally four or five on the specimens from the Gulf of Mexico and from two to six on the Philippine specimens. The fossil specimen from the Pleistocene of Panama is very vigorous; its apertural width is 0.20 mm. In spite of the large number of specimens observed, the ovicell is not yet known.[11]

Biology.—"Color in life bright pink to brick red. The younger zooecia are separated by delicate, raised, white walls which are very conspicuous against the red color of the colony. The white points of the blunt spines are also strongly contrasted with the ground color." (Osburn.)

[11] *Smittia turrita* Waters, 1883, is probably a distinct species of the *Tridenticulata* group.

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The colonies encrust corals, nullipores, sponges, and more rarely shells. The species is more abundant in shallow waters. The richness of ornamentation is greater in calm waters. It is limited to the equatorial zone.

Occurrence.—Fowey Light, 15 miles south of Miami, Fla., 40 fms.
Albatross Station D. 2319, north of Cuba; 23° 19′ 37″ N.; 82° 20′ 06″ W.; 143 fms.; gray coral.
Albatross Station D. 2365, east of Yucatan; 22° 18′ 00″ N.; 87° 04′ 00″ W.; 24 fms.; white rock coral.
Florida, 44–71 meters (Smitt); Tortugas, 19–24 meters (Osburn).

Geographic distribution.—China Sea, Tizard Reef, 43 meters; Philippines.

Geologic distribution.—Pleistocene of Panama (Canu and Bassler).

HOLOPORELLA SUBALBA new species

Plate 25, Figures 1–6; text Figure 33*b*

Description.—The zoarium is lamellar, tubular, irregularly bifurcated, little thickened, whitish. The zooecia are distinct, oriented in every direction, little erect; the frontal is smooth or somewhat granular surrounded by scattered areolar pores; the pleurocyst develops above the aperture to form a kind of tubular peristomie, oblique, longer proximally. The aperture is semielliptic, transverse, without visible cardelles. The interzooecial avicularia are irregularly developed but always somewhat spatulated. The ovicell is opened wide above the aperture.

Measurements.—Aperture $\begin{cases} ha = 0.12\text{–}0.15 \text{ mm.} \\ la = 0.14\text{–}0.17 \text{ mm.} \end{cases}$

Variations.—The tubular zoarial form is little explicable, for we have not a single specimen with an alga as its substratum. Some specimens encrust serpulae and are plurilamellar.

On the colonies there are always some places where the cells are more erect. The deep zooecia are visible only through their peristomie and their peristomice.

This species is very well characterized by its pleurocystal, smooth and oblique peristomie, at the base of which there are always some areolar pores.

Biology.—The biology of the Cellepores is very difficult to understand, for, irregularity being the rule, it is impossible to explain the reason for the innumerable variations.

Variations.—It is necessary to note some general observations. The interior of the tubes is always clean and does not contain a single parasite even in the waters where the larvae of the latter are abundant. One of our specimens is very significant; it is juxtaposed to a colony of *Petraliella bisinuata,* and although the interior face of

Petraliella is occupied by several parasitic colonies of *Smittina* and of *Gemellipora*, the inferior face and interior of the *Holoporella* contains absolutely nothing.

The zoarial development is very rapid; one of our colonies completely suppressed a serpula on which the larva was fixed.

Occurrence.—*Albatross* Station D. 2362, east of Yucatan; 22° 08′ 30″ N.; 86° 53′ 30″ W.; 25 fms.; coral sand.
Albatross Station D. 2363, east of Yucatan; 22° 07′ 30″ N.; 87° 06′ 00″ W.; 21 fms.; white rock coral.
Albatross Station D. 2365, east of Yucatan; 22° 18′ 00″ N.; 87° 04′ 00″ W.; 24 fms.; white rock coral.

Cotypes.—Cat. Nos. 7528, 7529, U.S.N.M.

HOLOPORELLA (?) TUBULOSA, new species

Plate 24, Figures 1–6; text Figure 33*a*

Description.—The zoarium creeps over Serpulae and emits free cylindrical bifurcated branches, sometimes adjacent. The zooecia are distinct, separated by a salient thread, very large, oriented in every direction, not erect, elongated, irregular; the frontal is flat, formed of a granular tremocyst and of large expanded tremopores. The peristomie is thin, salient, *tubular*. The aperture is oval, the point toward the top very little embedded in the peristomie. The peristomie is thin, irregular, suborbicular, rarely indented proximally.

Measurements.—Aperture $\begin{cases} ha = 0.18\text{–}0.20 \text{ mm.} \\ la = 0.15\text{–}0.17 \text{ mm.} \end{cases}$

Zooecia $\begin{cases} Lz = 1.20 \text{ mm.} \\ lz = 0.75 \text{ mm.} \end{cases}$

Structure.—Our micrometric measurements were taken on the most characteristic zooecia, but their form is generally indefinite and their dimensions variable.

The operculum is transverse, although the aperture is a little elongated. Its form is that of *Holoporella*; the linear attachments may be confused with the lateral borders.

Affinities.—This is a very divergent type in the genus *Holoporella*, for the cells are not accumulated. The long smooth peristomie approaches very much *Coleopora*, but the absence of the band around the operculum does not authorize the classification in this genus.

The ovicell is not known. A single specimen from each locality has been found. The specimen from Habana was free.

Occurrence.—*Albatross* Station D. 2160, off Habana, Cuba; 23° 10′ 31″ N.; 82° 20′ 37″ W.; 167 fms.; coral.
Albatross Station D. 2319, north of Cuba; 23° 10′ 37″ N.; 82° 20′ 06″ W.; 143 fms.; gray coral.
Albatross Station D. 2405, Gulf of Mexico; 28° 45′ 00″ N.; 85° 02′ 00″ W.; 30 fms.

Cotypes.—Cat. No. 7532, U.S.N.M.

HOLOPORELLA VAGANS Busk, 1885

Plate 25, Figures 7–13; text Figure 33 *e-g*

1885. *Cellepora vagans* BUSK, Polyzoa of *Challenger*. Report Results Voyage *Challenger*, vol. 10, pt. 30, p. 198, pl. 29, fig. 10; pl. 35, fig. 11.

Measurements.—Aperture $\begin{cases} ha = 0.14\text{–}0.16 \text{ mm.} \\ la = 0.16\text{–}0.18 \text{ mm.} \end{cases}$

Length of avicularia = 0.30–0.50 mm.

Variations.—The characters of our specimens are in perfect accord with those Busk has given for his *Cellepora vagans*. The oral sinus is very small although the rimule of the operculum is very large The zooecia are surrounded by areolar pores. The small oral avicuarium has a very salient beak. The marginal or ancestrular cells are oriented. Finally the interzooecial avicularia are long, rather thin with generally a linear mandible.

Busk gave only a small figure and spoke little of the variations. Here the small specimens are orbicular. The largest are unilamellar and free, or perhaps they form small rods, increasing cylindrically without base of fixation. The interzooecial avicularia are a little enlarged at their beak and their mandible is somewhat spatulate.

On the massive and tuberose colonies the tuberosities are formed by groups of large zooecia. Between these tuberosities there are groups of small zooecia in which the orifice measures only 0.10 by 0.14 mm.

None of our specimens were ovicelled. The operculum does not correspond to the form of the aperture. In spite of the apertural proximal sinus, the operculum shows the essential characters of *Holoporella*. In view of this anomaly, we have made many preparations of specimens from different localities and all the opercula had the characteristic form of *Holoporella* with the two lateral bands.

Affinities.—In the form of the interzooecial avicularia this species is very close to *Holoporella albirostris* Smitt, 1873. It differs from it in the presence of a small proximal sinus with aperture and in the absence of a large avicularian umbo.

Biology.—The colonies have a beautiful flesh color. The larvæ fix themselves on small grains of solidified mud. The young colonies form small disks in which the maximum dimension is 10 mm. The older and larger colonies have forms incompatible with their development on the sea bottom. It is presumed that they escape from the bottom and are able to float with a certain ease. The absence of a base of fixation confirms this hypothesis. This phenomenon is not limited to the present species, but it can be observed on a very large number of massive and free species. It is necessary then to conclude that all the Cellepores have been floating colonies and that this is the principal cause for their irregular development. Their extreme lightness in dry condition is well known.

We have not observed parasites on the inferior face of our lamellar specimens.

Occurrence.—Fowey Light, 15 miles south of Miami, Fla.; 40 fms. *Albatross* Station D. 2639, Straits of Florida; 25° 04′ 50″ N.; 80° 15′ 10″ W.; 56 fms.; coral sand.

Geographic distribution.—Pacific: Honolulu, Sandwich Islands, 32–64 meters. Indian Ocean: Crozet Island, 340 meters.

Plesiotypes.—Cat. Nos. 7530, 7531, U.S.N.M.

Genus SCHISMOPORA MacGillivray, 1888

SCHISMOPORA DICHOTOMA Hincks, 1864

Plate 22, Figures 7–9; text Figure 34

1914. *Cellepora dichotoma* OSBURN, Bryozoa of the Tortugas Islands. Publication Carnegie Institution, Washington, No. 182, p. 214.

1880. *Cellepora dichotoma* JELLY, A synonymic Catalogue of Marine Bryozoa, p. 51 (Bibliography.)

Measurements.—Aperture $\begin{cases} ha = 0.12 \text{ mm.} \\ la = 0.09\text{–}0.10 \text{ mm.} \end{cases}$

Variations.—This is a species well known in the Temperate Zone and its presence in the eastern Atlantic has been noted from Norway to the Azores Islands. In the Western Atlantic it undergoes notable variations. Already at Beaufort, N. C., the zooecia are much shorter, less oriented, and the colonies have no more the vigor of the British specimens. In the Gulf of Mexico, as our figures show, as well as those of Smitt, 1873 (*C. avicularis*, p. 53), the zooecia are short and very erect like those of more typical Cellepores.

FIG. 34.—SCHIZMOPORA DICHOTOMA HINCKS, 1864. OPERCULUM AND MANDIBLE, × 85

The colonies are more constantly arborescent and sometimes are lamellose. Finally the apertural dimensions are somewhat divergent. The operculum has a form identical with that Nordgaard figured in 1903,[12] but it is smaller and contains two muscular attachments distant from the border. Certainly the specimens from the Gulf of Mexico belong to a variety distinct from the northern type.

Our specimens from the Pliocene of Panama are free, cylindrical, bifurcated; the zooecia and the avicularia very closely resemble the figure of Smitt, 1873 (*C. avicularis*); the width of the aperture (0.10 mm.) is almost that indicated by Smitt (0.09 mm.). These specimens, like the recent specimens from the Gulf of Mexico, scarcely resemble *Cellepora dichotoma* of the northern seas, of which we have very fine specimens; they are far removed also from the variety discovered at Beaufort by Osburn. We give two photographs, for Hincks's synonymy seems premature to us.

[12] See Canu and Bassler, 1920 p. 599, fig. 178.

Occurrence.—Pliocene: Minnitimmi Creek, Bocas Island, Almirante Bay, Panama.
Albatross Station D. 2405, Gulf of Mexico.

Plesiotypes.—Cat. Nos. 7588, 70855, U.S.N.M.

Genus CELLEPORA Linnaeus, 1767

CELLEPORA MINUTIPOROSA new species

Plate 28, Figure 1

Description.—The zoarium encrusts corals. The zooecia are distinct, large, poorly oriented, little erect, noncumulate. The frontal is convex and covered with a large number of very small pores. The apertura is subcircular and bears a very broad, round rimule. The oral avicularium is triangular, ascending and adjacent to one side of the apertural rimule. The ovicell is recumbent, relatively small, not closed by the operculum. The interzooecial avicularium is large with spathulate mandible; there are other small avicularia with semicircular mandibles.

Measurements.—Apertura $\begin{cases} ha = ? \\ la = 0.20 \text{ mm.} \end{cases}$

Recumbent zooecia $\begin{cases} Lz = 1.40 \text{ mm.} \\ lz = 0.75\text{–}1.10 \text{ mm.} \end{cases}$

Affinities.—Our specimens were dead and without chitinous organs, so that we have not been able to make a complete study of the species. Probably a special genus will be necessary in order to admit species with such structure and in which the cells are not heaped on top of one another.

Occurrence.—*Albatross* Station D. 2662, Atlantic; 29° 24′ 30″ N.; 79° 43′ W.; 434 fms.; gray sand and broken shells.

Holotype.—Cat. No. 7474, U.S.N.M.

Family LIRIOZOIDAE Levinsen, 1909

Genus PASYTHEA Lamouroux, 1812 (GEMELLIPORA Smitt, 1873, part)

"Zooecium in the erect portion pinnate. Stem at first a double calcareous tube, then a succession of geminate zooecia of which two pairs constitute an internode, from the side of which equidistant, opposite pinnae, also composed of geminate zooecia, are given off at right angles. Zooecia geminate, closely connate, subcompressed, the oral portion subtubular and twisted round to opposite faces, front and back, in each pair. Surface smooth, entire, with a row of four to six punctae on each side and a few on the front. Peristome slightly thickened." (Busk, 1874.)

Genotype.—*Cellaria tulipifera* Ellis and Solander, 1786.

History.—The names *Pasythea* Lamouroux, 1812, and *Liriozoa* Lamarck, 1812, have been applied to the same species, *Cellaria tulip-*

ifera Ellis and Solander, 1786. *Pasythea* has been chosen by Busk, 1884, because of its priority. Smitt, 1873, discovered a similar species *eburnea* but placed it in his new genus *Gemellipora*, making it the genotype.[13] Waters, 1899, recognized Smitt's error and classed *G. eburnea* in *Pasythea*. In 1904 he retained the term *Gemellipora* with *Gemellipora glabra* Smitt, 1873, for the type, which MacGillivray, 1895, and Maplestone, 1901, had already done before him.

Levinsen, 1909, for these two species alone formed a distinct family Liriozoidae and two genera *Gemellipora* Smitt, 1873 (for *G. eburnea*), and *Liriozoa* Lamarck, 1812 (for *L. tulipifera*). The names are chosen in perfect accord with the rules of nomenclature. The characters observed by Levinsen in order to separate the two genera are clearly zoarial; the cells are arranged by threes in *Liriozoa* and by pairs in *Gemellipora*. We do not recognize this classification because the number of species is not sufficient and finally because the zooecial grouping does not appear to correspond to clearly differentiated functions. We now follow the simpler classification of Waters and later if the studies on the larvae of the two species, of their ovicells, of their anatomical characters, confirm the ideas of Levinsen we will be the first to admit it.

PASYTHEA EBURNEA Smitt, 1873

Plate 8, Figures 11, 12

1873. *Gemellipora eburnea* SMITT, Floridan Bryozoa. Kongl. Svenska Vetenskaps-Akademiens Handlingar vol. 11, No. 4, p. 35, pl. 7, figs. 152–156 (not pl. 35, pl. 9, figs. 177, 178).
1885. *Pasythea eburnea* BUSK, Polyzoa collected by *Challenger*. Results Voyage *Challenger*, vol. 10, pt. 30, p. 5, pl. 34, fig. 1.
1899. *Pasythea eburnea* Waters, Bryozoa from Madeira. Journal Royal Microscopical Society, p. 12, pl. 3, fig. 22 (opercula).
1909. *Gemellipora eburnea* LEVINSEN, Studies on Cheilostomatous Bryozoa, p. 313.

We have found only one fine specimen of this remarkable species and we have nothing to add to the excellent study of Busk, 1885. This author thought that the frontal pores are equivalent to the septules observed on the lateral walls of the zooecia in other cheilostomata. The small fragments of the frontal which we have photographed seem to verify this.

Occurrence.—*Albatross* Station D. 2331, north of Cuba; 23° 10′ 31″ N.; 82° 19′ 55″ W.; 114 fms.; coral.
Florida, 275 meters (Smitt); Carribbean Sea, off Culebra Island, 631 meters (Busk); and off Sombrero Island, 729 meters (Busk).

[13] "The name of the genus is chosen in reference to the colonial form of one of the Floridan species which may be named *G. eburnea*" (Smitt, 1872).

Geographic distribution.—Eastern Atlantic Gulf of Gascony: (Waters); Madeira (Waters). Western Atlantic: Off Barra Grande, Brazil, 658 meters (Busk).

Plesiotypes.—Cat. No. 7566, U.S.N.M.

Suborder HEXAPOGONA Canu and Bassler, 1927

Family MAMILLOPORIDAE Canu and Bassler, 1927

Following Waters, 1919, we have tried to place a little order in the classification of the Batopora-Mamillopora group. After the present studies on *Mamillopora cupula* and the studies that we have made on Philippine species we can state that the limits given by Waters to the genus *Mamillopora* are too great. In reality there are several genera perfectly distinguished by their opercula as well as their general structure.

The known genera of this family are as follows:

Mamillopora Smitt, 1873, Miocene—Recent.

Fedora Jullien, 1882—Recent.

Anoteropora Canu and Bassler, 1927, Pliocene—Recent.

Stenosipora Canu and Bassler, 1927, Eocene (Lutetian, Priabonian).

Kionidella Koschinsky, 1885, Eocene (Lutetian) and Oligocene (Vicksburgian).

Prattia D' Archiac, 1847, Eocene (Auversian).

Ascosia Jullien, 1882—Recent.

Genus MAMILLOPORA Smitt, 1873

1873. *Mamillopora* Smitt, Floridan Bryozoa. Kongl. Svenska Vetenskaps-Akademiens Handlingar, vol. 11, p. 33.

The zoarium is cupuliform or conical and floating. The two faces are covered by mammillosities. The superior face contains only the aperture and its wide peristome. The aperture is subelliptical with two submedian cardelles. The peristome bears an elliptical or oval avicularium. The ovicelled zooecia are much larger.

Genotype.—*Mamillopora cupula* Smitt, 1873.

Range.—Miocene (Burdigalian)—Recent.

The other known species of the genus are as follows:

Mamillopora (*Cupularia*) *bidenta* Reuss, 1869 (according to Waters), Eocene (Priabonian).

Mamillopora tuberosa Canu and Bassler, 1919, Miocene (Bowden).

Mamillopora cavernulosa, new name (=*M. tuberosa* Canu and Bassler, part), Miocene (Costa Rica).

MAMILLOPORA TUBEROSA Canu and Bassler, 1919

1919. *Stichoporina tuberosa* Canu and Bassler, Geology and Paleontology of the West Indies Bryozoa. Publication Carnegie Institution; Washington, No. 291, p. 98, pl. 7, figs. 1–8 (not plates 1 and 6 = *Mamillopora cavernulosa* and *M. cupula*).

1923. *Mamillopora tuberosa* CANU and BASSLER, North American Later Tertiary and Quaternary Bryozoa. Bull. 125, U. S. National Museum, p. 192, pl. 7, figs. 1–8 (not pl. 6, figs. 16–19).

This species differs from the genotype in its much larger and more constant mammillosities and in the presence of large hydrostatic cavities on the inner face.

Occurrence.—Miocene (Bowden); Bowden, Jamaica.

MAMILLOPORA CAVERNULOSA, new name

1919. *Stichoporina tuberosa* CANU and BASSLER, Geology and Paleontology of the West Indies Bryozoa. Publication Carnegie Institution, Washington, No. 291, p. 98, pl. 1, figs. 20–23 (not pl. 7 and 6).

1919. *Stichoporina tuberosa* CANU and BASSLER, Geology and Paleontology of the Panama Canal Zone Bryozoa. Bull. 103, U. S. National Museum, p. 14, pl. 53, figs. 9–12.

This species differs from the genotype in its smaller dimensions, its finely punctated ovicell, and in the presence of numerous hydrostatic *cavities* on the inner face.

Occurrence.—Miocene (Gatun formation); Banana River, Costa Rica.

MAMILLOPORA CUPULA Smitt, 1873

Plate 26, Figures 3–13; text Figure 35

1873. *Mamillopora cupula* SMITT, Floridan Bryozoa. Kongl. Svenska Vetenskaps Akademiens Handlingar, vol. 11, p. 33, pl. 7, figs. 146, 147 *a–c*.

1919. *Stichoporina tuberosa* CANU and BASSLER (part), Geology and Paleontology of the West Indies Bryozoa. Publication Carnegie Institution, Washington, No. 291, p. 98, pl. 6, figs. 16–19 (not pl. 1 and 7=*Mamillopora cavernulosa* and *M. tuberosa*).

1923. *Mamillopora tuberosa* CANU and BASSLER, North American Later Tertiary and Quaternary Bryozoa. Bull. 125, U. S. National Museum, p. 192, pl. 6, figs. 16–19.

Measurements.—Aperture of nonovicelled zooecia $\begin{cases} ha=0.14\text{–}0.20 \text{ mm.} \\ la=0.10\text{–}0.14 \text{ mm.} \end{cases}$

Aperture of ovicelled zooecia $\begin{cases} ha=0.20 \text{ mm.} \\ la=0.16 \text{ mm.} \end{cases}$

Structure.—The colonies have a discoidal or conical form. Their diameter is rather variable and measures 7 mm. at the maximum. One of our conical specimens was dredged alive, and although dry it preserved its ectocyst and its opercula and was then perfectly inclosed. Plunging it in water, it floats with the point on top but completely immersed with the point touching the surface of the liquid. This is then a floating species like *Conescharellina*, but its position is inversed. Each colony is a small hydrostatic apparatus utilizing the principle of Archimedes as well as capillarity and adapting itself easily to various bathymetric exigencies of the oceanic depths. The cupuliform colonies float with much more difficulty.

The seat of this hydrostatic apparatus is the interior face of the colonies. This is variable according to the form and size. The zooecia appear hexagonal, especially on specimens with the ectocyst; on others the character is little visible, and more often the cells are grouped in radial series. Each hexagon bears small, hollow, very irregular elevations and either a very small avicularium or a large avicularium identical with those of the superior cellular face. The large avicularia are arranged in widely spaced circular series. This character is specific and permits one to easily distinguish the species in the fossil forms in spite of the great irregularity of the elevations. We have already shown that in many other genera of bryozoa these elevations are really hydrostatic, and we have here still another proof. The physiologic function of the avicularium is here impossible to establish. The small specimens are deprived of them and certain species do not have them at all. The most reasonable hypothesis is that they are organs of defense against parasitism, for on the 50 specimens observed none of them bears parasitic colonies.

The longitudinal section shows that the cells are simple, erect hexagons with bases somewhat convex. This is a more simple architecture than that of *Conescharellina* and of *Flabellopora*, in which the bases are hexagonal pyramids.

The aperture is large, provided with two cardelles, and is placed at the center of the superior base. It is surrounded by a very thick peristome and covered also by the small very irregular tuberosities, characteristic of the genus. There is therefore a zooecial surface visible, contrary to that observed in other genera of the family. The peristome always bears to the right or to the left an elliptical avicularium more or less salient, the pivot of which is indicated by two lateral denticles. Smitt's figure is incorrect, for the avicularium appears here as interzooecial, although it is always peristomial and is not visible at the interior.

The ovicelled zooecia are wider than the adjacent zooecia; their aperture is also somewhat larger. The visible zooecial length is double, for they are formed of two cavities separated by a vertical partition. The proximal cavity is an ordinary zooecium, while the very large distal cavity is uniquely destined for the development of the embryos. The operculum closes the ovicell but it may fall and become supported on the separating partition, opening thus the ovicell for the escape of the larvae. This is really a kind of endozooecial ovicell, for the distal cavity occupies the place of another zooecium. This is another generic character that is not observed in other genera which have hyperstomial ovicells more or less embedded in the distal zooecia.

The operculum is much chitinized and bordered with a more or less broad and thick sclerite. It bears two broad linear attachments outlining the two lucidae and attached to the marginal sclerite. The two lucidae indicate the place of the cardelles. A transverse and thick sclerite placed below the axis of rotation serves probably as attachment for one of the walls of the compensatrix. The dimensions are not constant, for the aperture increases in size from the center to the circumference.

The ancestrula is frequently a zooecium larger than the adjacent zooecia; it is surrounded by six smaller zooecia, but their structure is identical and normal.

Biology.—*Mamillopora cupula* is a floating species. It has not been dredged in the high seas and appears to prefer the vicinity of the shores. The geometric regularity indicates that it can easily turn on its axis either to accomodate itself to the aquatic movements or to search for nourishment. It can at its pleasure rise or descend, but it is absolutely deprived of organs of motion. In our sections we have not discovered a substratum for the fixation of the larva, as in *Conescharellina* or *Flabellopora*. The larva is not fixed then (as in *Lunulites*) but it is transformed into a swimming larva. This is a very curious phenomenon, indicating a larval structure very different from that of the other bryozoa. The discovery of the larva is therefore very desirable.

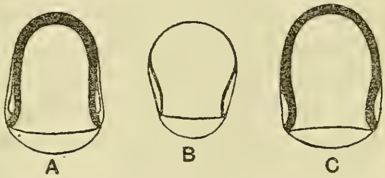


FIG. 35.—MAMILLOPORA CUPULA SMITT, 1873. *A–C.* THREE FORMS OF OPERCULA, × 85

Occurrence.—*Albatross* Station D. 2405, Gulf of Mexico; 28° 45′ 00″ N.; 85° 02′ 00″ W.; 30 fms.; gray sand, broken coral.

Fowey Light, 15 miles south of Miami, Fla.; 40 fms.

Albatross Station D. 2411, Gulf of Mexico; 26° 33′ 30″ N.; 83° 15′ 30″ W.; 27 fms.; fine white sand, black specks.

Albatross Station D. 2639, Straits of Florida; 25° 04′ 50″ N.; 80° 15′ 10″ W.; 56 fms.; coral sand.

Florida, 48–110 meters (Smitt).

Miocene: Rio Cana, Santo Domingo.

Plesiotypes.—Cat. Nos. 7541, 7542, U.S.N.M.

Family CHAPERIIDAE Jullien, 1888

Genus CHAPERIA Jullien, 1888

CHAPERIA GALEATA Busk, 1852

1923. *Chaperia galeata* CANU and BASSLER, North American Later Tertiary and Quaternary Bryozoa. Bull. 125, United States National Museum, p. 52, pl. 34, figs. 8–10. (Bibliography, geologic and geographic distribution.)

Our specimens are ovicelled, ectocysted and ornamented with their distal spines. They are rare.

Occurrence.—*Albatross* Station D. 2405, Gulf of Mexico; 28° 45′ 00″ N.; 85° 02′ 00″ W.; 30 fms.; gray sand, broken coral.

Order CYCLOSTOMATA Busk

The poverty of the Cyclostomatous fauna in the recent seas is more apparent than real. The great difficulty of determination causes authors to neglect the difficult, incomplete, or very rare specimens. In reality the species are rather abundant but they are rarely represented by a sufficient number of specimens for detailed study.

For the Gulf of Mexico region, Smitt cites 11 species and Osburn, 1914, 2 only, of which 1 is new for the area. We describe or cite 15 species in this work, 11 of which are new. The total is now 28 species. This number is not complete, for we have neglected seven species, unfortunately represented by unique specimens or those not in a condition for study.

From the point of view of the paleontologist, a knowledge of the cyclostomatous bryozoa is absolutely indespensable and the neglect of the study of the recent species is much to be regretted.

Family CRISIIDAE Johnston, 1847

Genus CRISIA Lamouroux, 1816

CRISIA DENTICULATA Lamarck, 1812

Plate 30, Figure 4

1838. *Crisia denticulata* Milne Edwards, Mémoires sur les Crisies. Annales des Sciences Naturelles Zoologie, ser. 2, vol. 9, p. 9, pl. 7, fig. 1.
1873. *Crisia eburnea* Smitt, Kongl. Svenska Vetenskaps-Akademiens Handlingar, vol. 10, p. 4, pl. 1, figs. 1 to 4 (not 5).
1891. *Crisia denticulata* Harmer, On the British species of Crisia. Quarterly Journal Microscopical Science, vol. 32, p. 129, pl. 12, figs. 1–3. (Bibliography.)
1914. *Crisia denticulata* Osburn, Bryozoa of the Tortugas Islands. Publication Carnegie Institution No. 182, p. 185.

The segments collected are few in number but their determination does not appear doubtful. The restrictions made by Osburn are well founded. The joints are black.

Occurrence.—*Albatross* Station D. 2317, north of Cuba; 24° 25′ 45″ N.; 81° 46′ 45″ W.; 45 fms.; coral.

Albatross Station D. 2405, Gulf of Mexico; 28° 45′ 00″ N.; 85° 02′ 00″ W.; 30 fms.; gray sand, broken coral.

Florida, 11–97 meters (Smitt); Tortugas, 16–24 meters (Osburn).

CRISIA ELONGATA Milne Edwards, 1838

Plate 30, Figure 3

1838. *Crisia elongata* MILNE EDWARDS, Mémoires sur les Crisies. Annales des Sciences Natuielles Zoologie, ser. 2, vol 9, p. 10, pl. 7, fig. 2.

This species is well characterized by the great length of the segments, which may bear 26 to 30 tubes. Our specimens are very similar to the figure of Milne Edwards, but their micrometric dimensions vary visibly from the dimensions given by Waters, 1914, for specimens from British East Africa. We have figured the ovicell.

Occurrence.—*Albatross* Station D. 2405, Gulf of Mexico; 28° 45′ 00″ N.; 85° 02′ 00″ W.; 30 fms.; gray sand, broken coral.
Pliocene: Minnitimmi Creek, Bocas Island, Almirante Bay, Panama.

Plesiotypes.—Cat. No. 7481, U.S.N.M.

CRISIA species

Plate 30, Figures 1, 2

We have discovered a curious segment with white joints. It is close to a variety of *C. denticulata* figured by Hincks, 1880, but its dimensions appear larger. We figure the specimen and believe that it belongs to a new species, although we are not able to give it a detailed description.

Occurrence.—*Albatross* Station D. 2405, Gulf of Mexico; 28° 45′ 00″ N.; 85° 02′ 00″ W.; 30 fms.; gray sand, broken coral.

Family DIASTOPORIDAE Gregory, 1899

Forma PROBOSCINA Audouin, 1826

In the different Gulf of Mexico localities studied we have collected seven species of *Stomatopora* and *Proboscina* which are represented by such unique and incomplete specimens that their description would be doubtful and useless to science.

PROBOSCINA ROBUSTA, new species

Plate 30, Figure 7

Description.—The zoarium encrusts sponges. It is formed of long biserial branches, straight or undulated; the angle of divergence is small. The tubes are short, striated transversely, terminated by a very salient peristomie. The peristome is thin and orbicular.

Measurements.—Diameter of orifice, 0.20 mm.
Diameter of peristome, 0.24 mm.
Distance of peristomes, 0.80 mm.
Diameter of branches, 0.64 mm.

Affinities.—The figured specimen only has been found but it was interesting to us because of its great vigor. *Proboscina parviangulata* Canu and Bassler, 1920, can alone be compared with it but it differs from that species in its more closely spaced peristomes and in the occasional presence of paired tubes.

The branches enlarge before bifurcating and they bear three or four rows of tubes.

Occurrence.—*Albatross* Station D. 2319, north of Cuba; 23° 10′ 37″ N.; 82° 20′ 06″ W.; 143 fms.; gray coral.

Holotype.—Cat. No. 7572, U.S.N.M.

Family ONCOUSOECIIDAE Canu, 1918

Genus ONCOUSOECIA Canu, 1918

ONCOUSOECIA ARCUATA, new species

Plate 31, Figure 2

Description.—The zoarium encrusts shells; the branches are long, somewhat arched, claviform, mono to triserial. The tubes are thin, rather long, little visible, striated transversely. The peristome is thin, orbicular, little salient. The ovicell is globular, as wide as the branches; the oeciostome is terminal, a little smaller than the peristome.

Measurements.—Diameter of orifice, 0.10 mm.
Diameter of peristome, 0.12 mm.
Distance of peristomes, 0.72 mm.
Diameter of branches (at the extremity), 0.60 mm.

This species is very well characterized by its globular ovicells.

Occurrence.—*Albatross* Station D. 2639, Straits of Florida; 25° 04′ 50″ N.; 80° 15′ 10″ W.; 56 fms.; coral sand.

Holotype.—Cat. No. 7564, U.S.N.M.

Genus PERISTOMOECIA Canu and Bassler, 1920

PERISTOMOECIA FLORIDANA, new species

Plate 31, Figures 6–9

Description.—The zoarium encrusts dead shells; the branches are formed of small successive palm-shaped areas and are dichotomous. The tubes are visible, cylindrical, striated transversely, terminated by a very long free and erect peristome. The peristome is thin, orbicular, or oval. The ovicell is orbicular, convex, with a small salient oeciostome at the center.

Measurements.—Diameter of orifice, 0.06 mm.
Diameter of peristome and of tubes, 0.08–0.10 mm.
Separation of peristomes, 0.50 mm.
Distance of peristomes, 0.50 mm.

Affinities.—All the *Berenicea* forms resemble each other, and when the micrometric dimensions are close their differentiation is very difficult. In order to separate them accurately it is necessary to know the variations of the zoarial form, the ovicell and its deformations, and the protoecium which is almost always destroyed.

There are no recent species in which all these characters have been carefully studied and figured. Their comparison is therefore quite useless. Here the free peristome attains almost to 0.50 mm. in length; it is very fragile and is broken on dead or dried specimens.

Occurrence.—*Albatross* Station D. 2639, Straits of Florida; 25° 04′ 50″ N.; 80° 15′ 10″ W.; 56 fms.; coral sand.

Cotypes.—Cat. No. 7567, U.S.N.M.

Family PLAGIOECIIDAE Canu, 1918

Genus PLAGIOECIA Canu, 1918

PLAGIOECIA DISPAR, new species

Plate 31, Figure 10

Description.—The zoarium is orbicular; it encrusts small dead shells. The tubes are distinct, separated by a furrow or by a thread, cylindrical with a little salient and very oblique peristome. The peristome is thin, orbicular, or oval. The ovicell is very long, quite convex, not marginal.

Measurements.—Diameter of orifice, 0.05 mm.
Diameter of peristome, 0.07 mm.
Distance of tubes, 0.44 mm.
Separation of tubes, 0.30 mm.

Affinities.—This species is well characterized by the subcentral place of its ovicell, contrary to the general rule. In the length of this ovicell, it approaches *Diastopora lactea* Calvet, 1903, but differs from it in the absence of concentric wrinkles on the colonies and in the somewhat smaller micrometric measurements.

Occurrence.—*Albatross* Station D. 2639, Straits of Florida; 25° 04′ 50″ N.; 80° 15′ 10″ W.; 56 fms.; coral sand.

Holotype.—Cat. No. 7571, U.S.N.M.

PLAGIOECIA SARNIENSIS Norman, 1864

Plate 34, Figure 10

1889. *Diastopora sarniensis* JELLY, A synonymic catalogue of Marine Bryozoa, p. 85. (Bibliography.)

1907. *Diastopora sarniensis* CALVET, Bryozoaires. Expedition scientifique *Travaileur* et *Talisman*, p. 415. (Bibliography.)

Our specimen encrusts a fragment of shell and is ovicelled. This is a cosmopolitan species.

Occurrence.—Pliocene: Minnitimmi Creek, Bocas Island, Almirante Bay, Panama.

Geographic distribution.—Eastern Atlantic: British Channel. Mediterranean and Adriatic. Pacific: Queen Charlotte Islands, Australian shores, China Sea.

Plesiotypes.—Cat. No. 70852, U.S.N.M.

Genus ENTALOPHORA Lamouroux, 1821

ENTALOPHORA PROBOSCIDEOIDES Smitt, 1872

Plate 34, Figure 11

1872. *Pustulopora proboscideoides* Smitt, Floridan Bryozoa. Kongl. Svenska Vetenskaps-Akademiems, vol. 10, p. 11, pl. 4, figs. 26, 27.

Affinities.—Smitt compared his species with a species of Gabb and Horn, 1862 (p. 170, pl. 21, fig. 60*a*), found in the Eocene of Alabama. The figure of the American authors represents a very small fragment, and it is very difficult to be certain of the identification, since we have not discovered an analogous specimen in our immense amount of material from Eocene and Miocene localities.

Our specimens are quite similar to the figures of Smitt.

Occurrence.—Recent: Florida, 110 meters (Smitt). Pliocene: Minnitimmi Creek, Bocas Island, Almirante Bay, Panama.

Plesiotypes.—Cat. No. 70839, U.S.N.M.

Family MECYNOECIIDAE Canu, 1918

Genus MECYNOECIA Canu, 1918

MECYNOECIA DEFLEXA Smitt, 1872

Plate 31, Figure 1

1872. *Entalophora deflexa* Smitt, Floridan Bryozoa. Kongl. Svenska Vetenskaps-Akademiens Handlingar, vol. 10, p. 11, pl. 5, figs. 28–30.

The synonymy of this species is in controversy, but as our materials are not sufficient we have abstained from making any criticism. Our specimens conform to Smitt's figures.

We have been rather fortunate to discover a base which we have figured. Up to the present the species appears restricted to America around Florida.

Occurrence.—*Albatross* Station D. 2405, Gulf of Mexico; 28° 45′ 00″ N.; 85° 02′ 00″ W.; 30 fms.; gray sand, broken coral.
Albatross Station D. 2639, Straits of Florida; 25° 04′ 50″ N.; 80° 15′ 10″ W.; 56 fms.; coral sand.
Gulf of Mexico, Egmont Key, Florida; Florida, 26 meters (Smitt).

Plesiotypes.—Cat. No. 7553, U.S.N.M.

Family DIAPEROECIIDAE Canu, 1918

Genus DIAPEROECIA Canu, 1918

DIAPEROECIA RADICATA Kirkpatrick, 1888

Plate 31, Figures 3–5

1872. *Idmonea milneana* Smitt, Floridan Bryozoa. Kongl. Svenska Vetenskaps-Akademiens Handlingar, vol. 10, p. 8, pl. 3, figs. 14–17.

Variations.—Most of our specimens correspond well to Smitt's figures; the tubes, nonadjacent, are arranged in oblique rows to the number of three, but, as Smitt has already noted, there are only one or two tubes per row on certain small branches. Moreover, we found specimens having a larger number of tubes on the branches; they have a more idmoneiform aspect, although they never present true alternating fascicles.

In the two cases the ovicell is always the same. It belongs to the *Diaperoecia* type with central oeciostome. The latter is curved toward the base in a contrary direction to the peristome of the adjacent tubes. The tube which engenders the ovicell is always placed in the immediate vicinity of the median longitudinal axis of the branch.

Here the oeciostome is indeed specific, and we have not observed very important variations on our specimens. On the other idmoneiform species of this genus (*Diaperoecia pulcherrima* Kirkpatrick, 1890) its form is very different.

The decoration of the tubes is not as beautiful as in specimens from the Philippines where the specimens are highly ornamented. We attribute this phenomenon to the great calm of the waters of the Pacific, while in the vicinity of Florida the passage of the Gulf Stream profoundly modifies the fauna. The species was in reproduction March 15, 1885.

Occurrence.—*Albatross* Station D. 2405, Gulf of Mexico; 28° 45′ 00″ N.; 85° 02′ 00″ W.; 30 fms.; gray sand, broken coral.

Albatross Station D. 2639, Straits of Florida; 25° 04′ 50″ N.; 80° 15′ 10″ W.; 56 fms.; coral sand.

Gulf of Mexico, Egmont Key, Fla. Florida, 19–97 meters (Smitt).

Plesiotypes.—Cat. No. 7488, U.S.N.M.

Genus DIPLOSOLEN Canu, 1918

DIPLOSOLEN OBELIUM Johnston, 1838

Plate 31, Figure 11

1889. *Diastopora obelia* JELLY, A synonymic Catalogue of Marine Bryozoa, p. 83. (Bibliography.)

1896. *Diastopora obelia* NEVIANI, Briozoi Postpliocenici di Spilinga. Atti Accademia di Scienze Naturali in Catania, ser. 4, vol. 9, p. 60. (Bibliography.)

1901. *Diastopora obelia* NEVIANI, Bryozoi neogenici delle Calabrie. Palaeontographia Italica, vol. 6, p. 240. (Local bibliography.)

1905. *Diastopora obelia* NEVIANI, Briozoi fossili di Carrubare. Bollettino Societa Geologica Italiana, vol. 23, p. 551.

1907. *Diastopora obelia* CALVET, Bryozoaires. Expédition scientifique *Travailleur* et *Talisman*, p. 464. (Complementary bibliography.)

The study of the bibliography of this species will certainly give good biologic information. Its discovery to the south of North

America is very important. As it has not yet been discovered among the fossils, we must conclude that it arrived here only in the recent epoch. However, the genus *Diplosolen* is know since the Jacksonian.

Occurrence.—*Albatross* Station D. 2319, north of Cuba; 23° 10′ 37″ N.; 82° 20′ 06″ W.; 143 fms.; gray coral.
Albatross Station D. 2321, north of Cuba; 23° 10′ 54″ N.; 82° 18′ 00″ W.; 230 fms.; fine gray sand.

Geologic distribution.—Helvetian of Touraine, France (Canu collection) Tortonian of Hungary (U. S. National Museum); Sicilian of Italy (Neviani). Pleistocene of Italy (Neviani, Sequenza).

Geographic distribution.—Northern Hemisphere, where it inhabits the principal seas; Spitzberg, Sea of Kara, Nova Zembla, Greenland, Jean Mayen (Gulf of St. Lawrence) Scandinavian, Danish and British coasts and English Channel, Gulf of Gascony, Grand Banks of Newfoundland.

Plesiotypes.—Cat. Nos. 7489, 7490, U.S.N.M.

Genus CRISULIPORA Robertson, 1910

CRISULIPORA ORIENTALIS, new species

Plate 29, Figures 3–8

Description.—The zoarium is attached to floating bodies; it is articulated and formed of claviform bi to tri furcate segments in which the noncellular face is plain or concave. The tubes are distinct, separated by a furrow, finely striated transversely by lines of punctations, terminated by a long, free, arched and erect peristome. The peristome is thin and orbicular.

Measurements.—Diameter of peristome, 0.14 mm.
Maximum length of peristome, 0.56 mm.
Distance of peristomes, 0.80 mm.
Separation of peristomes, 0.72 mm.
Maximum length of segments, 7.00 mm.
Maximum width of segments, 3.00 mm.

Affinities.—Like the other species of this genus, this species is attached to floating algae; the colonies are not bushy. They creep in the manner of *Proboscina* but remain free. The rounded substratum is the cause of the dorsal concavity of the segments. The species differs from *Crisulipora occidentalis* Robertson, 1910, in the concave form of the dorsal of the segments, in the flabellated segments, and in the smaller micrometric dimensions. It differs from *Crisulipora flabellata* Canu and Bassler, 1920, in its much larger and broader segments and in the greater length of the free peristomes.

The genus begins in the Vicksburgian of Alabama and we have described four species. The simultaneous presence on the western and eastern shores of the United States is proof of the ancient communication between the Pacific and the Atlantic and that the Isthmus of Panama is of relatively recent formation. The genus *Crisulipora* appears to be a genus purely American, for it has not yet been observed on the other continents.

Occurrence.—Gulf of Mexico, Egmont Key, Fla.

Cotypes.—Cat. No. 7837, U.S.N.M.

Family HORNERIDAE Gregory, 1899

Genus HORNERA Lamouroux, 1821

HORNERA GALEATA Smitt, 1872

1872. *Hornera galeata* SMITT, Floridan Bryozoa. Kongl. Svenska Vetenskaps Akademiens Handlingar, vol. 10, p. 10, pl. 4, figs. 23–25.

Occurrence.—*Albatross* Station D. 2319, north of Cuba; 23° 10′ 37″ N.; 82° 20′ 06″ W.; 143 fms.; gray coral.
Florida, 296 meters (Smitt).

Family LICHENOPORIDAE Smitt, 1866

Genus LICHENOPORA Defrance, 1823

LICHENOPORA RADIATA Audouin, 1826

Plate 29, Figures 1, 2

1889. *Lichenopora radiata* JELLY, A synomymic Catalogue of the Marine Bryozoa, p. 137.

1923. *Lichenopora radiata* CANU and BASSLER, North American Later Tertiary and Quaternary Bryozoa. Bull. 125, U. S. National Museum, p. 204, pl. 44, fig. 10. (Bibliography, geographic and geologic distribution.)

Our specimens are rare, but their discovery is important because it exemplifies the great vigor of the species. It is universal as far as the polar circle and its geologic distribution is considerable since the Miocene proving the great instability of the oceanic shores.

Occurrence.—*Albatross* Station D. 2319, north of Cuba; 23° 10′ 37″ N.; 82° 20′ 06″ W.; 143 fms.; gray coral.
Albatross Station D. 2334, north of Cuba; 23° 10′ 42″ N.; 82° 18′ 24″ W.; 67 fms.; white coral.

Plesiotypes.—Cat. No. 7539, U.S.N.M.

LICHENOPORA BUSKI? Harmer, 1915

Plate 29, Figure 9

For the bibliography and discussion, see our Philippine volume.

Variations.—The figured specimens show all the zooecial characters of *Lichenopora buski* Harmer, 1915. However, the colony is twice as large, with a considerably larger number of radial rows of tubes. As we have not discovered the ovicell, we have not judged it wise to consider it a new species.

Our specimen encrusted a colony of *Stylopoma spongites;* it was dead and deprived of an ectocyst.

Occurrence.—*Albatross* Station D. 2320, north of Cuba; 23° 10′ 39″ N.; 82° 18′ 48″ W.; 130 fms.; fine coral.

Plesiotype.—Cat. No. 7540, U.S.N.M.

LICHENOPORA BUSKIANA, new name

Plate 34, Figures 7, 8

1875. *Discoporella californica* Busk, Catalogue Marine Polyzoa British Museum, pt. 3, Cyclostomata, p. 32, pl. 30, fig. 5.

In 1923 (p. 203) we noted that *Lichenopora californica* of Conrad, 1855, and of Robertson, 1910, was neither the species of Busk, 1875, nor of D'Orbigny, 1852, and we preserved Conrad's name, D'Orbigny's specimen not having been figured yet. We now take the occasion to change Busk's species to *Lichenopora buskiana*, new name. Our determination is a little doubtful, for the specimen is incompletely developed and very small, but it has the characters cited by Busk in his diagnosis, "zoarium thick; fasciculi much raised and biserial; mouths of cells less than the cancelli." The veinules between the cancelli on the figure of Busk are here also quite visible.

It is interesting to discover in the Pliocene of Panama a species not observed in the Gulf of Mexico, but which lives in the Pacific. In addition to this one, we have already noted *Callopora curvirostris* Hincks, 1881, *Tremopora radicifera* Hincks, 1881, and *Hippopodina feegensis* Busk, 1884. The formation of the Isthmus of Panama seems, therefore, quite recent.

Occurrence.—Pliocene; Minnitimmi Creek, Bocas Island, Almirante Bay, northwest Panama.

Holotype.—Cat. No. 70847, U.S.N.M.

Genus DOMOPORA D'Orbigny, 1847

DOMOPORA FLORIDANA, new species

Plate 30, Figures 5, 6

The small specimen which we figure contains only two superposed colonies. The center is concave and occupied by large polygonal cancelli. The tubes are open on the circumference. They are adjacent and form little salient, indistinct, longitudinal lines separated by polygonal cancelli of the same diameter. This specimen was fixed on a nullipore. Our object in publishing this figure was to show the persistence in the recent seas of the zoarial form observed frequently in the ancient seas of the Cretaceous and Tertiary. We have discovered another species of *Domopora* in the Philippines. The extreme rarity of the material studied does not permit us, unfortunately, to make a scientific study of the ancient genus *Domopora*.

Occurrence.—*Albatross* Station D. 2405, Gulf of Mexico; 28° 45′ 00″ N.; 85° 02′ 00″ W.; 30 fms.; gray sand, broken coral.

Holotype.—Cat. No. 7491, U.S.N.M.

Family TUBULIPORIDAE Johnston, 1838

Genus IDMONEA Lamouroux, 1821

IDMONEA ATLANTICA Forbes, 1847

Plate 34, Figure 9

Small but well-preserved examples of this widespread species have been found in the Panama Pliocene deposits.

Occurrence.—Pliocene: Minnitimmi Creek, Bocas Island, Almirante Bay, Panama.

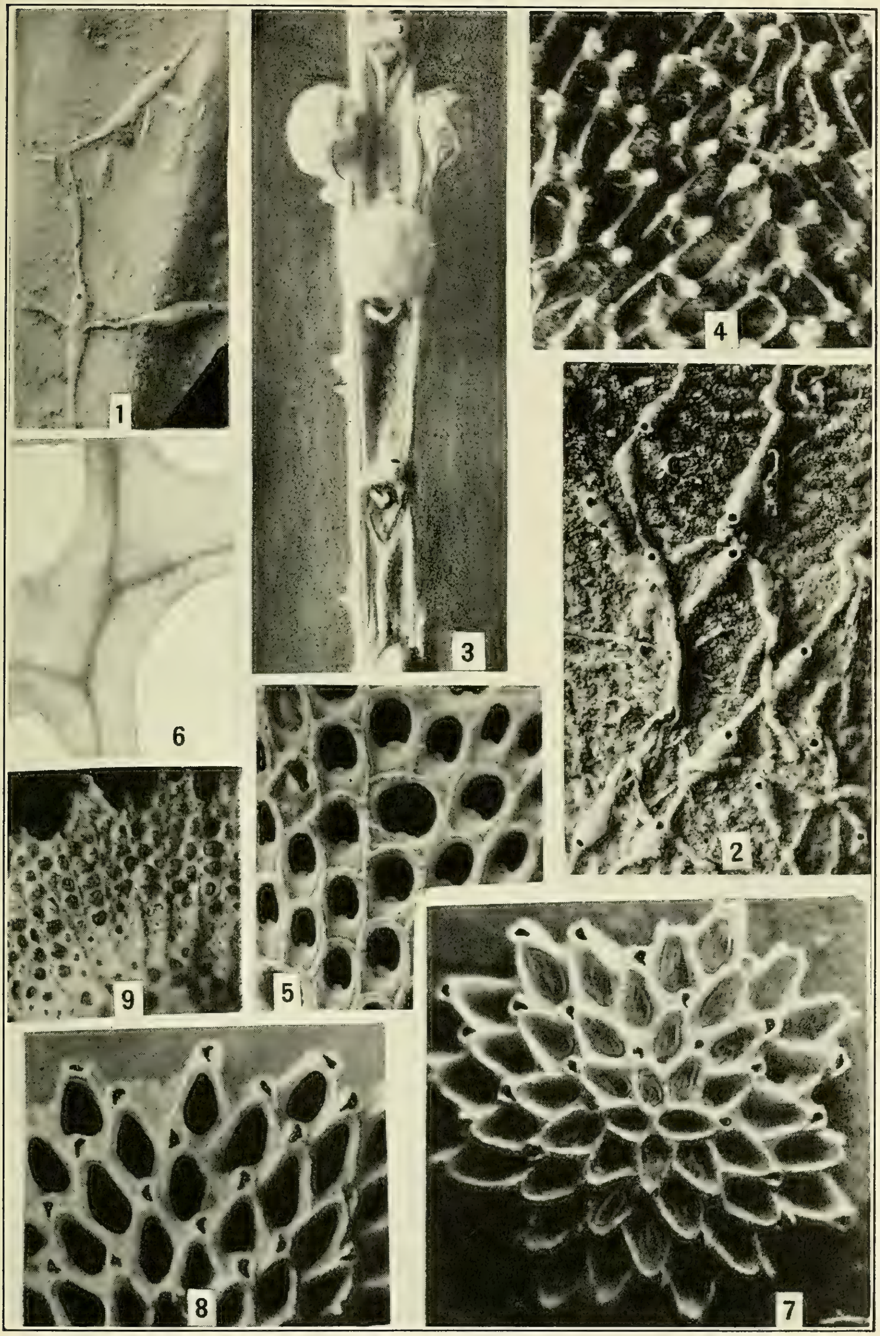
Plesiotypes.—Cat. No. 70845, U.S.N.M.

PLATES

EXPLANATION OF PLATES

Plate 1

		Page
Fig. 1.	*Aetea truncata* Landsborough, 1852	51
	Specimen incrusting a shell; × 20.	
	Albatross Station D. 2405, Gulf of Mexico.	
2.	*Aetea sica* Couch, 1844	51
	Creeping portion of zoarium; × 20.	
	Albatross Station D. 2672, Atlantic, east of Georgia.	
3.	*Levinsenella brasiliensis* Busk, 1884	26
	A branch with ectocyst and ovicells preserved; × 20.	
	Albatross Station D. 2117, Caribbean Sea.	
4.	*Nitscheina membranacea* Linnaeus, 1766	18
	Specimen with ectocyst, deformed in drying; × 20.	
	Albatross Station D. 2782, off Chili, South America.	
5,6.	*Acanthodesia savarti* Savigny-Audouin, 1826	14
	5. Surface of zoarium, × 20, showing the characteristic serrate denticle.	
	6. Tangential section illustrating structure of zooecial walls; × 85.	
	Albatross Station D. 2405, Gulf of Mexico.	
7–9.	*Cupuladria canariensis* Busk, 1852	15
	7. Young zoarium, × 20, illustrating central zooecia.	
	8. Marginal zooecia; × 20.	
	9. Inner face without ectocyst, showing the large pores; × 20.	
	Albatross Station D. 2405, Gulf of Mexico.	



BRYOZOA OF THE GULF OF MEXICO REGION

FOR DESCRIPTION SEE PAGE FACING

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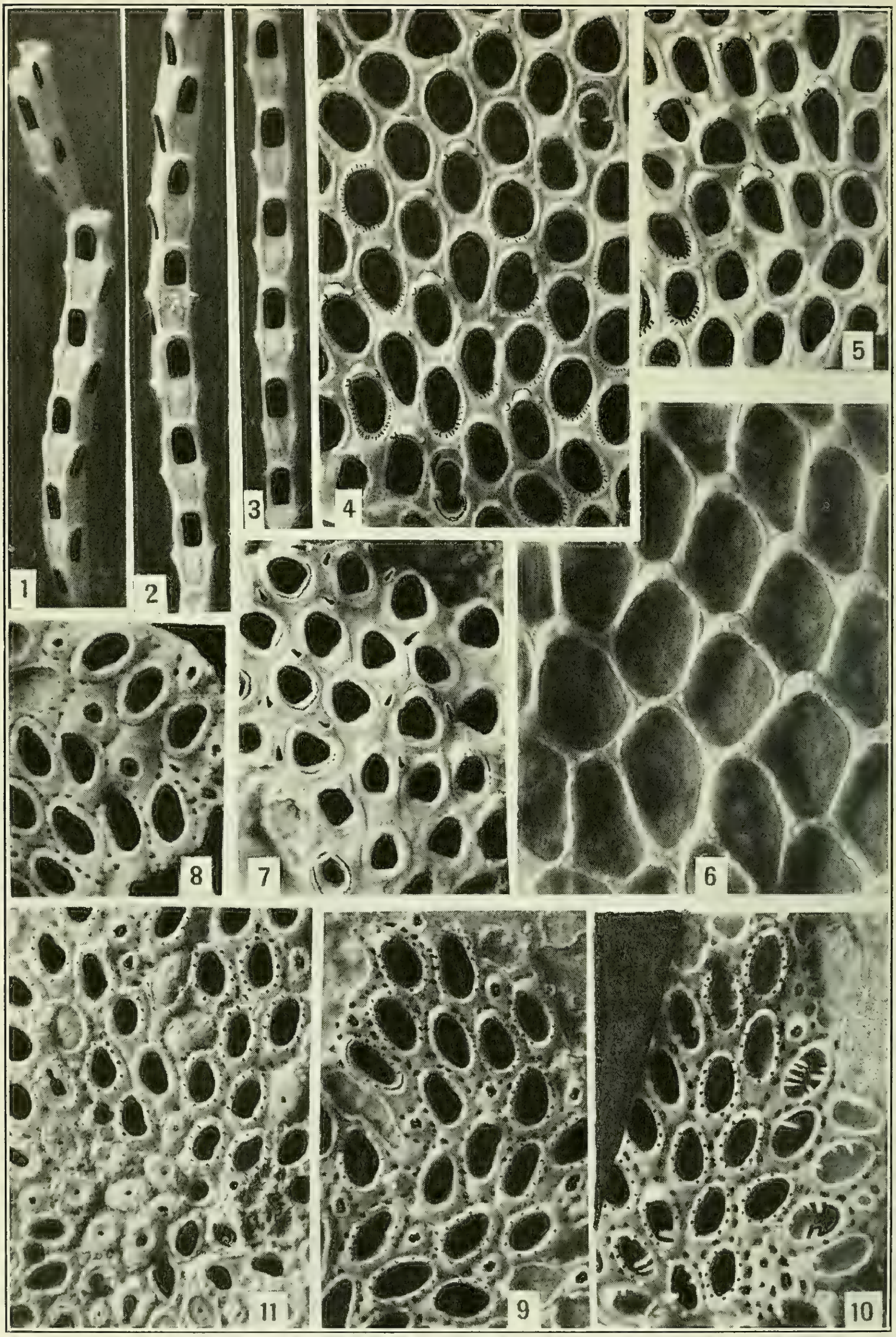


BRYOZOA OF THE GULF OF MEXICO REGION

FOR DESCRIPTION SEE PAGE FACING

Plate 2

Page

Figs. 1–3. *Quadricellaria caraibica*, new species 17

1. Segment showing side with small cells and articulation with another segment; × 20.

2, 3. Two segments exhibiting side with large cells; × 20.

Albatross Station D. 2136, Caribbean Sea.

4, 5. *Aplousina tuberosa*, new species 21

4. Portion of the incrusting zoarium with large zooecia and showing the two tubercles arranged on each side of the ovicell; × 20.

5. Specimen with small zooecia; × 20. Some of the nonovicelled zooecia are tuberose.

Albatross Station D. 2405, Gulf of Mexico.

6. *Aplousina gigantea* Canu and Bassler, 1927 20

The incrusting zoarium showing small endozooecial ovicells; × 20.

Albatross Station D. 2405, Gulf of Mexico.

7. *Membrendoecium strictorostris*, new species 23

Surface of the incrusting zoarium showing ordinary, ovicelled, and regenerated zooecia and the long narrow avicularia; × 20.

Albatross Station D. 2319, north of Cuba.

8–11. *Hincksina periporosa*, new species 22

8. Portion of the incrusting zoarium in which two zooeciules are transformed into monstrous zooecia; × 20.

Albatross Station D. 2405, Gulf of Mexico.

9. Ovicelled zooecia showing also zooeciules and interjunctural pores as well as one regenerated zooecium; × 20.

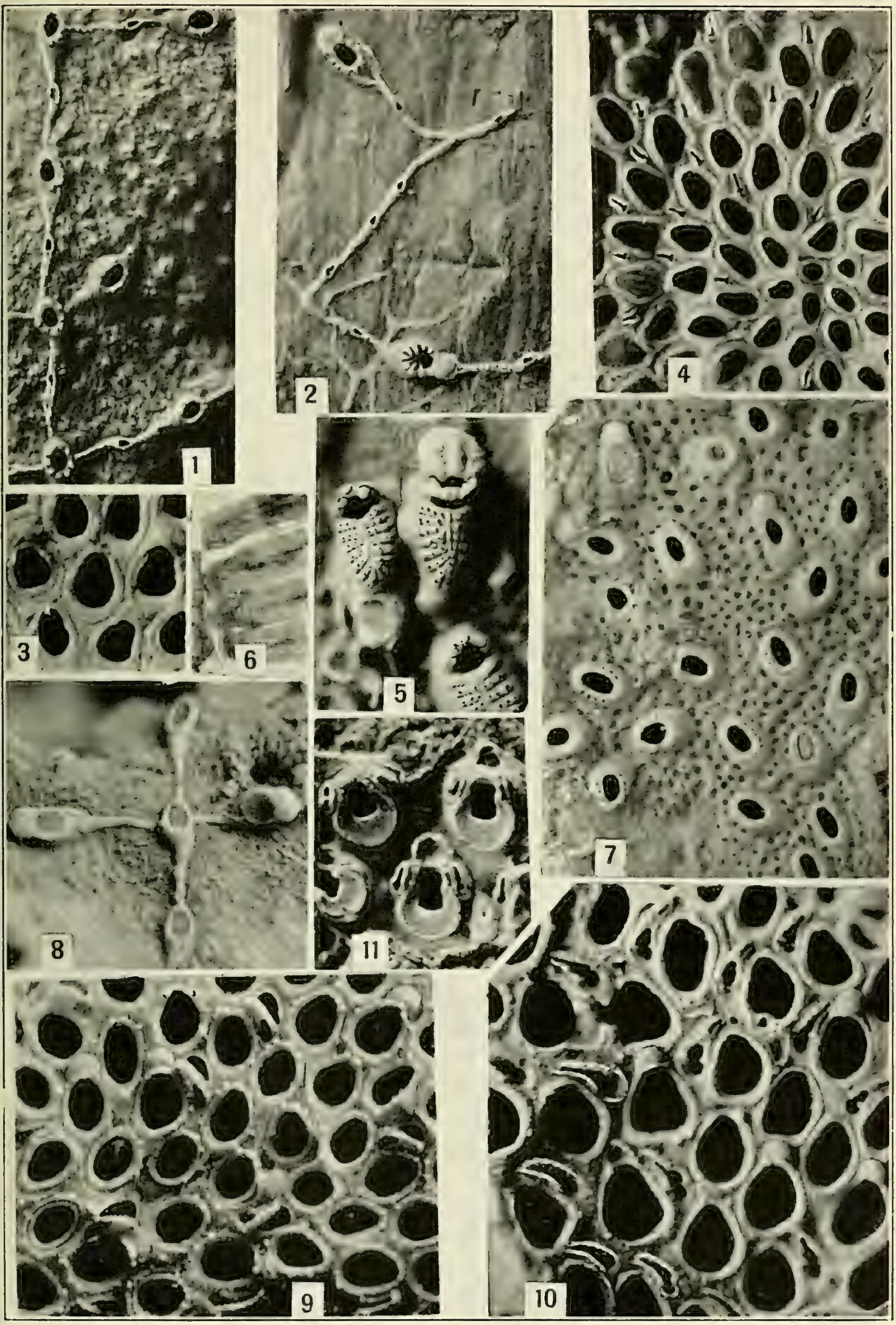
10. Ovicelled and normal zooecia showing the arrangement of the opesial spines.

11. Ancestrula and ancestrular zooecia. Calcified and regenerated zooecia are present; × 20.

Albatross Station D. 2319, north of Cuba.

PLATE 3

		Page
FIGS. 1, 2.	*Marssonopora uncifera*, new species	30
	1. The incrusting zoarium showing the stoloniferous zooeciules; × 20.	
	Albatross Station D. 2319, north of Cuba.	
	2. Specimen showing the unguiculate spines and the independent existence of the stoloniferous zooëciules which can branch among themselves; × 20. The ovicells are hyperstomial.	
	Albatross Station D. 2167, off Habana, Cuba.	
3.	*Alderina irregularis* Smitt, 1873	27
	Normal and ovicelled zooecia; × 20.	
	Albatross Station D. 2405, Gulf of Mexico.	
4.	*Callopora tenuirostris* Hincks, 1880	31
	Portion of the incrusting, ovicelled zoarium showing the ancestrula. The ancestrular zooecia are smaller than the marginal zooecia (not figured); × 20.	
	Albatross Station D. 2639, Straits of Florida.	
5, 6.	*Cribrilina lineata*, new species	38
	5. Incrusting linear branches; × 20.	
	6. View showing structure of the costules; × 85.	
	Albatross Station D. 2152, northwest of Habana Light.	
7.	*Callopora pumicosa*, new species	33
	The incrusting zoarium with some ovicelled and regenerated zooecia; × 20. The zooecia are dispersed over a porous calcareous pellicle.	
	Albatross Station D. 2639, Straits of Florida.	
8.	*Callopora caudata*, new species	34
	The incrusting uniserial zooecia branching at right angles; × 20.	
	Albatross Station D. 2319, north of Cuba.	
9, 10.	*Callopora curvirostris* Hincks, 1861	32
	9. Incrusting zoarium with small zooecia, some of which are regenerated; × 20. The falciform avicularia are embedded in special zooecia.	
	Albatross Station D. 2167, off Habana, Cuba.	
	10. Ovicelled zoarium with large zooecia; ×20.	
	Albatross Station D. 2319, north of Cuba.	
11.	*Antropora pustulata*, new species. (See also pl. 16, fig. 12.)	24
	Zooecia; ×20.	
	Albatross Station D. 2321, north of Cuba.	



BRYOZOA OF THE GULF OF MEXICO REGION

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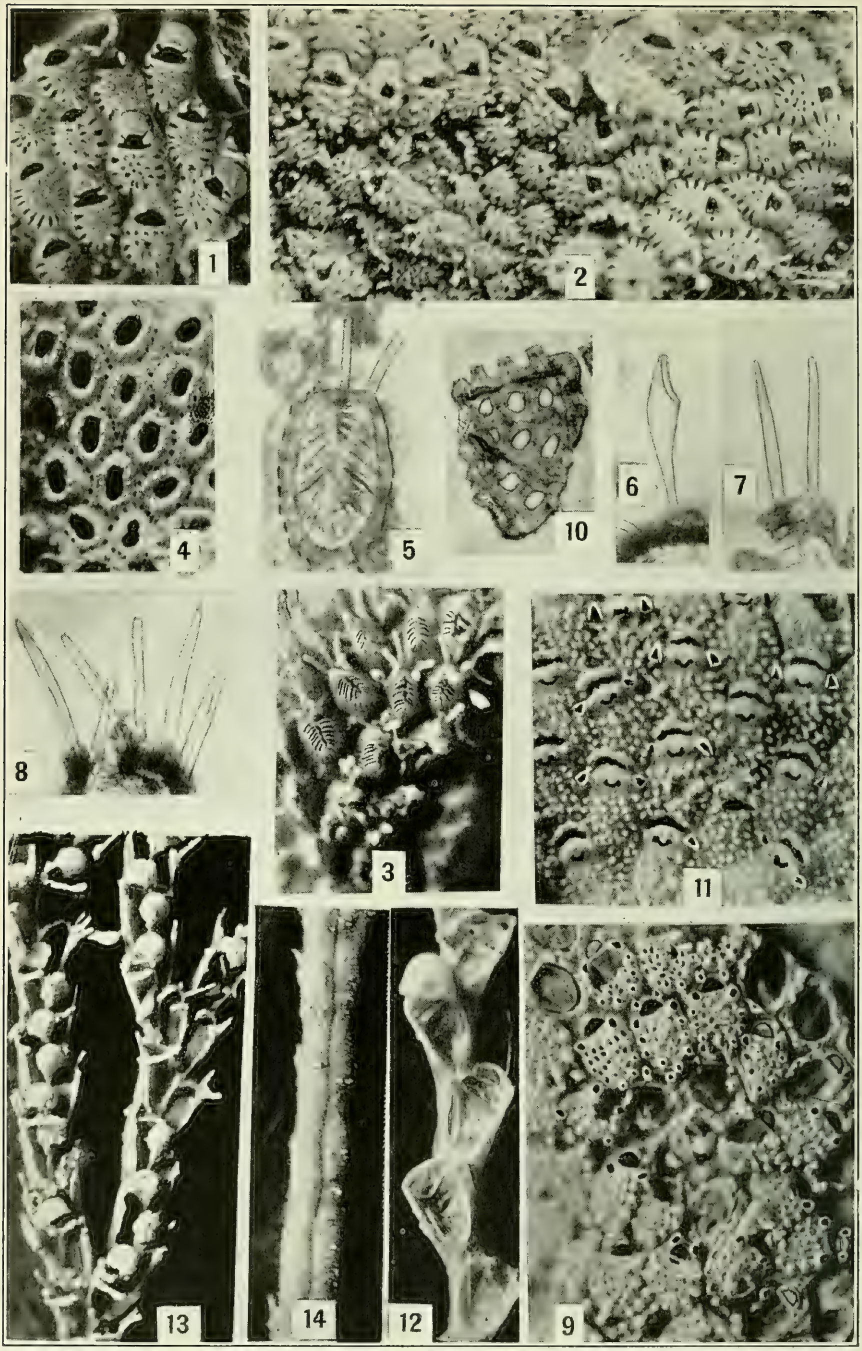


BRYOZOA OF THE GULF OF MEXICO REGION

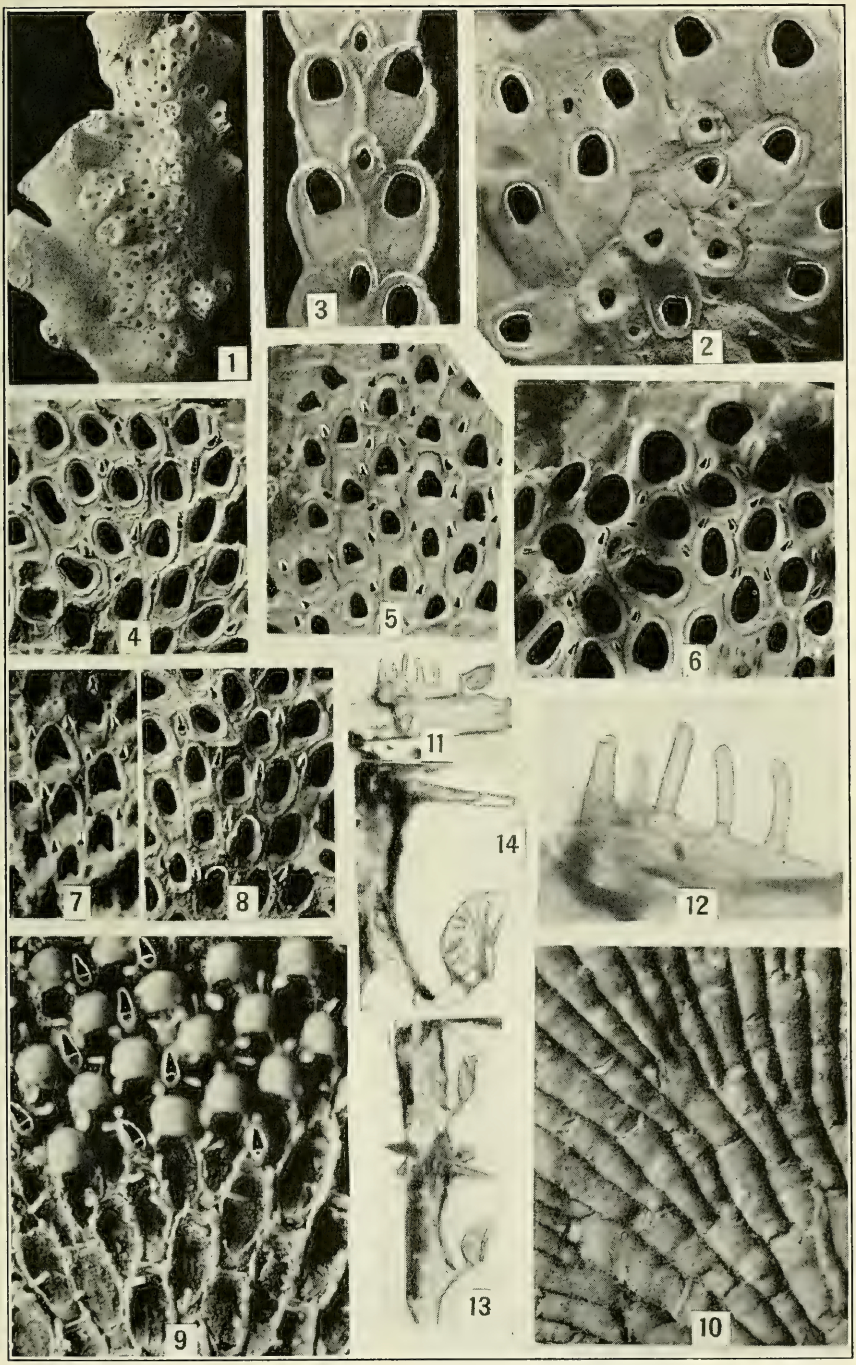
FOR DESCRIPTION SEE PAGE FACING

PLATE 4

		Page
FIGS. 1, 2.	*Membraniporella petasus,* new species	36
	1. Ovicelled specimen with smooth costules; × 20.	
	Albatross Station D. 2319, north of Cuba.	
	2. The incrusting zoarium showing ancestrular zooecia with thickened costules; × 20.	
	Albatross Station D. 2167, off Habana, Cuba.	
3–8.	*Cauloramphus opertus,* new species.	35
	3. Specimen with ectocyst, covered by its opesial spines; × 20.	
	4. Same specimen after boiling in Javelle water; × 20.	
	5. A zooecium viewed by transparency showing the opesium covered with opesial spines; × 50.	
	6. View showing structure of pedunculate avicularium; × 85.	
	7, 8. Views showing structure of distal spines; × 85.	
	Albatross Station D. 2405, Gulf of Mexico.	
9, 10.	*Acanthocella clypeata,* new species	39
	9. The broken part of the frontal showing the presence of the ectocyst under the costules and the membraniporoid structure of the zooecia; × 20.	
	10. A portion of the frontal showing the structure of the costules. The lumen line has much thickened walls; × 85.	
	Albatross Station D. 2373, Gulf of Mexico.	
11.	*Gephyrotes spinosum,* new species	29
	The incrusting zoarium illustrating spinous aspect of surface; × 20.	
	Albatross Station D. 2319, north of Cuba.	
12.	*Halophila johnstoniae* Gray, 1843	42
	An ovicelled branch with the ectocyst altered in drying.	
	Albatross Station D. 2405, Gulf of Mexico.	
13, 14.	*Bugula avicularia* Linnaeus, 1758	41
	13. Anterior face; × 20.	
	14. Posterior face; × 20.	
	Albatross Station 2392, Gulf of Mexico.	

Plate 5

		Page
Figs. 1–3.	*Rectonychocella abyssicola* Smitt, 1873	53
	1. Incrusting zoarium, × 3, showing free vincularian expansions.	
	2. A portion of the same zoarium in the vicinity of the ancestrula; × 20.	
	3. Zooecia, × 20, of another zoarium, some distance from the ancestrula.	
	Albatross Station D. 2152, northwest of Habana Light.	
4–8.	*Dacryonella typica*, new species	57
	4. Ordinary zooecia of the incrusting zoarium; × 20.	
	5. Group of small zooecia on an ovicelled specimen; × 20.	
	6. Extremity of a zoarium showing the great irregularity of the marginal zooecia; × 20.	
	7. Group of zooecia with large opesiular indentations; × 20.	
	8. Another group of zooecia; × 20.	
	Albatross Stations D. 2319, and D. 2320, north of Cuba.	
9–14.	*Dendrobeania lamellosa*, new species	41
	9. Anterior face of an ovicelled frond; × 20.	
	10. Posterior face showing the mode of branching; × 20.	
	11, 12. Structure of articulated opesial spines; × 25 and × 85.	
	13, 14. Structure of the pedunculated avicularium; × 25 and × 50.	
	Albatross Station D. 2354, east of Yucatan.	



BRYOZOA OF THE GULF OF MEXICO REGION

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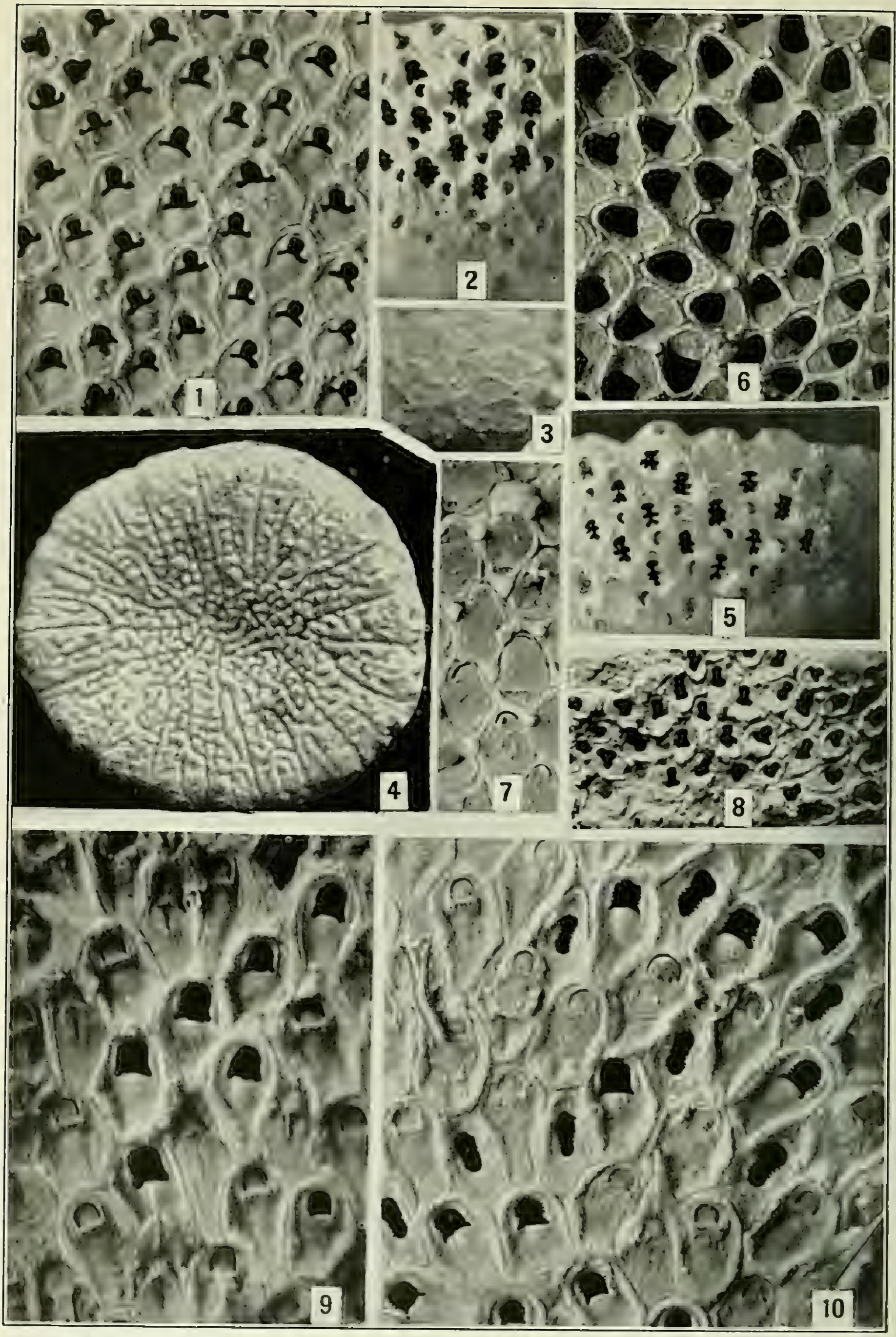


BRYOZOA OF THE GULF OF MEXICO REGION

FOR DESCRIPTION SEE PAGE FACING

Plate 6

Page

Fig. 1. *Floridina antiqua* Smitt, 1873 60

The incrusting zoarium showing typical features; × 20.

Albatross Station D. 2405, Gulf of Mexico.

2–5. *Cupularia doma* D'Orbigny, 1852 64

2. Lateral view of a colony having few initial zooecia; × 20.
3. Superior view (apex) of a colony with initial zooecia; × 20. There are eight zooecia around the ancestrula.
4. Tuberose base of a colony; × 20.
5. Lateral view of a colony having numerous initial cells; × 20.

Albatross Station D. 2639, Straits of Florida.

6, 7. *Floridinella typica*, new species 59

6. The incrusting zoarium, × 20, with ectocyst removed.
7. Zooecia covered by ectocyst and showing the interzooecial tuberosities; × 20. The opercular valve is supported on the mural rim.

Atlantic Ocean, 15 miles south of Miama, Fla.

8. *Floridinella parvula*, new species 59

The incrusting zoarium showing the small trifoliate zooecia; ×20.

Albatross Station 2639, Straits of Florida.

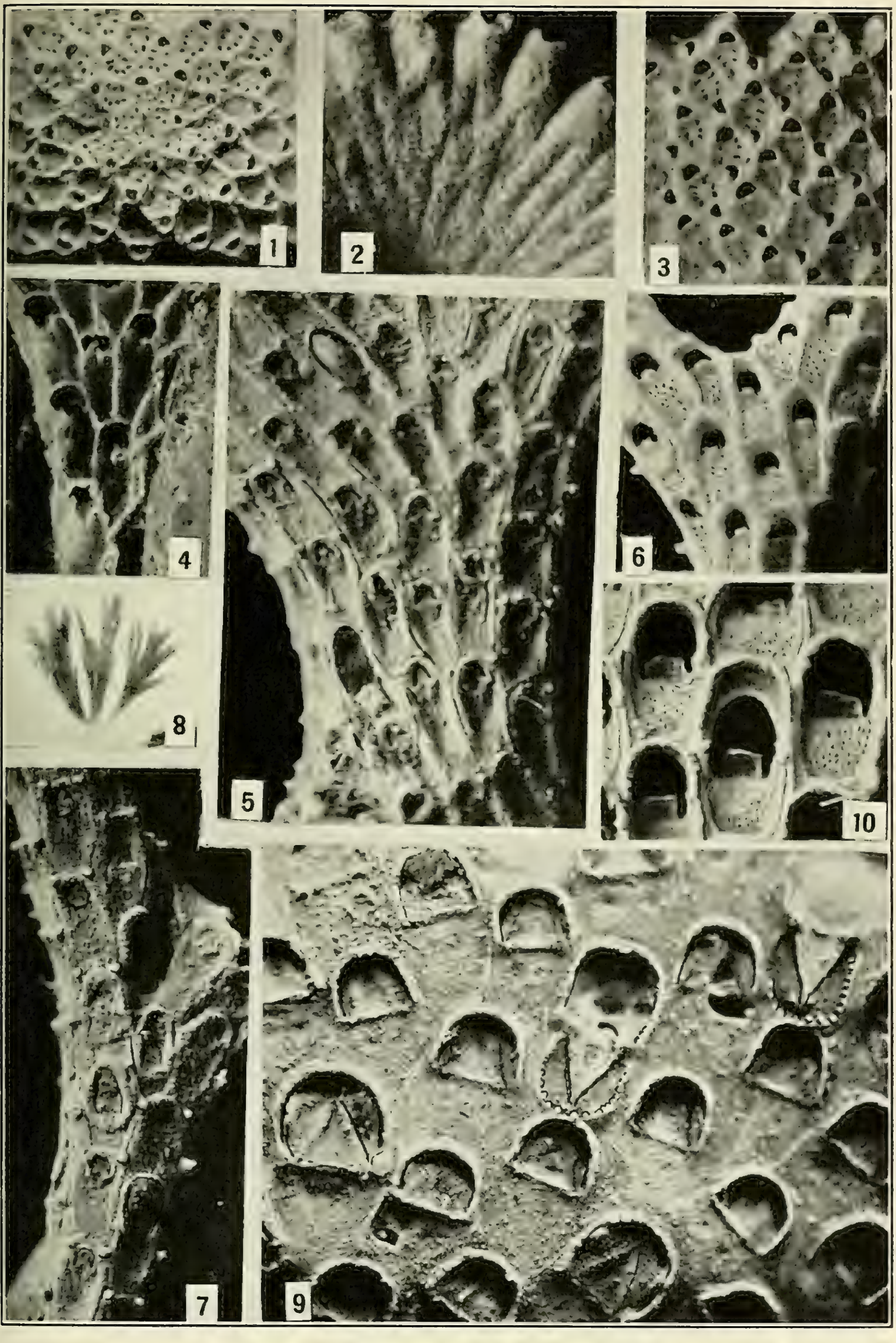
9, 10. *Velumella americana*, new species 54

9. The incrusting zoarium with ovicells; × 20. Sometimes the onychocellaria have lost their mandibles.
10. Zoarium in which many of the zooecia are covered by the ectocyst; × 20.

Albatross Station D. 2405, Gulf of Mexico.

PLATE 7

		Page
FIGS. 1–3.	*Cupularia umbellata* Defrance, 1823	64
	1. Hydrostatic zooecia; × 20.	
	2. Interior face; × 20.	
	3. Marginal zooecia; × 20.	
	Florida Keys, Gulf of Mexico.	
4–7.	*Siphonoporella dumonti*, new species	68
	4. Interior of a colony, showing the oblique position of the polypidian tube; × 20.	
	5. A compressed frond with the ectocyst preserved. The B zooecium has the opercular mandible; × 20.	
	6. Cylindrical specimen without ectocyst showing the place of the polypidian tube (=siphon) B zooecium with opercular mandible present; × 20.	
	7. Cylindrical specimen with ectocyst; × 20.	
	Albatross Station D. 2405, Gulf of Mexico.	
8–10.	*Steganoporella magnilabris* Busk, 1854	64
	8. Photograph of the retractor muscles; × 85.	
	9. Specimen with ectocyst; × 20. The small symmetric concavities of the ectocyst indicate the place of the opesiular muscles.	
	10. Zooecia, × 20, without ectocyst.	
	Atlantic Ocean, Fowey Light, 15 miles south of Miami, Fla.	



BRYOZOA OF THE GULF OF MEXICO REGION

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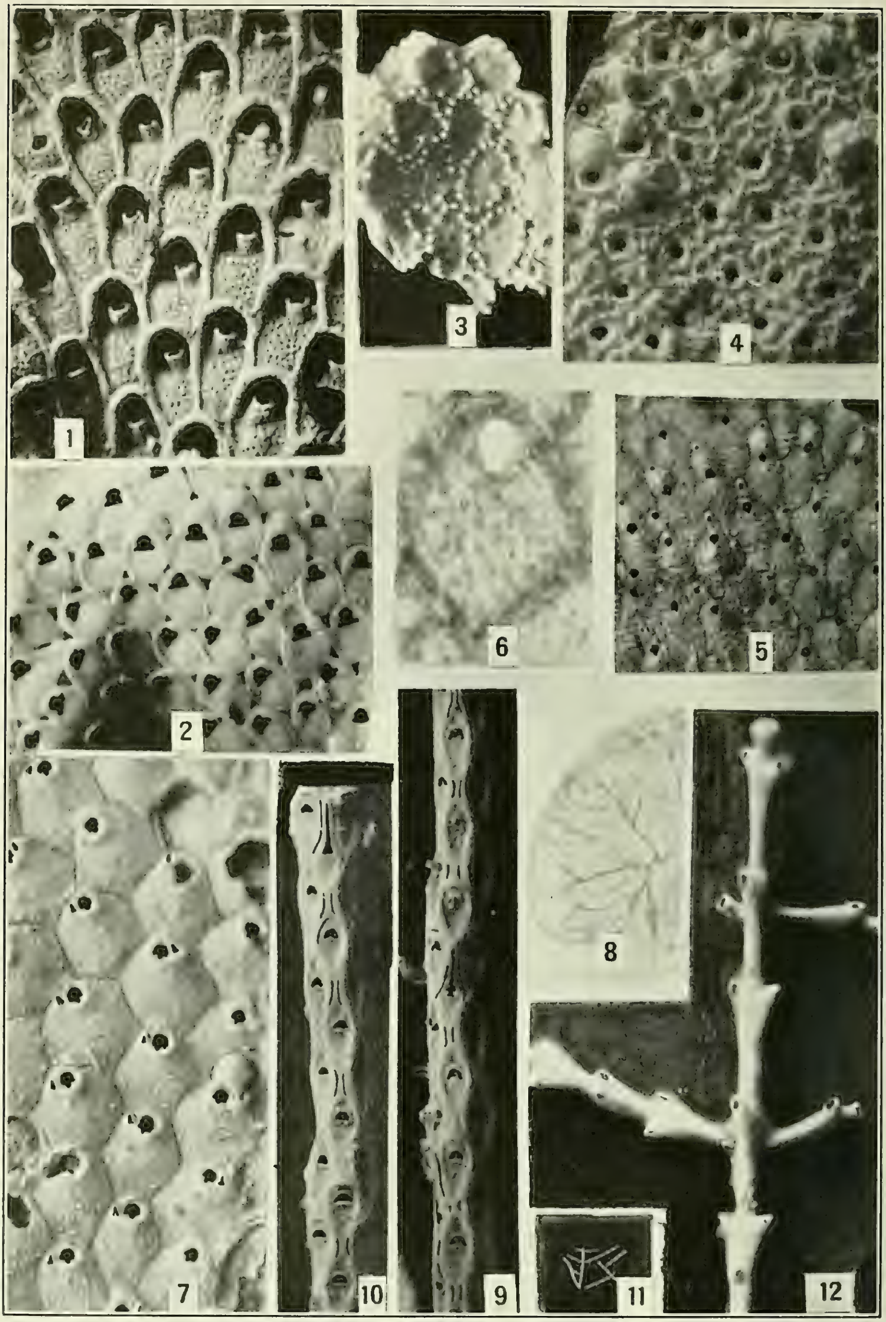


BRYOZOA OF THE GULF OF MEXICO REGION

FOR DESCRIPTION SEE PAGE FACING

Plate 8

		Page
Fig. 1.	*Siphonoporella granulosa*, new species	69
	The incrusting zoarium illustrating the granular cryptocyst; × 20.	
	Atlantic Ocean, 15 miles south of Miami, Fla.	
2, 3.	*Mollia patellaria* Smitt, 1873	69
	2. The incrusting zoarium with normal and ovicelled zooecia; × 20.	
	3. Inferior face showing the small tuberosities bearing the small radicular fibers; × 20.	
	Albatross Station D. 2405, Gulf of Mexico.	
4.	*Buffonellaria reticulata*, new species	89
	The incrusting zoarium with ovicelled zooecia and showing the reticulation of the zooecial frontal; × 20.	
	Albatross Station D. 2405, Gulf of Mexico.	
5, 6.	*Trypostega venusta* Norman, 1864	77
	5. The incrusting zoarium with ovicelled zooecia; × 20.	
	6. A zooecium viewed by transparency and showing the structure of the frontal and the form of the aperture; × 85.	
	Albatross Station D. 2405, Gulf of Mexico.	
7, 8.	*Buffonellaria divergens* Smitt, 1873	88
	7. Surface of the incrusting zoarium; × 20.	
	8. Structure of the frontal, an olocyst with radial fibers; × 85.	
	Albatross Station D. 2167, off Habana, Cuba.	
9–10.	*Cellaria nodosa*, new name	72
	9. Portion of a segment showing the large avicularium; × 20.	
	10. Fragment of an ovicelled segment; × 20. The nodosity bears the much larger ovicelled zooecium.	
	Albatross Station D. 2388, Gulf of Mexico.	
11–12.	*Pasythea eburnea* Smitt, 1873	151
	Principal and secondary branches; × 1 and 20.	
	Albatross Station D. 2331, north of Cuba.	

Plate 9

Page

FIGS. 1–4. *Schizopodrella incrassata,* new species ---------- 93

1. Fragment of a colony with two coalescent fronds; × 6
2. Group of ovicelled zooecia in the middle of a frond; × 20.
3. Young zooecia at the extremity of a branch; × 20.
4. Zooecia viewed by transparency, × 85, showing the tremopores and the frontal structure.

Albatross Station D. 2405, Gulf of Mexico.

5\. *Gemelliporidra aculeata,* new species ---------- 102

The incrusting zoarium; × 20.

Fowey Light, 15 miles south of Miami, Fla.

6\. *Hippodiplosia pertusa* Esper, 1794 ---------- 106

Incrusting specimen with several ovicelled zooecia. Some of the cells have preserved their opercula; × 20.

Albatross Station D. 2362, east of Yucatan.

7\. *Hippoporina cleidostoma* Smitt, 1873 ---------- 104

Incrusting specimen showing the variations of the aperture and the avicularia; × 20.

Albatross Station D. 2405, Gulf of Mexico.

8\. *Hippadenella floridana,* new species ---------- 105

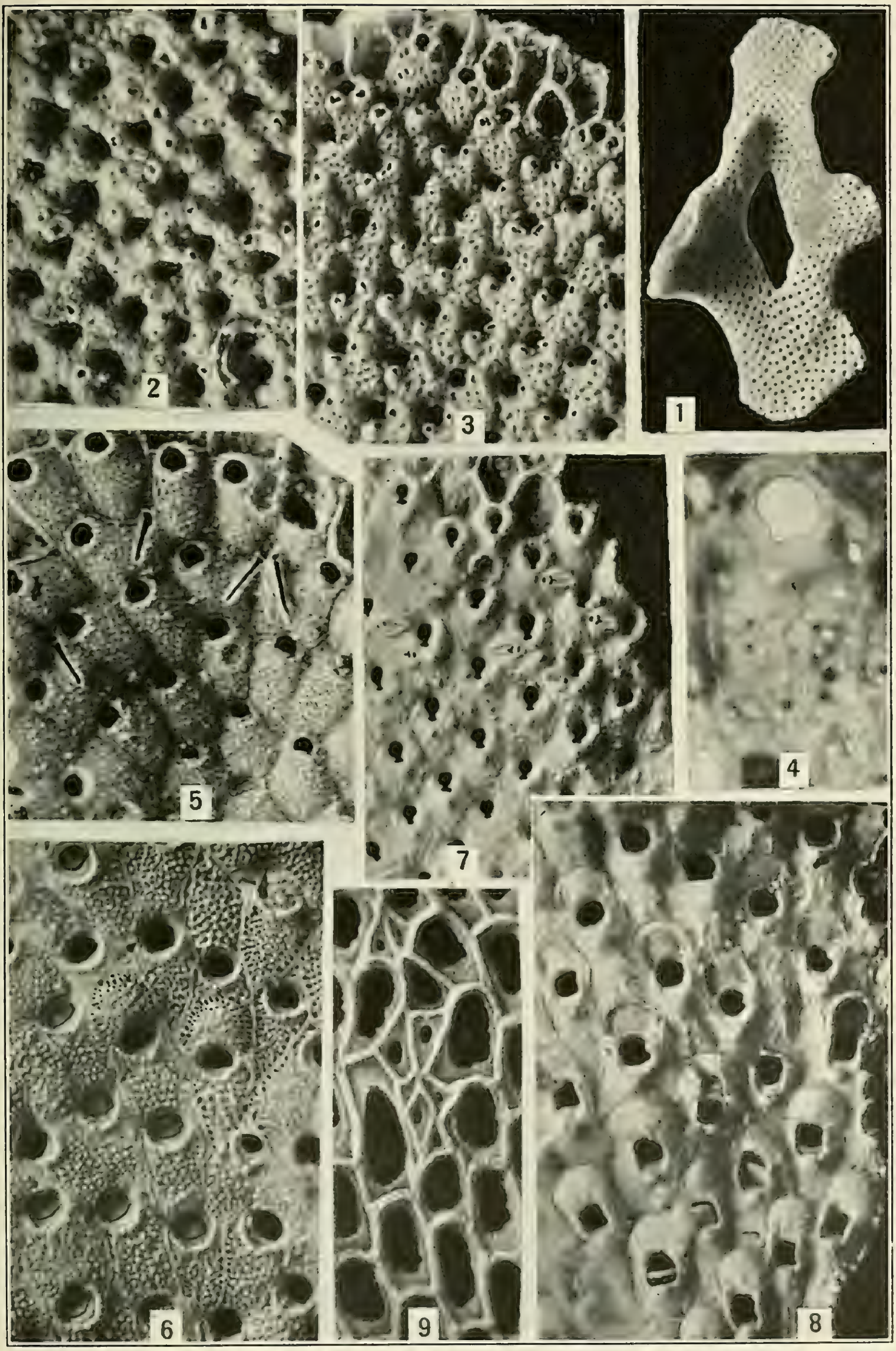
Incrusting specimen, × 20, showing the median avicularian chamber. The thick ectocyst hides the areolar pores.

Cedar Keys, Fla.

9\. *Hemiseptella denticulata* Smitt, 1872 ---------- 62

A specimen, × 20, exhibiting some deformed zooecia.

Punta Rosa, Fla.



BRYOZOA OF THE GULF OF MEXICO REGION

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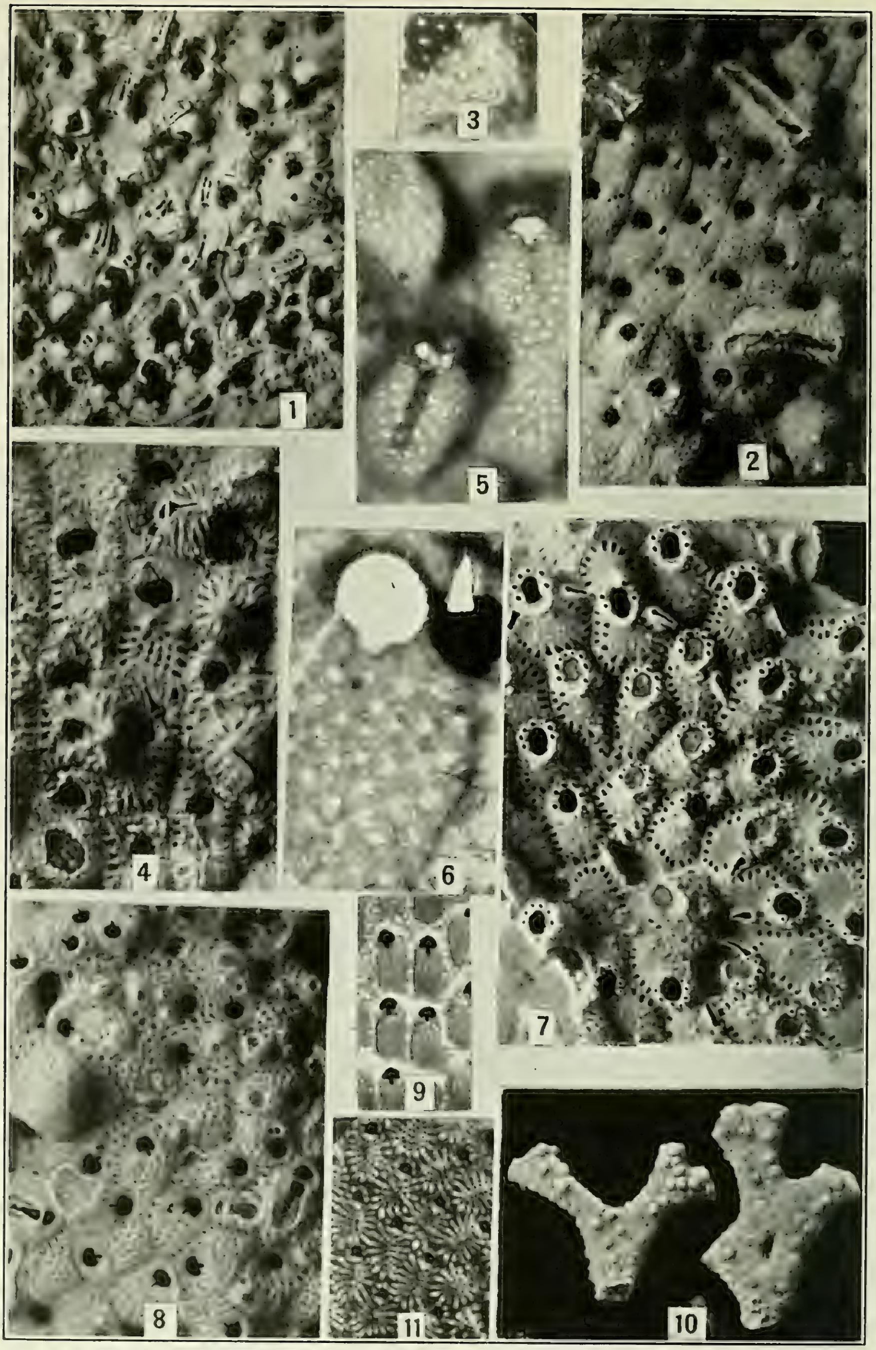


BRYOZOA OF THE GULF OF MEXICO REGION

FOR DESCRIPTION SEE PAGE FACING

PLATE 10

		Page
Fig. 1.	*Gemelliporella asper* Canu and Bassler, 1923	90
	Ovicelled incrusting colony; × 20.	
	Albatross Station D. 2322, north of Cuba.	
2, 3.	*Schizopodrella falcifera*, new species	95
	2. Incrusting specimen, × 20, exhibiting the small avicularia and the sporadic large falciform ones.	
	3. Structure of the frontal; × 85.	
	Albatross Station D. 2365, east of Yucatan.	
4–6.	*Schizopodrella floridana* Osburn, 1914	93
	4. Surface of zoarium; × 20, with ovicelled and nonovicelled zooecia.	
	5. Structure of the frontal; × 40. The tentacular sheath is visible in one zooecium.	
	6. Frontal of zooecial; × 85.	
	Albatross Station D. 2363, east of Yucatan.	
7.	*Hippomenella rubra*, new species	108
	Incrusting ovicelled specimen; × 20. Some of the cells are operculated.	
	Albatross Station D. 2405, Gulf of Mexico.	
8–10.	*Stylopoma spongites* Pallas, 1766	91
	8. Group of nonoriented cells on a bilamellar frond; × 20.	
	9. Interior showing the form of aperture and absence of condyles; × 20.	
	10. Bilamellar fronds; × 2.	
	Albatross Station D. 2405, Gulf of Mexico.	
11.	*Puellina radiata* Moll, 1803	73
	Ordinary zooecia; × 20.	
	Albatross Station D. 2650, Bahama Islands.	

Plate 11

Page

Figs 1–4. *Gemelliporidra typica,* new species 100

1. Multilamellar ovicelled specimen much calcified, showing a transverse spatulate avicularium; × 20.

Albatross Station D. 2330, north of Cuba.

2. Unilamellar specimen; × 20, with opercula in some zooecia.

Albatross Station D. 2390, north of Cuba.

3. Interior; × 20, showing the aperture removed from the distal border of the zooecium.

4. Frontal viewed by transparency, showing the true form of the aperture: × 20.

Albatross Station D. 2167, off Habana, Cuba.

5–11. *Gemelliporidra magniporosa* Canu and Bassler, 1923 103

5. Incrusting specimen; × 20, with regularly oriented zooecia. The avicularia are erect.

6. Unilamellar specimen; × 20, showing the formation of inverted zooecia.

7. Unilamellar specimen with giant zooecia; × 20.

Albatross Station D. 2169, off Habana, Cuba.

8. Structure of the frontal; × 85.

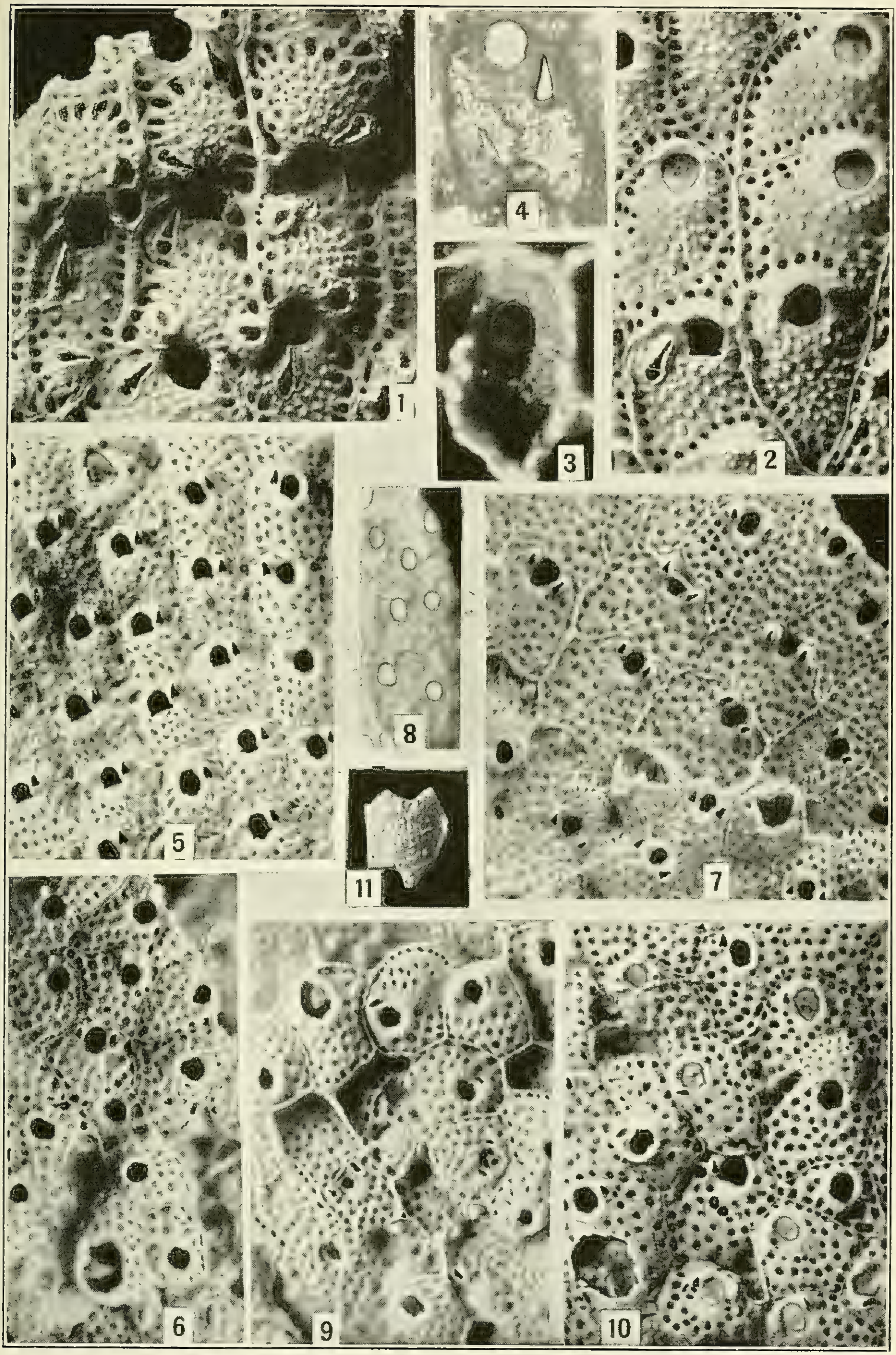
9. Multilamellar example; × 20, with inverted zooecia.

Albatross Station D. 2362, east of Yucatan.

10. Unilamellar ovicelled specimen; × 20. Some apertures have preserved their opercula.

11. Zoarium, natural size.

Albatross Station D. 2157, off Habana, Cuba.



Bryozoa of the Gulf of Mexico Region

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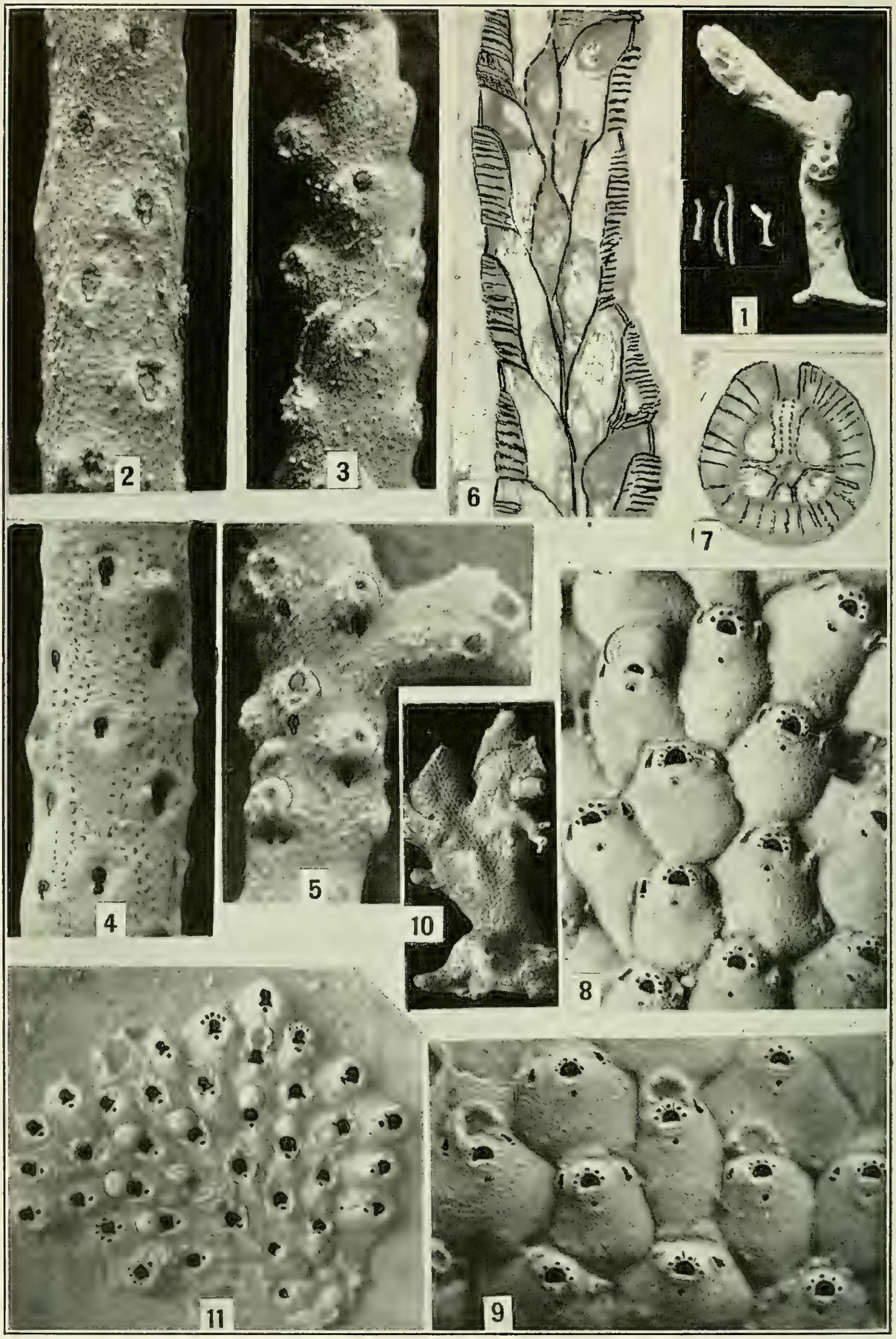


BRYOZOA OF THE GULF OF MEXICO REGION

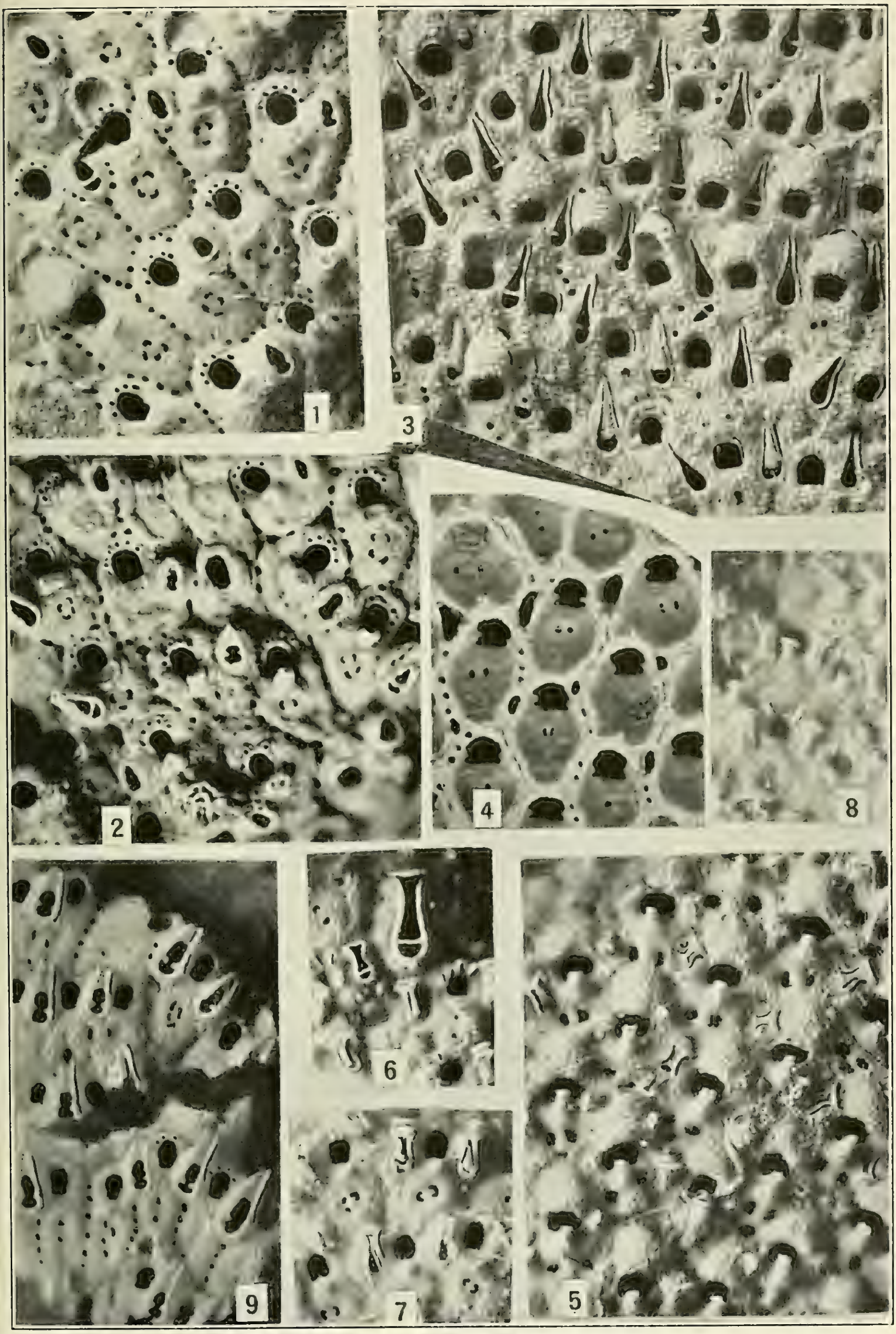
FOR DESCRIPTION SEE PAGE FACING

Plate 12

		Page
Figs. 1–7.	*Gemellipora glabra* Smitt, 1873	98
	1. Fragment, natural size and base of a branching colony; × 6.	
	2. Example; × 20, with ectocyst and opercula preserved.	
	3. Extremity of a young branch, × 20, with ectocyst.	
	4. Specimen without ectocyst, showing the frontal pores; × 20	
	5. Ovicelled specimen; × 20, showing the median cicatrix of the ovicell.	
	6. Longitudinal thin section; × 25.	
	7. Transverse thin section through the plane of an aperture; × 25.	
	Fowey Light, 15 miles south of Miami, Fla., and *Albatross* Station D. 2405, Gulf of Mexico.	
8–10	*Microporella ampla*, new species	
	8. Incrusting ovicelled specimen; × 20.	
	9. Another portion of the same exhibiting the great variations of the zooecial width; × 20.	111
	10. Encrusting zoarium, natural size.	
	Albatross Station D. 2152, 2½ miles northwest of Habana, Cuba.	
11.	*Lepralia palliolata*, new species	109
	The incrusting type specimen; × 20.	
	Albatross Station D. 2639, Straits of Florida.	

Plate 13

		Page
Figs 1, 2.	*Tremogasterina ventricosa*, new species	47
	1. Incrusting ovicelled specimen with long zooecia; × 20.	
	2. Portion of the same zoarium; × 20, in which the zooecia are broad and the pleurocyst is thick.	
	Albatross Station D. 2672, Atlantic, east of Georgia.	
3, 4.	*Tremogasterina granulata*, new species	45
	3. Portion of a unilamellar, much calcified colony. The frontal pore is little apparent and hidden by the pleurocyst; × 20.	
	4. Interior showing the two apertural cardelles and the frontal pores; × 20.	
	Fowey Light, 15 miles south of Miami, Fla.	
5–8.	*Tremogasterina malleolus*, new species	48
	5. Unilamellar, ovicelled zoarium showing the mandible in place; × 20.	
	6. A large avicularium replacing a zooecium. The distal spines are large. The mucron is much dilated at its extremity.	
	7. Frontal of several zooecia showing the form and the arrangement of the frontal pores.	
	8. Portion of an unilamellar zoarium; × 20, showing the large distal spines.	
	Albatross Station D, 2404, Gulf of Mexico.	
9.	*Tremogasterina lanceolata*, new species	48
	Fragments of the unilamellar zoarium; × 20. The pleurocyst is thick.	
	Albatross Station C. 2320, north of Cuba.	



BRYOZOA OF THE GULF OF MEXICO REGION

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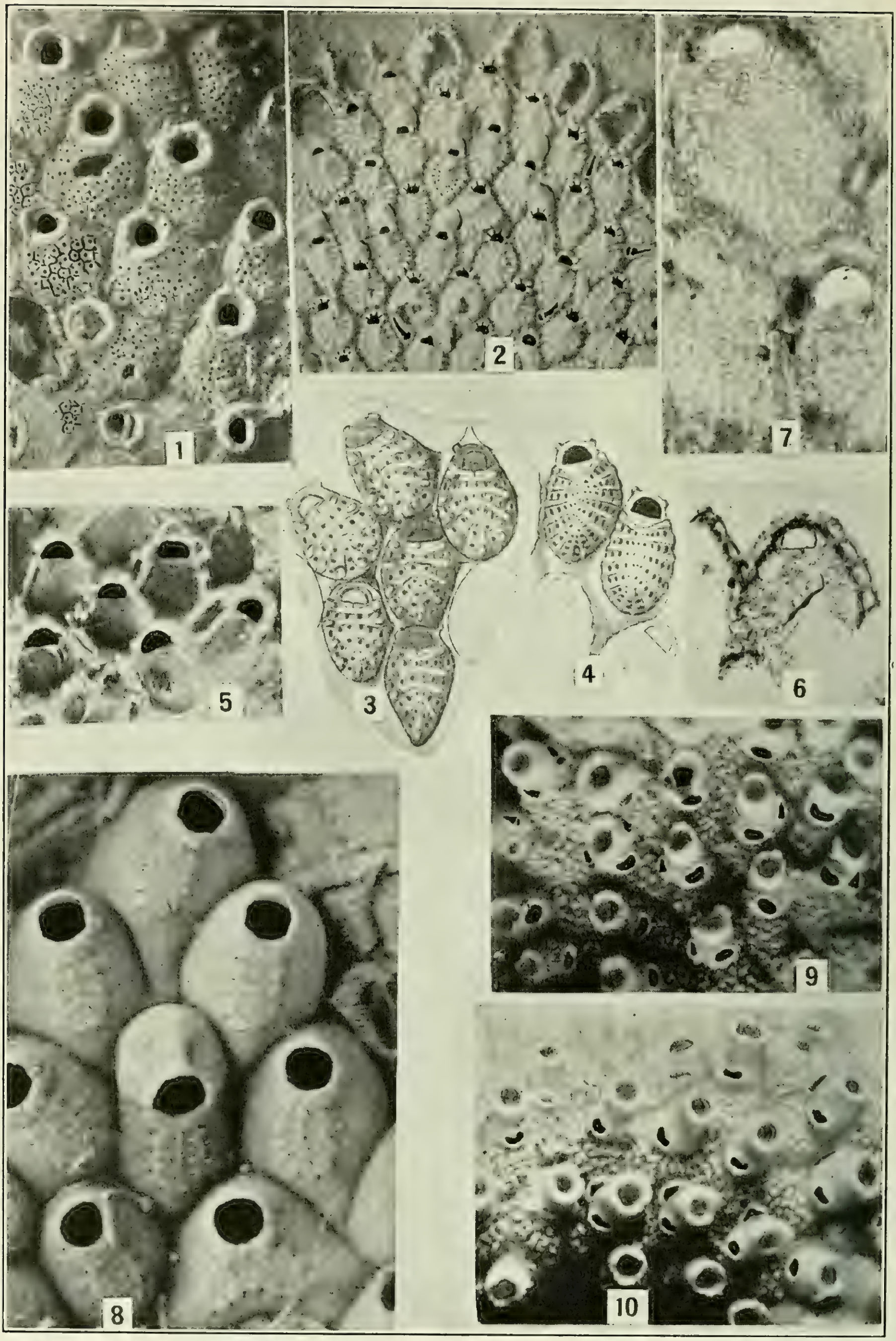


BRYOZOA OF THE GULF OF MEXICO REGION

FOR DESCRIPTION SEE PAGE FACING

PLATE 14

Page

FIG. 1. *Exechonella pumicosa,* new species ---------- 70

Zooecia of the incrusting zoarium; × 20.

Fowey Light, 15 miles south of Miami, Fla.

2. *Puellina innominata* Couch, 1844 ---------- 73

Zoarium, × 20, showing the tuberosities surrounding each zooecium.

Albatross Station D. 2405, Gulf of Mexico.

3–7. *Puellina floridana* Smitt, 1873 ---------- 74

3, 4. Zoarial surfaces, × 20 (after Smitt, 1873).

5. Interior; × 20. The costules are not visible.

6. Zooecium, × 50, seen by transparency, illustrating arrangement of dietellae.

7. Thin section, × 85, showing structure of the frontal.

Albatross Station D. 2405, Gulf of Mexico.

8. *Figularia* (?) *ampla,* new species ---------- 75

The incrusting type specimen; × 20.

Albatross Station D. 2167, off Habana, Cuba

9, 10. *Stenopsis fenestrata* Smitt, 1873 ---------- 84

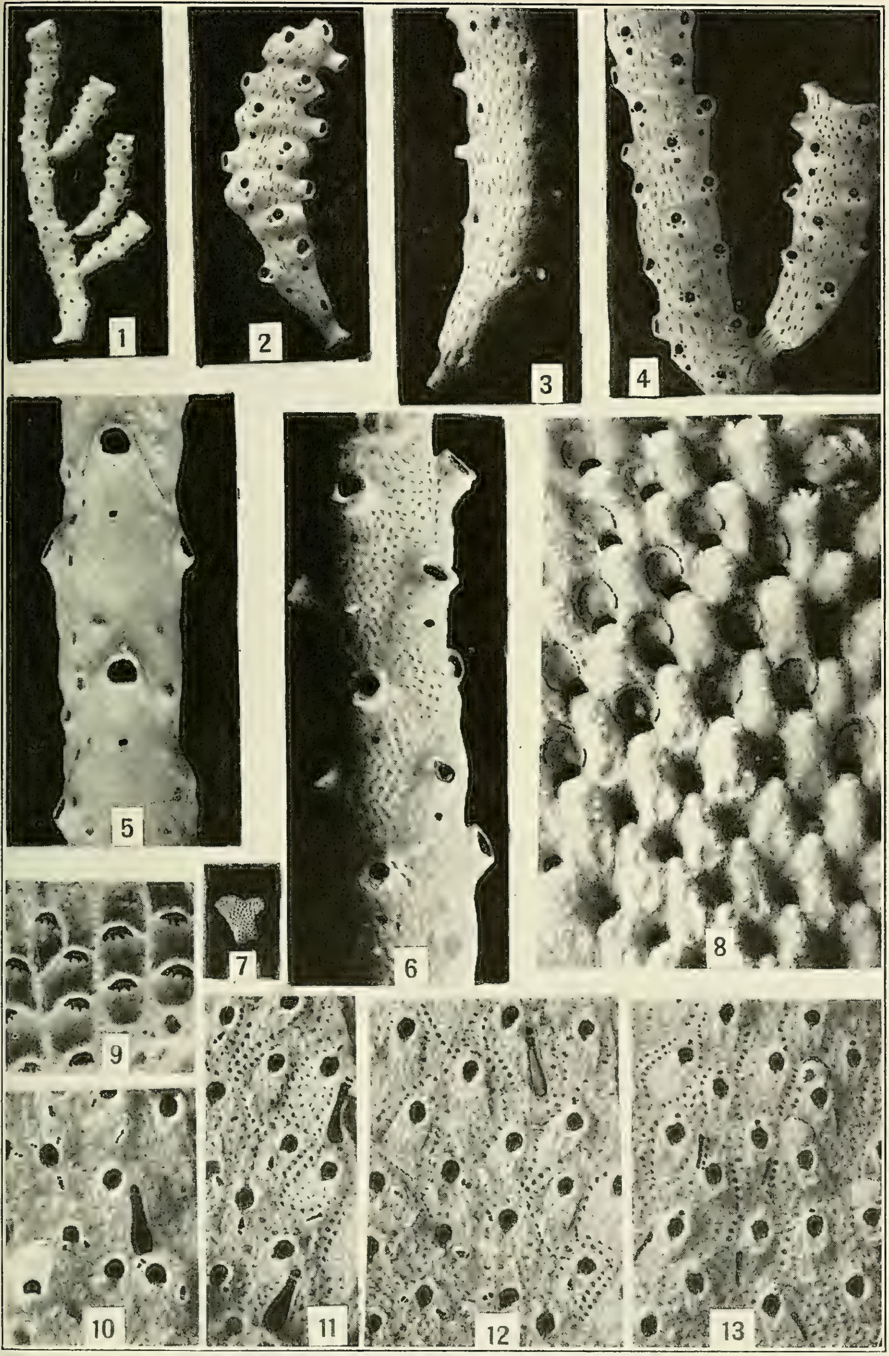
9. The incrusting zoarium, × 20, showing the great length of the peristomie.

10. Another view of the same; × 20.

Albatross Station D. 2405, Gulf of Mexico.

Plate 15

		Page
Figs. 1–4.	*Semihaswellia sinuosa*, new species	85
	1. A segment with its branches; × 6.	
	2. Ovicelled segment; × 20.	
	3. Dorsal of a segment, × 20, showing the longitudinal sulci and the small sporadic avicularia.	
	4. Portion of a segment showing the chitinous articulation of a branch on a basis ramae.	
	Albatross Station D. 2392, Gulf of Mexico.	
5.	*Tessaradoma gracile* Sars, 1850, variety	86
	Portion of a branch, × 20, exhibiting large dimensions.	
	Albatross Station D. 2117, Caribbean Sea.	
6.	*Tubucellaria cereoides* Ellis and Solander, 1786	113
	Portion of a segment; × 20.	
	Fowey Light, 15 miles south of Miami, Fla.	
7, 8.	*Cystisella americana*, new species	113
	The bilamellar ovicelled type specimen, natural size and surface; × 20.	
	Albatross Station D. 2387, Gulf of Mexico.	
9–13.	*Smittina trispinosa spathulata* Smitt, 1873	114
	9. Interior, × 20, showing the arrangement of the lyrule and the cardelles at the same level.	
	10, 11. Two variations, × 20, showing form of the large spathulated avicularium.	
	12. Surface of unilamellar specimen, × 20, with avicularia long and very thin. There are small avicularia around the aperture.	
	13. Unilamellar ovicelled specimen, × 20, with long thin avicularia and without spathulated avicularia.	
	Fowey Light, 15 miles south of Miami, Fla.	



BRYOZOA OF THE GULF OF MEXICO REGION

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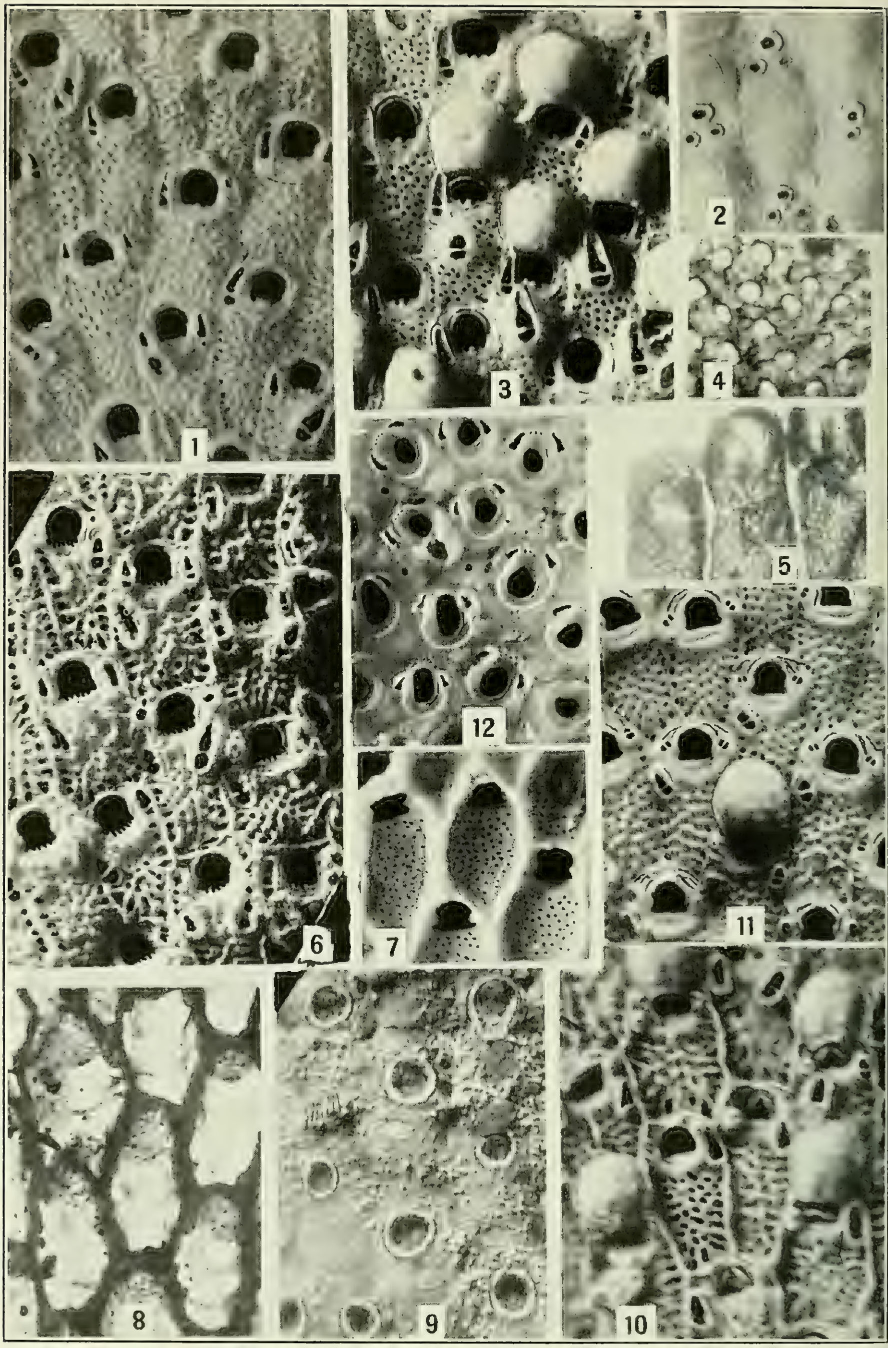


BRYOZOA OF THE GULF OF MEXICO REGION

FOR DESCRIPTION SEE PAGE FACING

Plate 16

	Page
Figs. 1–5. *Petraliella bisinuata* Smitt, 1873	78

1. Surface of the unilamellar zoarium; × 20.
2. Inner face; × 20. The radicular septules (cribriform areas of Waters) are placed in the distal portion of the cells.

Albatross Station D. 2405, Gulf of Mexico.

3. Operculated and ovicelled zooecia; × 20. The lyrule and the cardelles are placed above the operculum.
4. Structure of the frontal; × 85.
5. Frontal viewed by transparency; × 20. The distal border of the operculum is visible. It is much chitinized. The operculum has no proximal limit but unites with the posterior walls of the compensatrix.

Albatross Station D. 2363, east of Yucatan.

6–11. *Petraliella marginata*, new species	80

6. Unilamellar specimen, much calcified; × 20. The apertural avicularia are unequally developed and sometimes deformed by the large frontal avicularia.
7. Interior, × 20, showing the two condyles of rotation of the operculum, and the tremopores.
8. Dorsal, viewed by transparency, × 20, showing the structure of the radicular septules (cribriform areas of Waters).
9. Interior face of a unilamellar specimen; × 20. The radicular septules are large.
10. Ovicelled zooecia much calcified; × 20. The separating threads are quite salient. There are no frontal avicularia and the apertural avicularia are very large.

Albatross Station D. 2405, Gulf of Mexico.

11. Unilamellar specimen, ovicelled; × 20. The large avicularium is lacking or little developed.

Albatross Station D. 2366, Gulf of Mexico, off Yucatan.

12. *Antropora pustulata*, new species. (*See also* pl. 3, fig. 11.)	24

The incrusting zoarium, × 20, showing the interzooecial pustules.

Albatross Station D. 2167, off Habana, Cuba.

Plate 17

Page

Figs. 1–5. *Mucronella egyptiaca* Waters, 1909 ---------- 118

1, 2. Cylindrical unilamellar specimen, natural size, and surface; × 20.

3. View of the dorsal by transparency showing the biserial arrangement of the zooecia; × 25.

4. A similar view of the frontal, × 25, exhibiting the areolar pores.

5. A zooecium of 4, × 85, showing the false tremopores formed in the pleurocyst and not perforating the frontal.

Albatross Station D. 2389, Gulf of Mexico.

6–10. *Smittina labellum*, new species ---------- 116

6, 7. Zooecia of the unilamellar zoarium, × 20, showing the quite variable position of the large avicularium.

8. Incrusting ovicelled specimen, × 20, with spathulated avicularia.

Albatross Station D. 2339, north of Cuba.

9. Unilamellar ovicelled zoarium, × 20, with elongated zooecia. The lyrule is not visible.

10. Structure of the frontal; × 85.

Fowey Light, 15 miles south of Miami, Fla.

11–13. *Umbonula undulata*, new species ---------- 119

11. The bilamellar zoarium, natural size.

12. Zooecia, × 20, with umbo little salient and a few avicularia presence.

13. Zooecia, × 20, illustrating the salient avicularian umbo and absence of avicularia.

Cedar Keys, Fla.

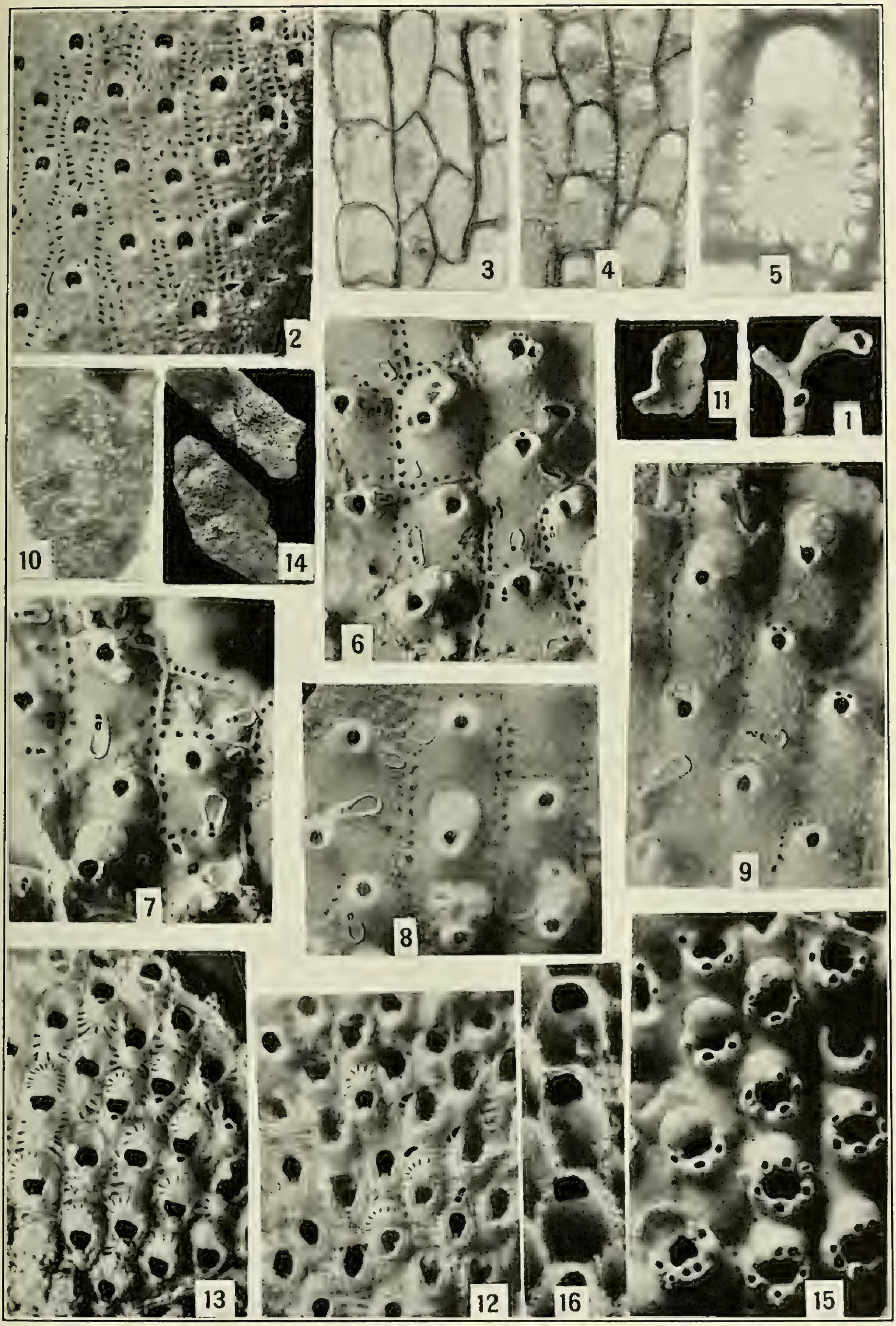
14–16. *Palmicellaria aviculifera*, new species ---------- 118

14. The incrusting zoarium, natural size.

15. Zooecia; × 20.

16. Interior showing the true form of the aperture; × 20.

Albatross Station D. 2650, Bahama Islands.



Bryozoa of the Gulf of Mexico Region

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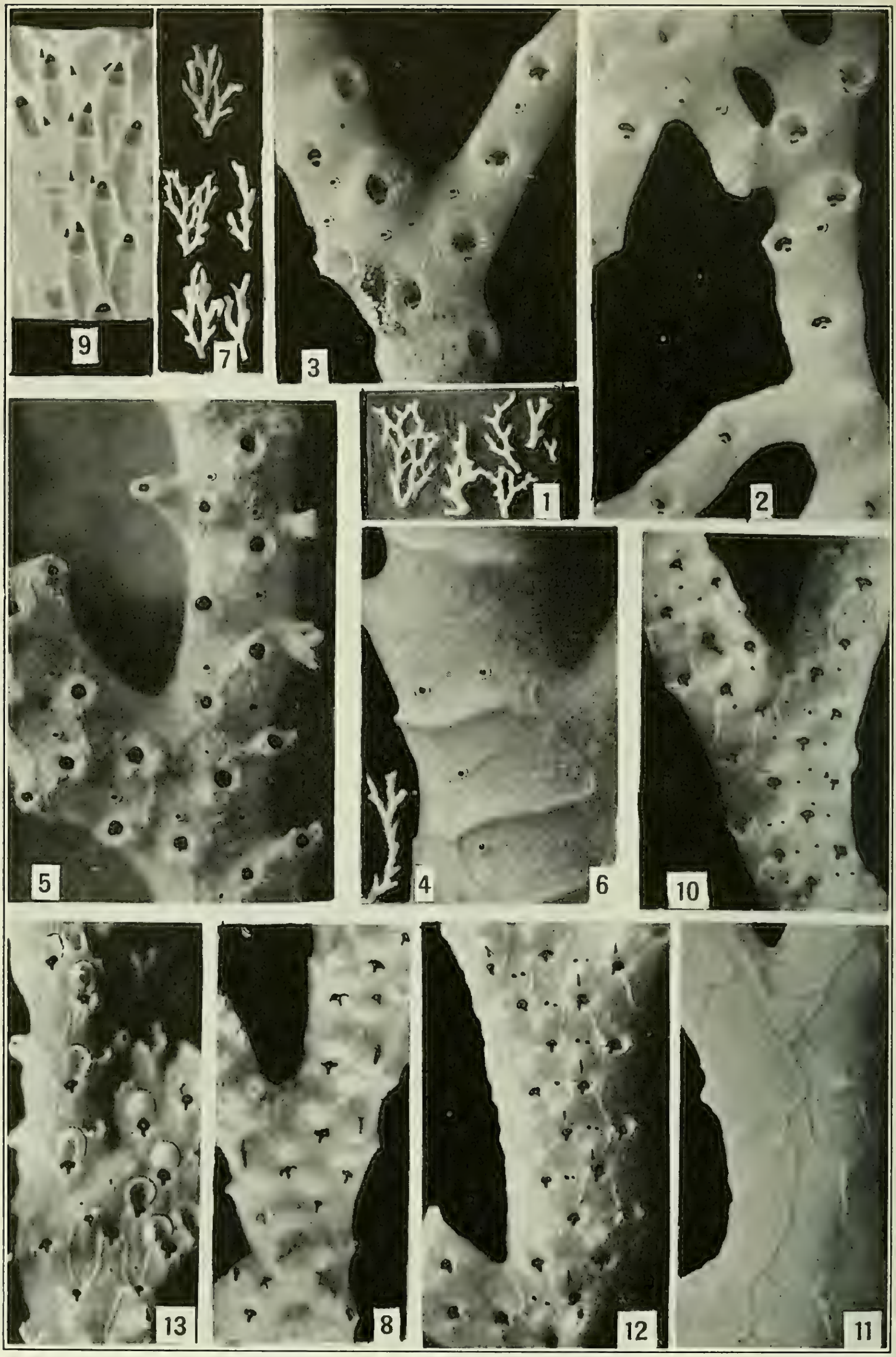


BRYOZOA OF THE GULF OF MEXICO REGION

FOR DESCRIPTION SEE PAGE FACING

Plate 18

		Page
Figs. 1–3.	*Bryocryptella reticulata*, new species	121
	1. Zoarial fragments, natural size.	
	2. Fragment of a zoarium; × 20. The distal border of the apertural avicularium bears a lyrule.	
	3. Ovicelled fragment of the same colony; × 20.	
	Albatross Station D. 2343, north of Cuba.	
4–6.	*Reteporella prominens*, new species	124
	4. Fragment, natural size.	
	5. Cellular face; × 20.	
	6. Noncellular face of the same colony; × 20.	
	Albatross Station D. 2354, east of Yucatan.	
7–13.	*Retepora marsupiata* Smitt, 1873	122
	7. Fragmentary zoaria, natural size.	
	8. Ovicelled branch; × 20. Three zooecia have a large frontal avicularium.	
	9. Interior; × 20. The peristomie is very long and is not perforated by a reteporidan pore.	
	10. Zoarial surface; × 20. The frontal is decorated with very small round avicularia.	
	11. Noncellular face showing the arrangement of vibices; × 20.	
	Albatross Station D. 2411, Gulf of Mexico.	
	12. Ovicelled branch; × 20. There is one cell (at base) with a large avicularium.	
	13. Branch showing the structure of the ovicell; × 20.	
	Albatross Station D. 2117, Caribbean Sea.	

Plate 19

Page

Figs. 1–4. *Schizellozoon elongatum*, new species 123

1. Zoarial fragments, natural size.
2. Fragment of a colony with narrow fenestrae, showing the ovicell structure; × 20.
3. Portion of same zoarium, × 20, illustrating the large frontal avicularia.
4. Dorsal face of same showing the vibices; × 20.

Albatross Station D. 2666, western Atlantic.

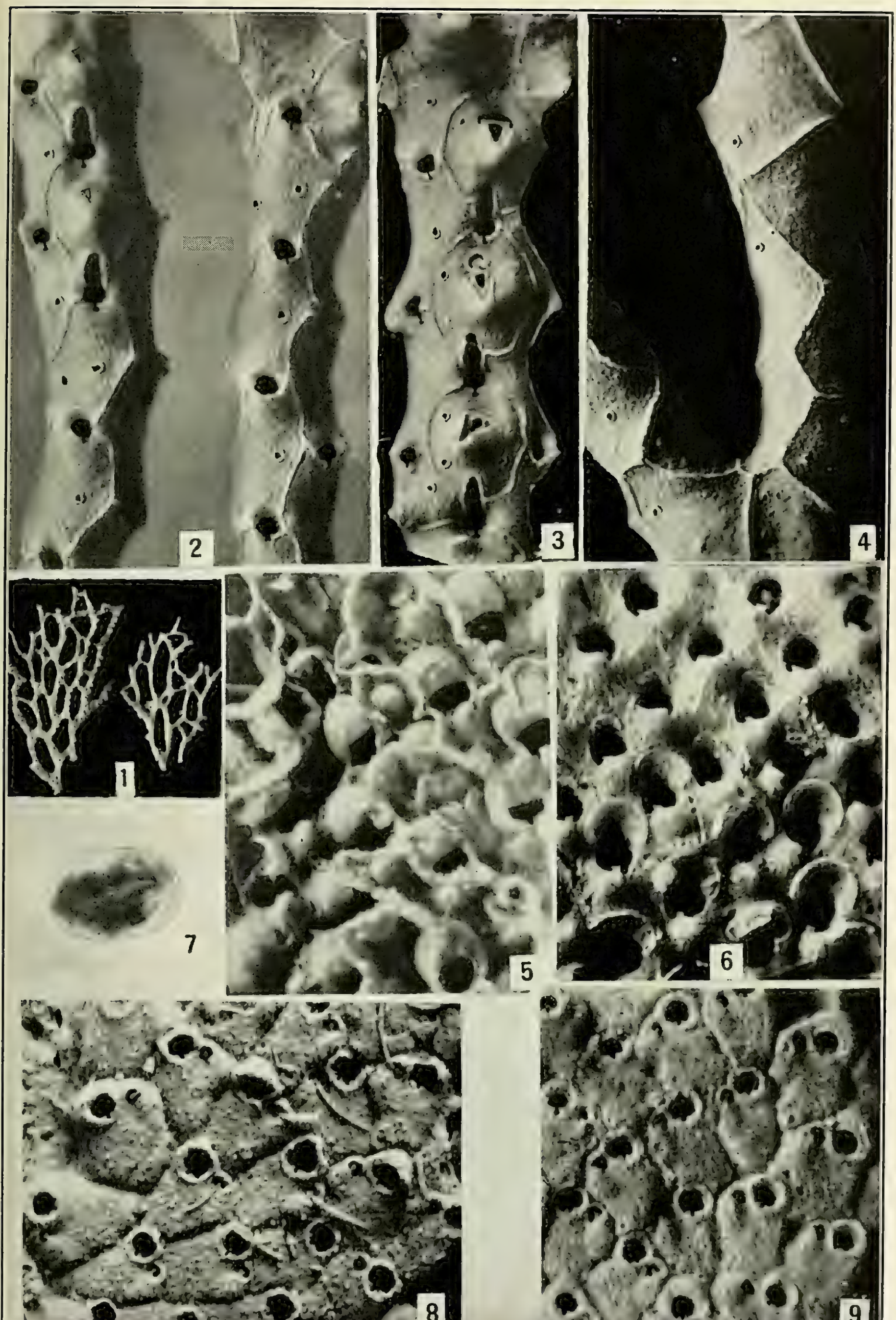
5–7. *Rhamphostomella magnirostris*, new species 120

5. Portion of a bilamellar ovicelled zoarium, with calcified and irregular zooecia; × 20.
6. Bilamellar ovicelled zoarium, × 20, with oriented and regular zooecia. The ectocyst covers the frontal.
7. Operculum, × 85, very much thickened but becoming thin at the border.

Cedar Keys, Fla.

8, 9. *Mastigophora porosa* Smitt, 1873 134

8. Specimen with ectocyst, operculum, and vibraculum; × 20.
9. Incrusting ovicelled specimen without ectocyst; × 20. Fowey Light, 15 miles south of Miami, Fla.



BRYOZOA OF THE GULF OF MEXICO REGION

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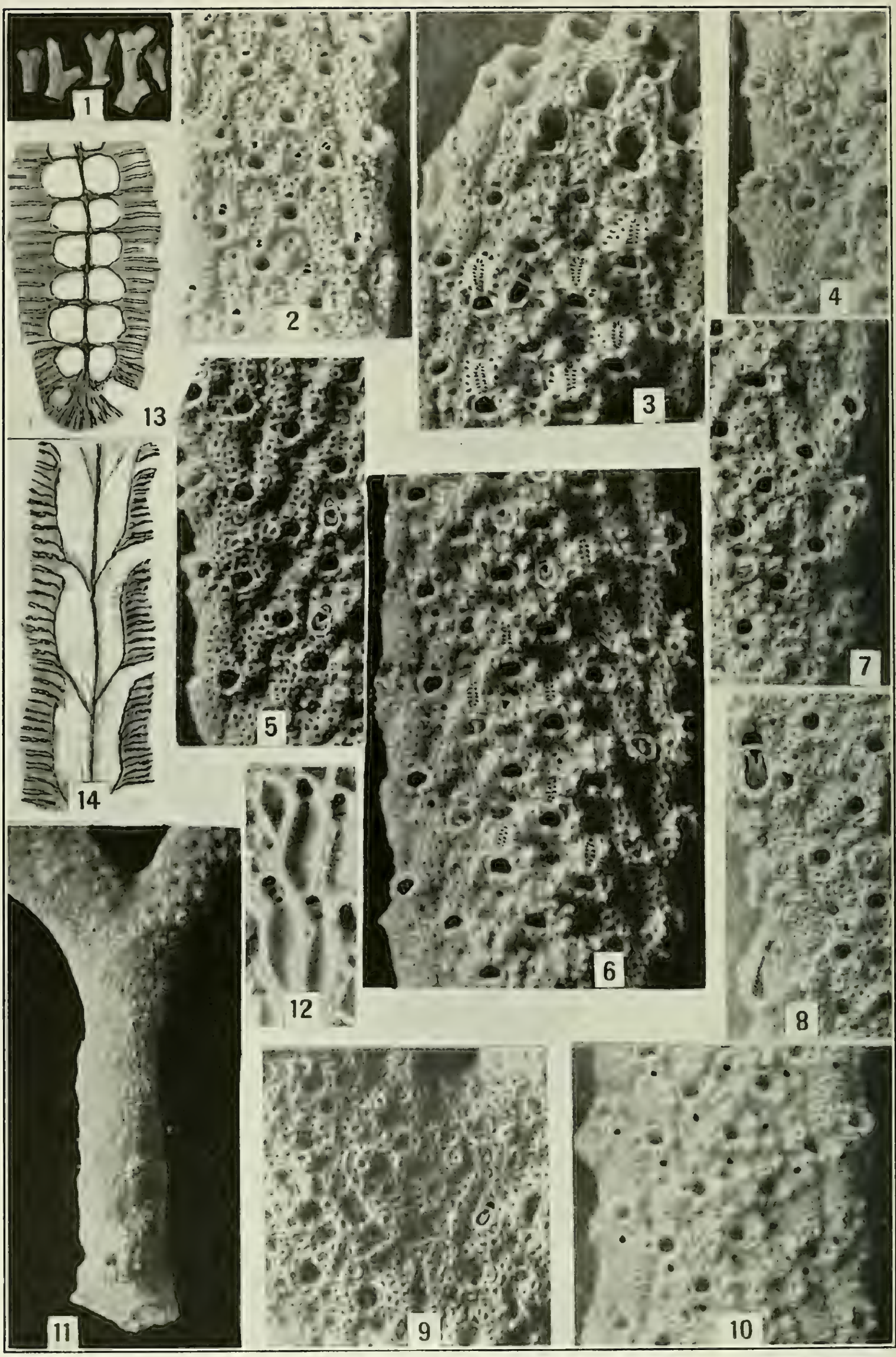


BRYOZOA OF THE GULF OF MEXICO REGION

FOR DESCRIPTION SEE PAGE FACING

PLATE 20

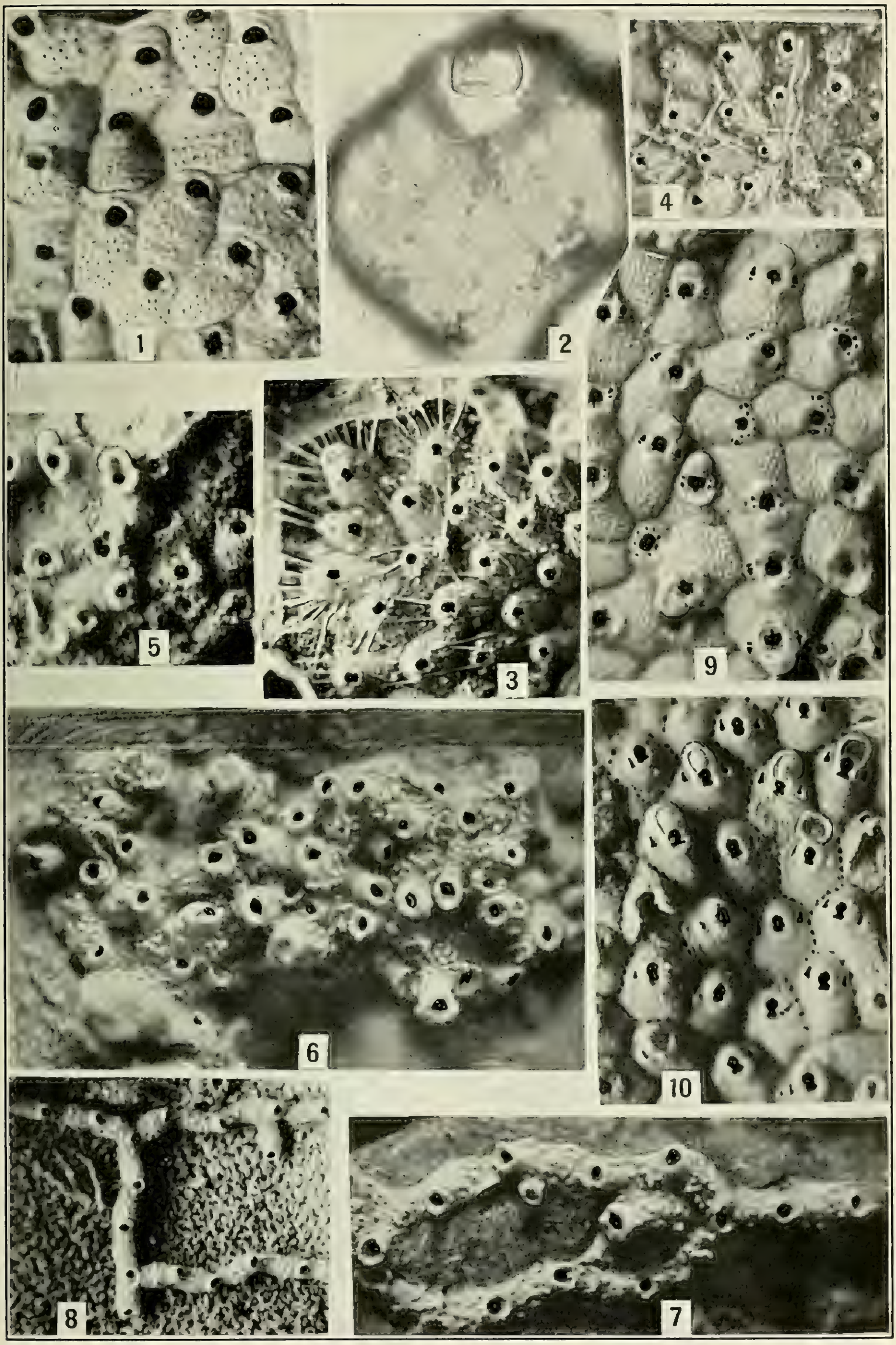
	Page
FIGS. 1–14. *Cigclisula serrulata* Smitt, 1873	125

1. Zoarial fragments, natural size.
2. Surface of the free bilamellar zoarium; × 20. There is a small avicularium above each peristome.
3. Young ovicelled branch, × 20, showing structure of the costulated ovicells.
4. Another branch, × 20, showing that the lateral zooecia do not have a frontal avicularium.
5. An example, × 20, in which the axial zooecia bear a large spatulate frontal avicularium.
6. An adult frond, × 20, illustrating structure of the ovicells.
7. Frond, × 20, showing the great irregularity of the adventitious organs.
8. An example, × 20, in which the lateral zooecia are transformed into large spatulate avicularia.
9. A variation, × 20, with numerous and complicated pores. At the base of this zoarium there are normal zooecia.
10. Surface; × 20. All the zooecia bear a spiramen. The frontal pore opens in the peristomie.
11. Basal part of a zoarium; × 6. The base is little expanded but is concave and prehensile.
12. Interior of zooecia, × 20, showing the spiramen opening into the peristomie.
13. Transverse section, × 25, showing the septules and the great thickness of the frontal walls.
14. Longitudinal section; × 25.

Fowey Light, 15 miles south of Miami, Fla.

Plate 21

	Page
Figs. 1, 2. *Tremoschizodina lata* Smitt, 1873	131
1. Portion of the incrusting zoarium; × 20. The two superior zooecia are ovicelled. The tremocyst is detachable.	
2. Structure of the frontal; × 85.	
Albatross Station D. 2405, Gulf of Mexico.	
3, 4. *Crepidacantha longiseta*, new species	135
3. The incrusting zoarium, × 20, with ovicells.	
4. Another part of the same, × 20, showing ancestrula.	
Albatross Station D. 2169, off Habana, Cuba.	
5–8. *Lagenipora verrucosa*, new species	137
5. Group of ovicelled zooecia; × 20.	
6. Multiserial colony with expanded peristomes; × 20.	
7. Monoserial, reticulated colony; × 20.	
Albatross Station D. 2324, north of Cuba.	
8. A linear monoserial colony; × 12.	
Albatross Station D. 2320, north of Cuba.	
9. *Mastigophora pesanseris* Smitt, 1873	133
The incrusting zoarium, × 20, showing ovicelled and ancestrular zooecia.	
Albatross Station D. 2639, Straits of Florida.	
10. *Crepidacantha setigera* Smitt, 1873	135
An incrusting ovicelled specimen; × 20. Marginal spines are no longer present.	
Albatross Station D. 2639, Straits of Florida.	



BRYOZOA OF THE GULF OF MEXICO REGION

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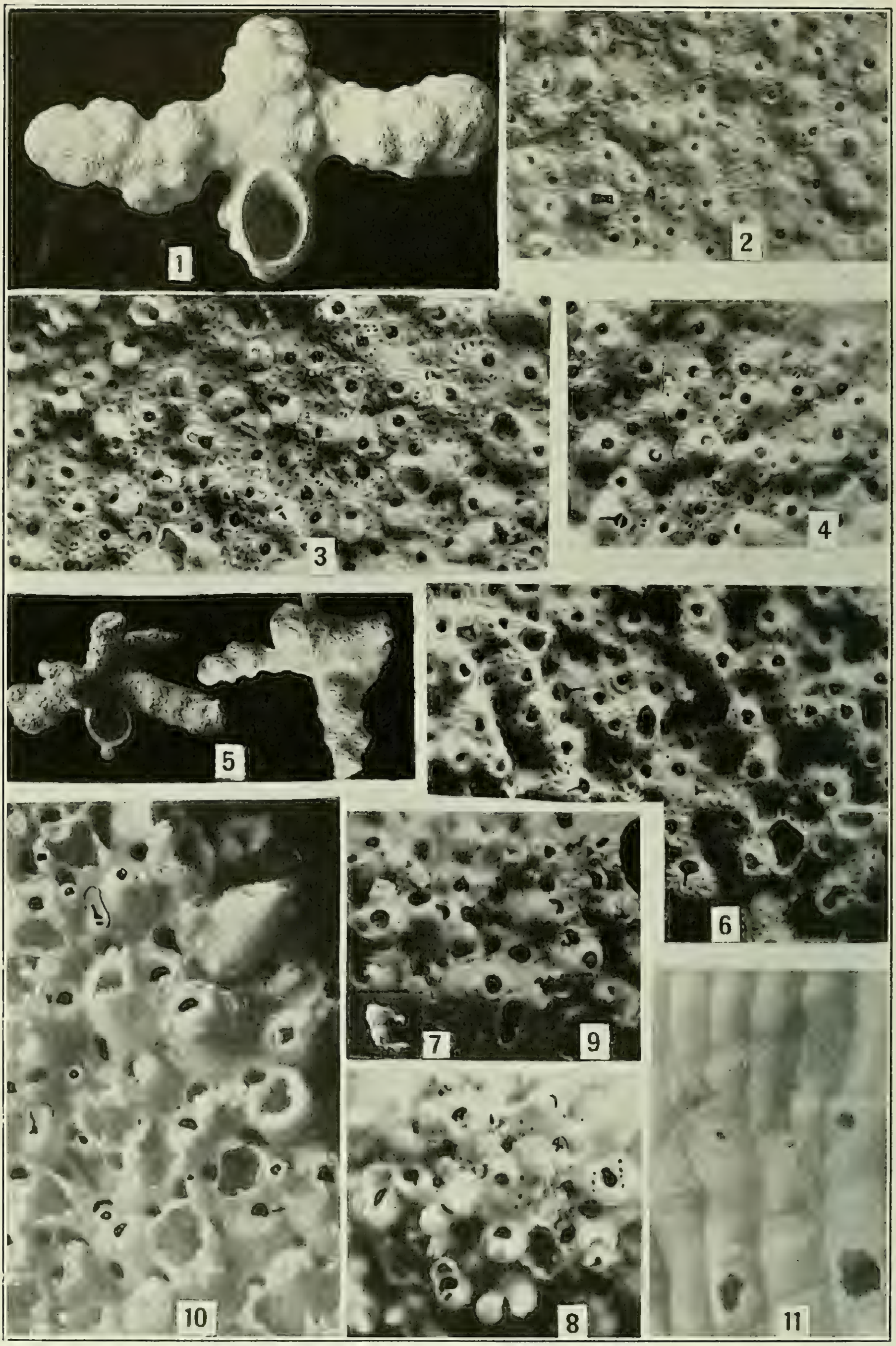


BRYOZOA OF THE GULF OF MEXICO REGION

FOR DESCRIPTION SEE PAGE FACING

Plate 22

		Page
Figs. 1–4.	*Hippoporidra edax* Busk, 1859	139
	1. Zoarium, natural size, encrusting a gastropod.	
	2. Portion of large zoarium, × 20, with large interzooecial avicularia.	
	3. Ovicelled portion of a zoarium with marginal zooecia; × 20.	
	4. Group of cells with very salient umbo; × 20.	
	Albatross Station D. 2363, east of Yucatan.	
5–6.	*Hippoporidra calcarea* Smitt, 1873	140
	5. Two zoaria, natural size, incrusting gastropods.	
	6. Zooecia, × 20, showing the large characteristic avicularia.	
	Albatross Station D. 2387, Gulf of Mexico.	
7–9.	*Schizmopora dichotoma* Hincks, 1864	149
	7. View of colony, natural size.	
	8. Group of ovicelled zooecia; × 20.	
	9. Portion of the same zoarium; × 20.	
	Albatross Station D. 2405, Gulf of Mexico.	
10, 11.	*Holoporella albirostris* Smitt, 1873	142
	10. Unilamellar specimen, with large very salient superficial zooecia; × 20.	
	11. Inferior face of the same specimen, × 20.	
	Albatross Station D. 2405, Gulf of Mexico.	

Plate 23

Page

Figs. 1–3. *Bracebridgia subsulcata* Smitt, 1873 127

1. Zoarium, natural size.
2. Zooecia, × 20, showing the oral avicularia with point toward the top and the zooecial avicularia pointed below.
3. Interior of zooecia, × 20, illustrating absence of ascopore or spiramen.

Albatross Station D. 2405, Gulf of Mexico.

4–5. *Adeona plagiopora* Smitt, 1873 126

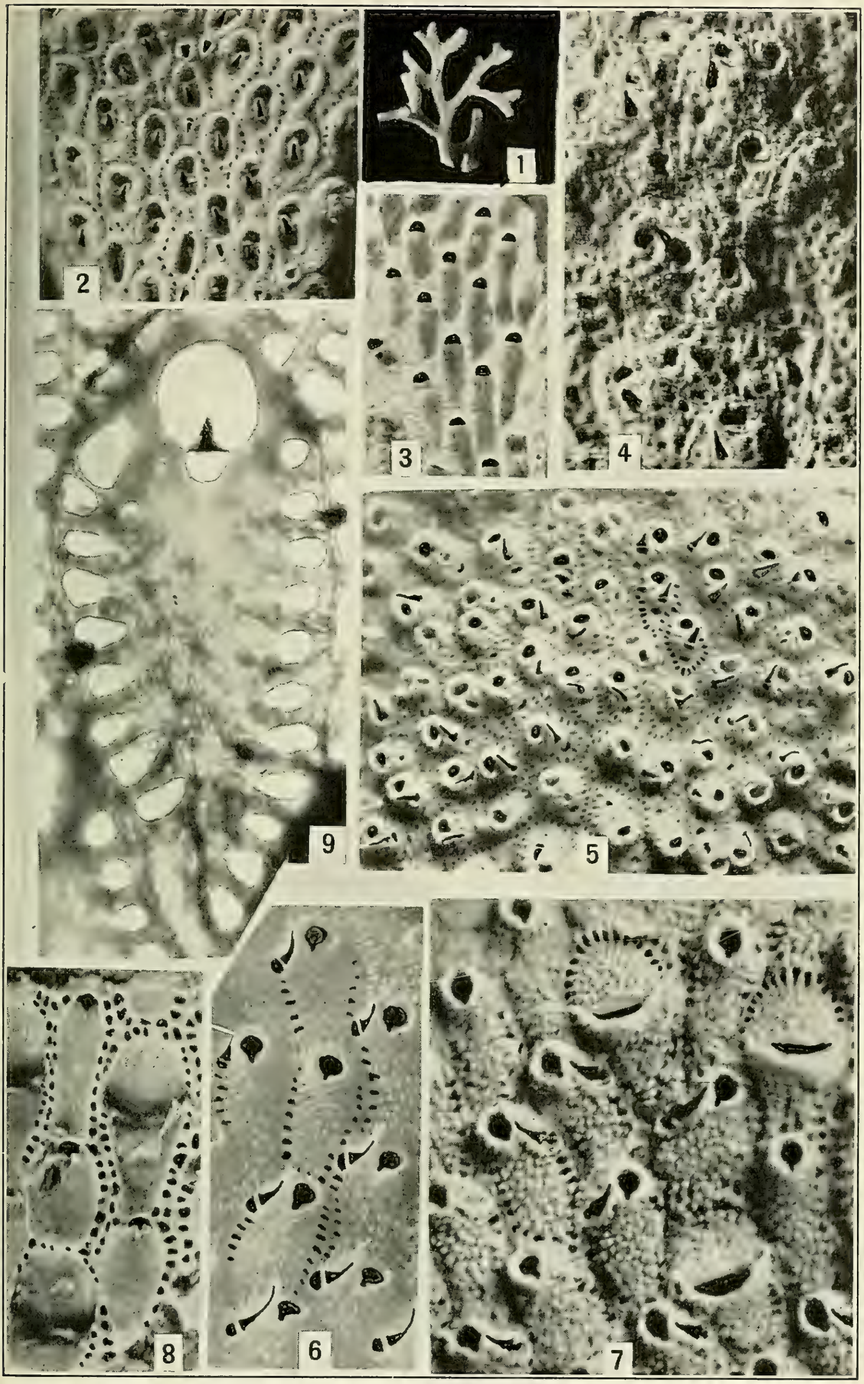
4. Much calcified zooecia, × 20, around a gonoecium.
5. Ancestrular zooecia of an incrusting specimen; × 20.

Fowey Light, 15 miles south of Miami, Fla., and *Albatross* Station D. 2405.

6–9. *Metrarabdotos unguiculatum*, new species 128

6. Nonovicelled portion of the unilamellar zoarium; × 20.
7. Ovicelled and nonovicelled zoecia; × 20.
8. Interior of an ovicelled colony, × 20.
9. Tangential section of the frontal, × 85, showing the structure of the pleurocyst and the interareolar costules.

Albatross Station D. 2363, east of Yucatan.



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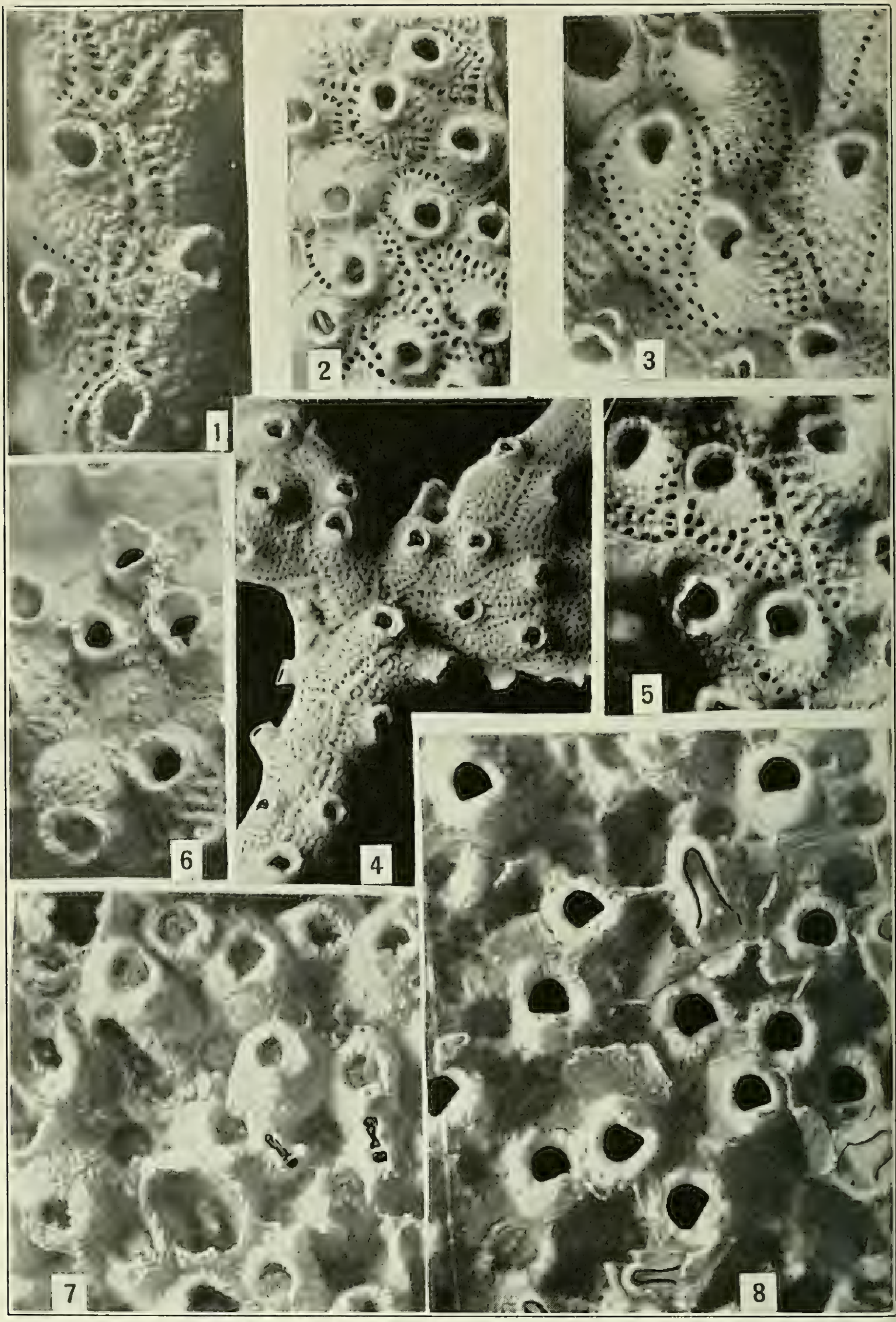


BRYOZOA OF THE GULF OF MEXICO REGION

FOR DESCRIPTION SEE PAGE FACING

Plate 24

	Page
Figs. 1–6. *Holoporella tubulosa*, new species	147

1. Portion of a regular cylindrical zoarium, × 20.
2. Zooecia of a unilamellar specimen, × 10.
3. Several zooecia of same specimen as Figure 2 × 20.
4. A free cylindrical colony, × 10. Some of the peristomes are indented in front.
5. Zooecia of the same, × 20
6. A specimen with ectocyst, × 20. An ovicelled zooecium is present.

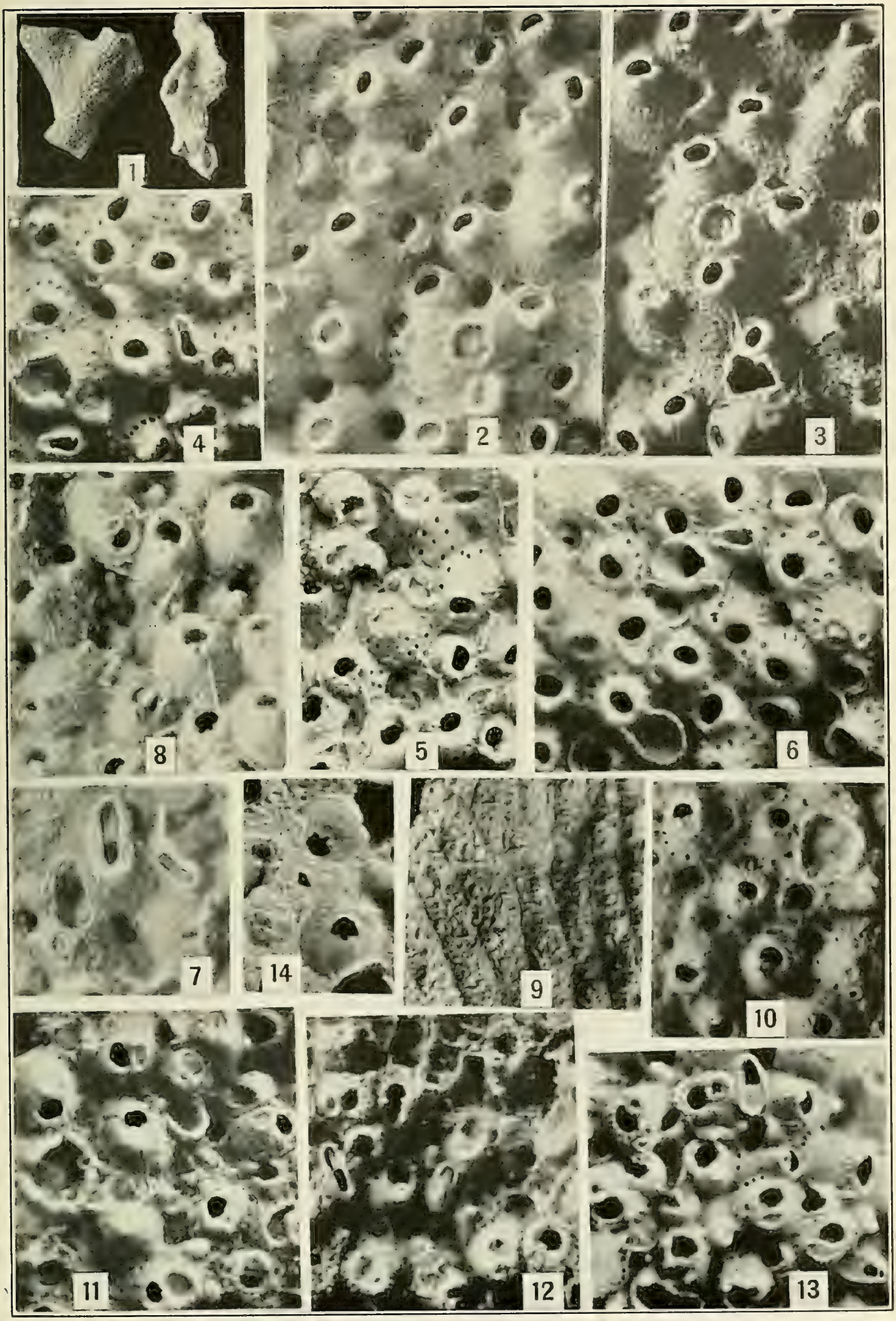
Albatross Station D. 2405(2, 3) D. 2160(1) D. 2319 (4, 5). Gulf of Mexico.

7, 8. *Holoporella magnifica* Osburn, 1914	143

7. Surface × 20
8. Surface, × 20, with ectocyst present but broken in places.

Albatross Station D. 2405, Gulf of Mexico.

Plate 25



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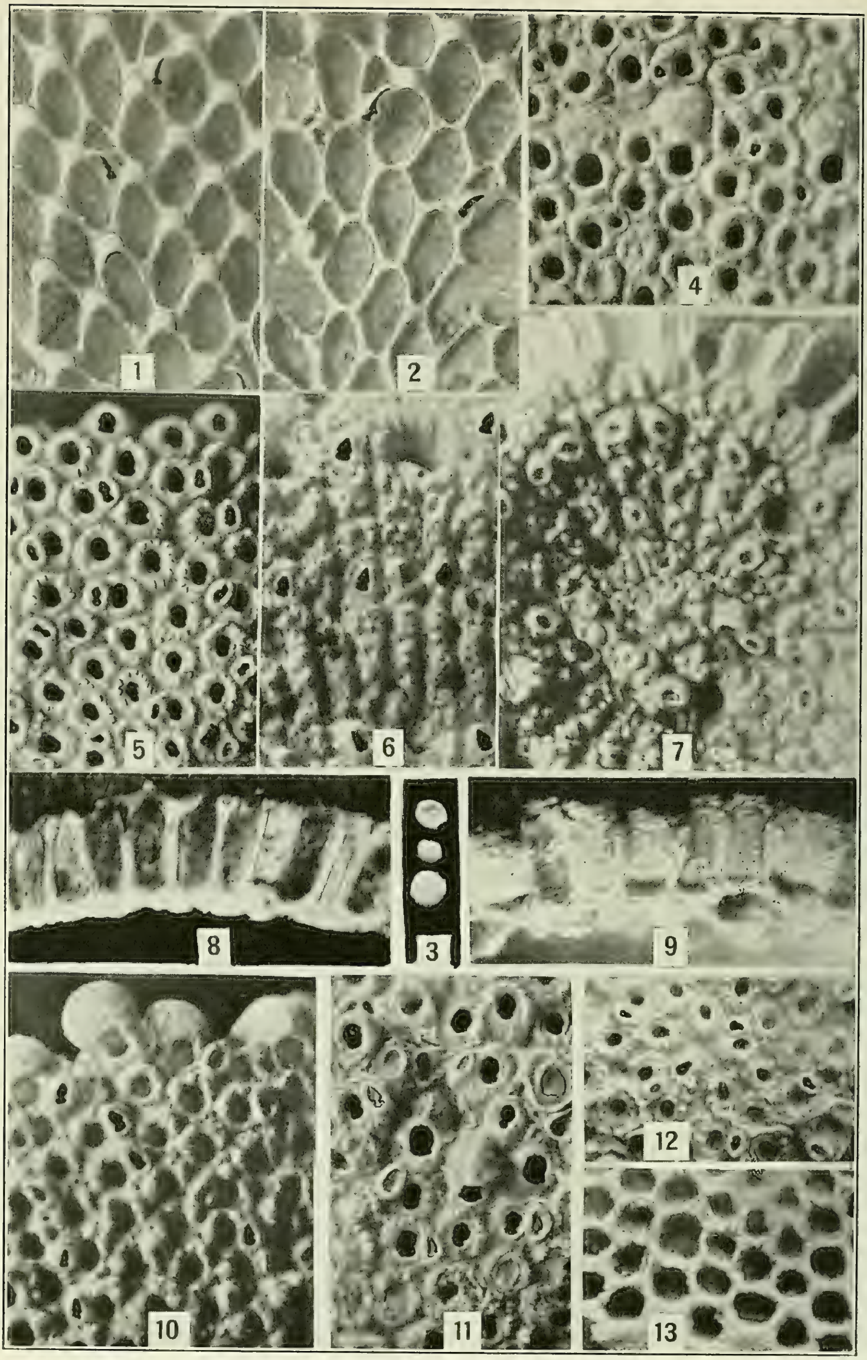


BRYOZOA OF THE GULF OF MEXICO REGION

FOR DESCRIPTION SEE PAGE FACING

PLATE 26

Page

FIGS. 1,2. *Callopora tenuissima*, new species........................... 34

1. Surface of the incrusting zoarium, × 20, showing ovicelled zooecia.
2. Ovicelled and ordinary zooecia, × 20. The avicularia are developed in the interior of the zooecia with aborted polypide.

Albatross Station D. 2387, between Florida and New Orleans.

3–13. *Mamillopora cupula* Smitt, 1873........................... 153

3. The small discoid zoaria, natural size.
4. Zooecia with noncarinated ovicells, × 20.
5. Surface, × 20, showing the thick peristome covered with small mammillosities.
6. Inner side, × 20, showing radial ribs.
7. Inner side, × 20, illustrating the helicoidal arrangement of the avicularia.
8. Median section, × 20. There is no substratum for the larva.
9. Lateral view, × 20, of the marginal ovicelled zooecia of Figure 10.
10. Marginal ovicelled zooecia, × 20.
11. Zooecia with carinated ovicells, × 20.
12. Ancestrular part of colony, × 20.
13. Interior of zooecia, × 20. The avicularia are peristomial and not visible.

Albatross Station D. 2411. Gulf of Mexico and Fowey Light, 15 miles south of Miami, Fla.

Plate 27

	Page
Figs. 1–4. *Schizopodrella isabelleana* Smitt, 1873	97

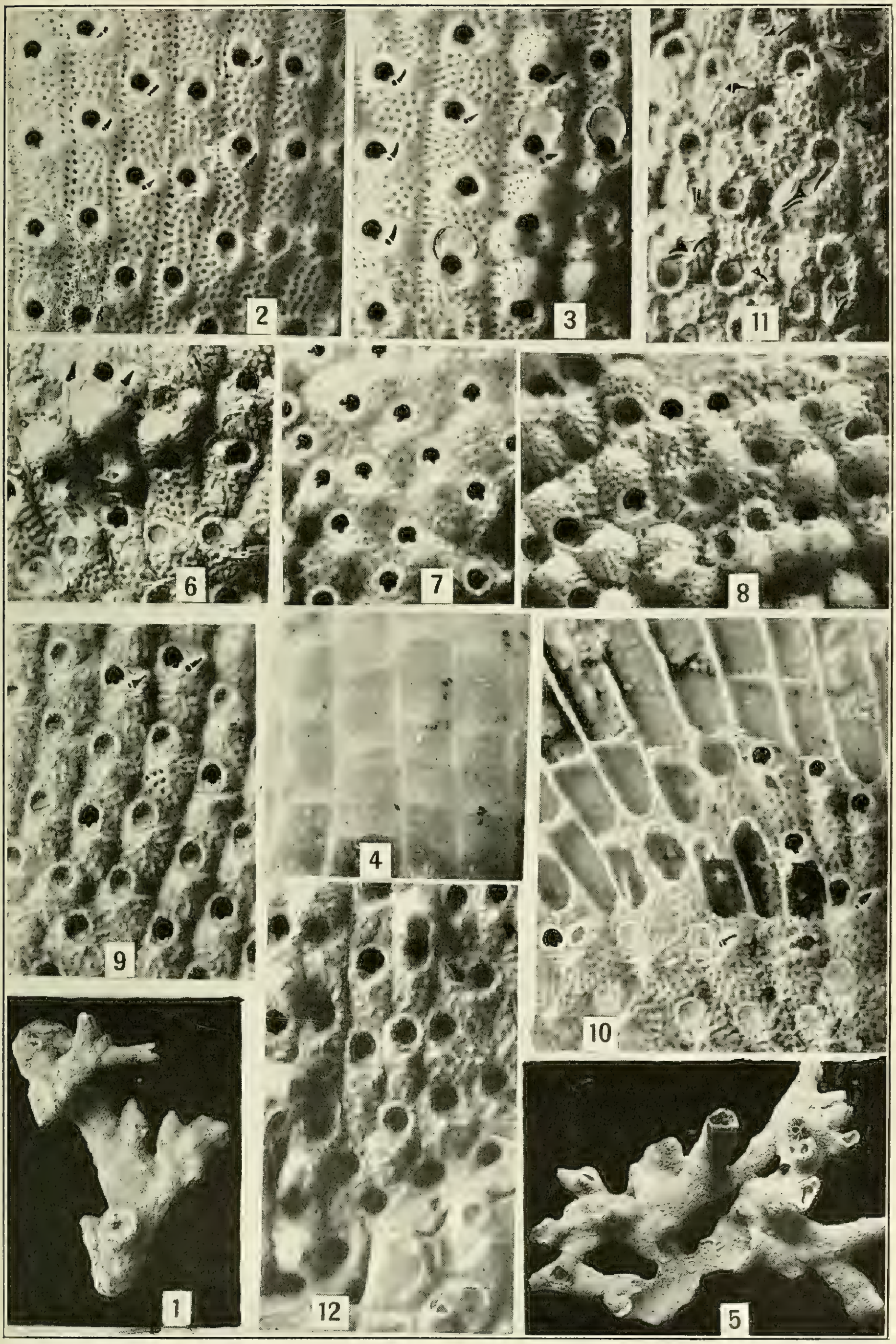
1. Zoarium, natural size, consisting of hollow branches.
2. Surface, $\times$ 20, with narrow oriented zooecia and small avicularia.
3. Ovicelled portion of the same colony, $\times$ 20, with broad zooecia.
4. Inner side of a colony, $\times$ 20. The internal denticles are visible by transparency.

St. Thomas, Virgin Islands, West Indies.

5–12. *Schizopodrella pungens*, new species	95

5. Portion of colony, natural size.
6. Surface with ovicelled zooecia, $\times$ 20. The umbo and avicularia are salient.
7. Specimen, $\times$20, after treatment with Javelle water. The avicularia are salient and the armature of the poster and the short spines are visible.
8. A group of ovicelled zooecia, $\times$ 20.
9. Zooecia with ectocyst and opercula, $\times$ 20. The umbo is quite salient.
10. Marginal zooecia, $\times$ 20.
11. Superior layer of a plurilamellar tubuliform colony, $\times$ 20. The avicularia are large and the extremity of the uplifted mandible is always supported on the proximal border of the rimule.
12. Specimen with ectocyst, $\times$ 20. The ectocyst is thickened considerably above the diseased or accidentally broken zooecia.

Cedar Keys, Fla.



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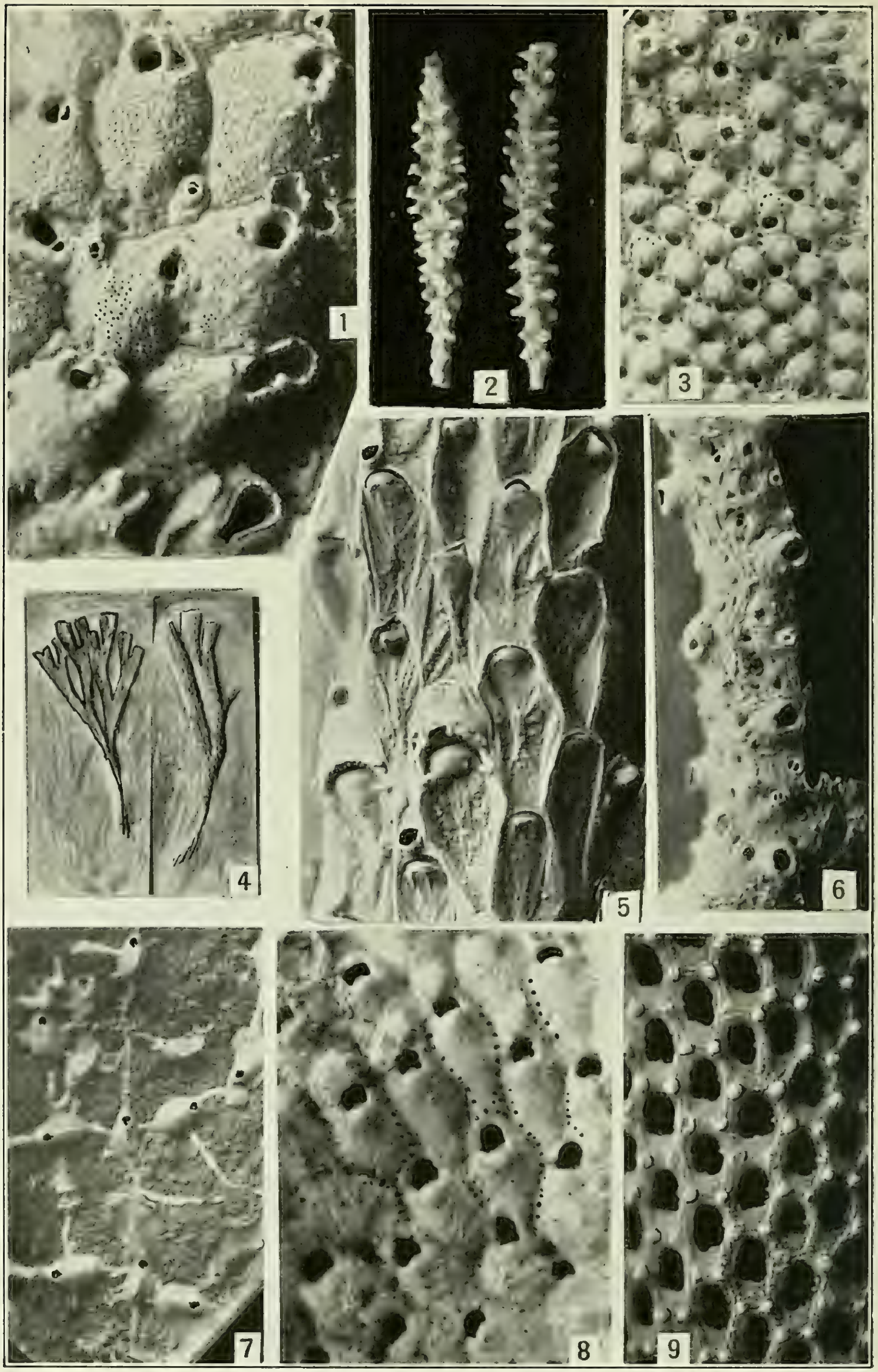


BRYOZOA OF THE GULF OF MEXICO REGION

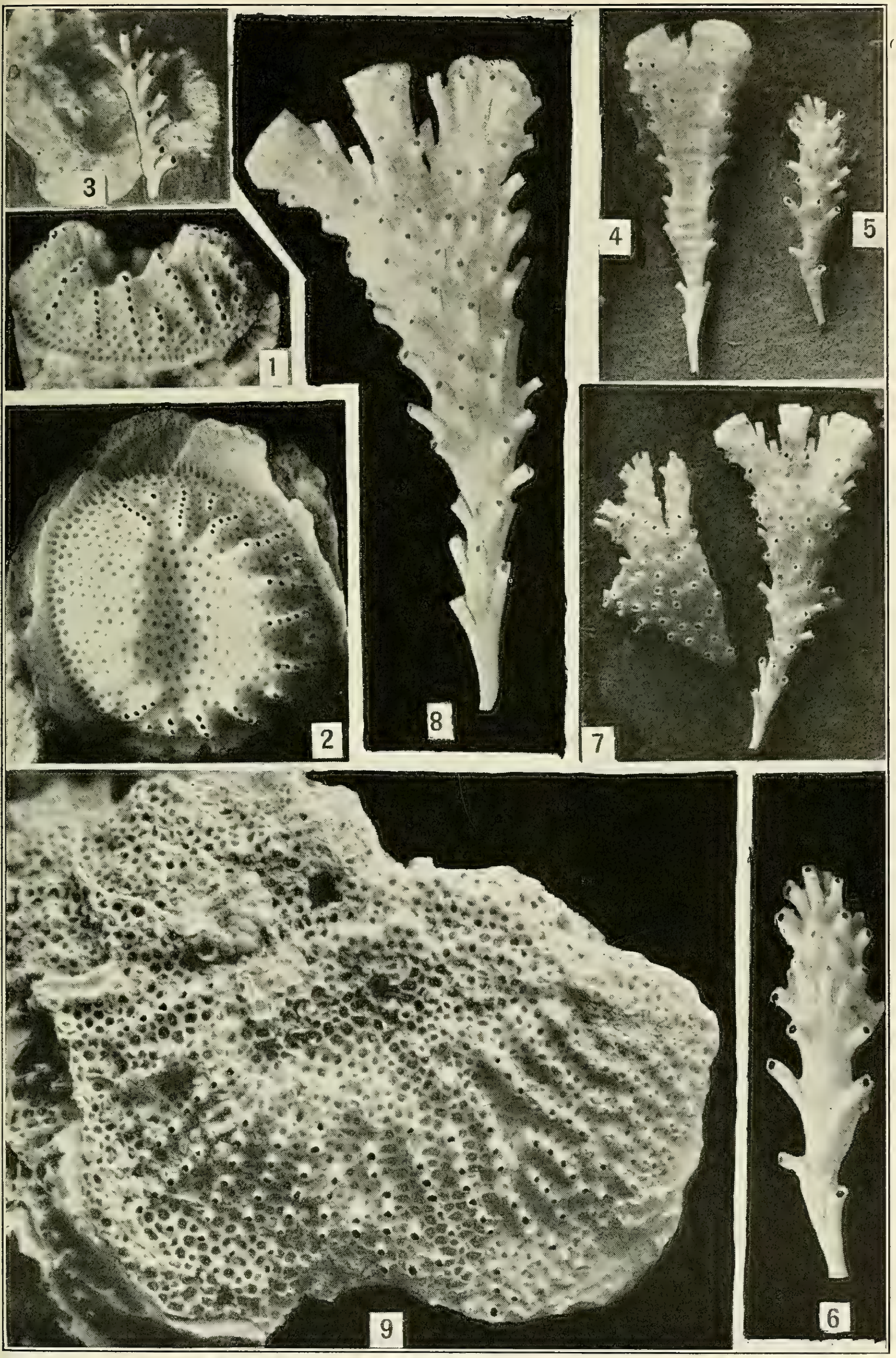
FOR DESCRIPTION SEE PAGE FACING

Plate 28

		Page
Fig. 1.	*Cellepora minutiporosa,* new species	150
	Surface of the incrusting zoarium, × 20.	
	Albatross Station D. 2662. Western Atlantic.	
2, 3.	*Smittina echinata,* new species	115
	Two zoaria, natural size, and the surface, × 20.	
	Cedar Keys, Fla.	
4, 5.	*Flustra (Carbasea) capitata,* new species	19
	Two zoaria, natural size, and celluliferous side, × 20, with two ovicelled zooecia. Desiccation of the specimen has deformed the ectocyst.	
	Albatross Station D. 2750. Off Chili.	
6.	*Tessaradoma gracile* Sars, 1863	86
	Albatross Station D. 2753. Lesser Antilles.	
7.	*Hippothoa divaricata* Lamouroux, 1821	77
	An example, × 20, showing the characteristic carina in the zooecia.	
	Albatross Station D. 2654. Bahama Islands.	
8.	*Bryocryptella convexa,* new species	121
	Surface of the incrusting zoarium, × 20.	
	Albatross Station D. 2650. Bahama Islands.	
9.	*Hemiseptella hexagonalis,* new species	63
	Portion of the incrusting zoarium, × 20.	
	Albatross Station D. 2619. Western Atlantic.	

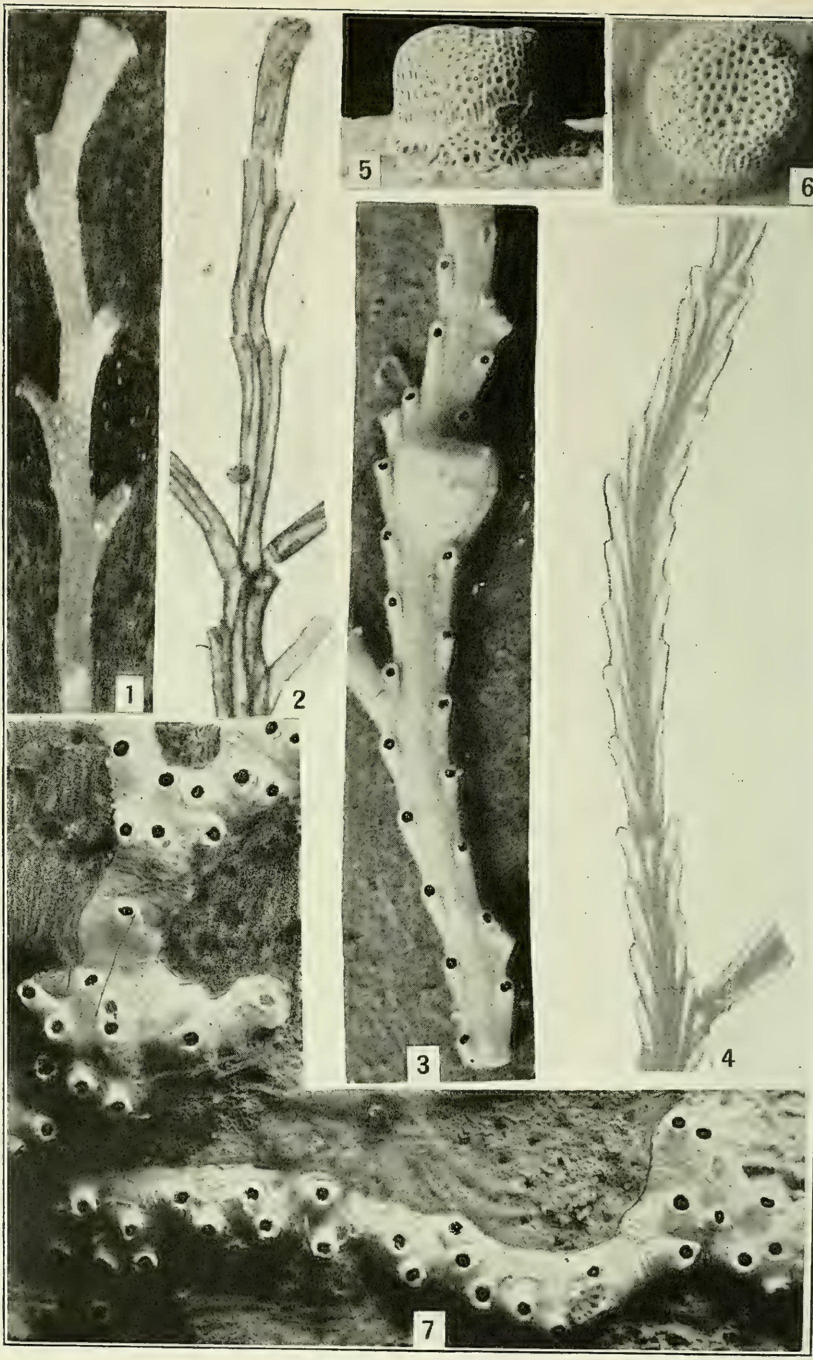
Plate 29

	Page
Figs. 1, 2. *Lichenopora radiata* Audouin, 1826	163
Lateral and superior views of a zoarium, × 12.	
Albatross Station D. 2334. North of Cuba.	
3–8. *Crisulipora orientalis*, new species	162
3. The jointed segments, × 6, attached to floating alga.	
4. Noncellular side of a flabellate bifurcated segment, × 6.	
5, 6. A young nonflabellate segment, × 6 and × 12.	
7, 8. Two flabellate trifurcated segments, × 6 and one of these × 12.	
Gulf of Mexico, Egmont Key, Fla.	
9. *Lichenopora buski*? Harmer, 1915	163
View of specimen doubtfully referred here.	
Albatross Station D. 2320. North of Cuba.	



BRYOZOA OF THE GULF OF MEXICO REGION

FOR DESCRIPTION SEE PAGE FACING



Bryozoa of the Gulf of Mexico Region

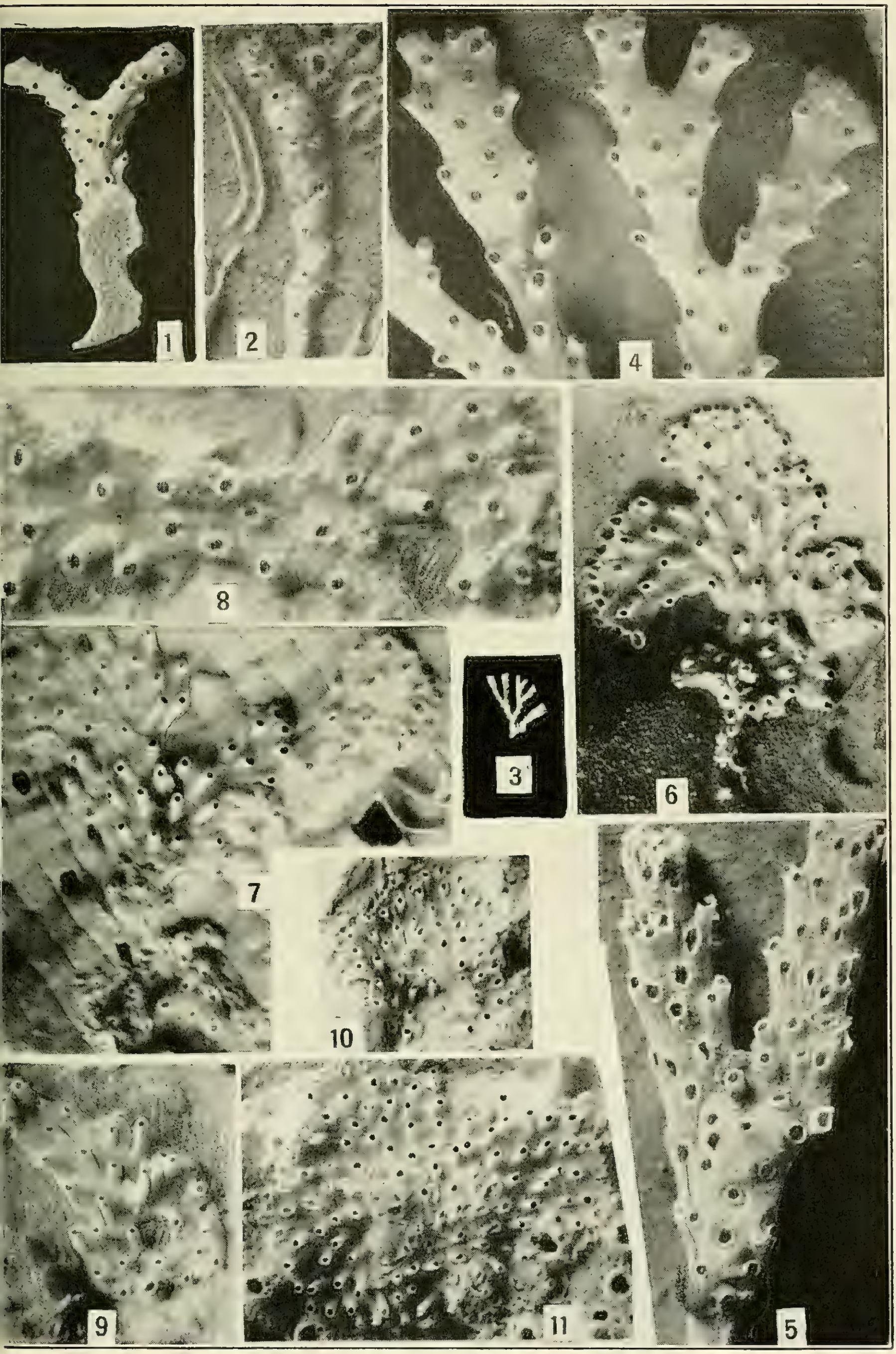
For description see page facing

Plate 30

	Page
Figs. 1, 2. *Crisia* species	157
1. A segment, × 25.	
2. An example, × 25, viewed by transparency, showing the arrangement of the tubes.	
Albatross Station D. 2405. Gulf of Mexico.	
3. *Crisia elongata* Milne Edwards, 1838	157
An ovicelled segment × 25, with four bases ramae and 26 tubes.	
Albatross Station D. 2405. Gulf of Mexico.	
4. *Crisia denticulata* Lamarck, 1812	156
Segments, × 25, viewed by transparency, showing the bases ramae and two dark-colored joints.	
Albatross Station D. 2405. Gulf of Mexico.	
5, 6. *Domopora floridana*, new species	164
Lateral and superior views of the type specimen, × 12.	
Albatross Station D. 2405. Gulf of Mexico.	
7. *Proboscina robusta*, new species	157
The incrusting type specimen, × 12.	
Albatross Station D. 2319. North of Cuba.	

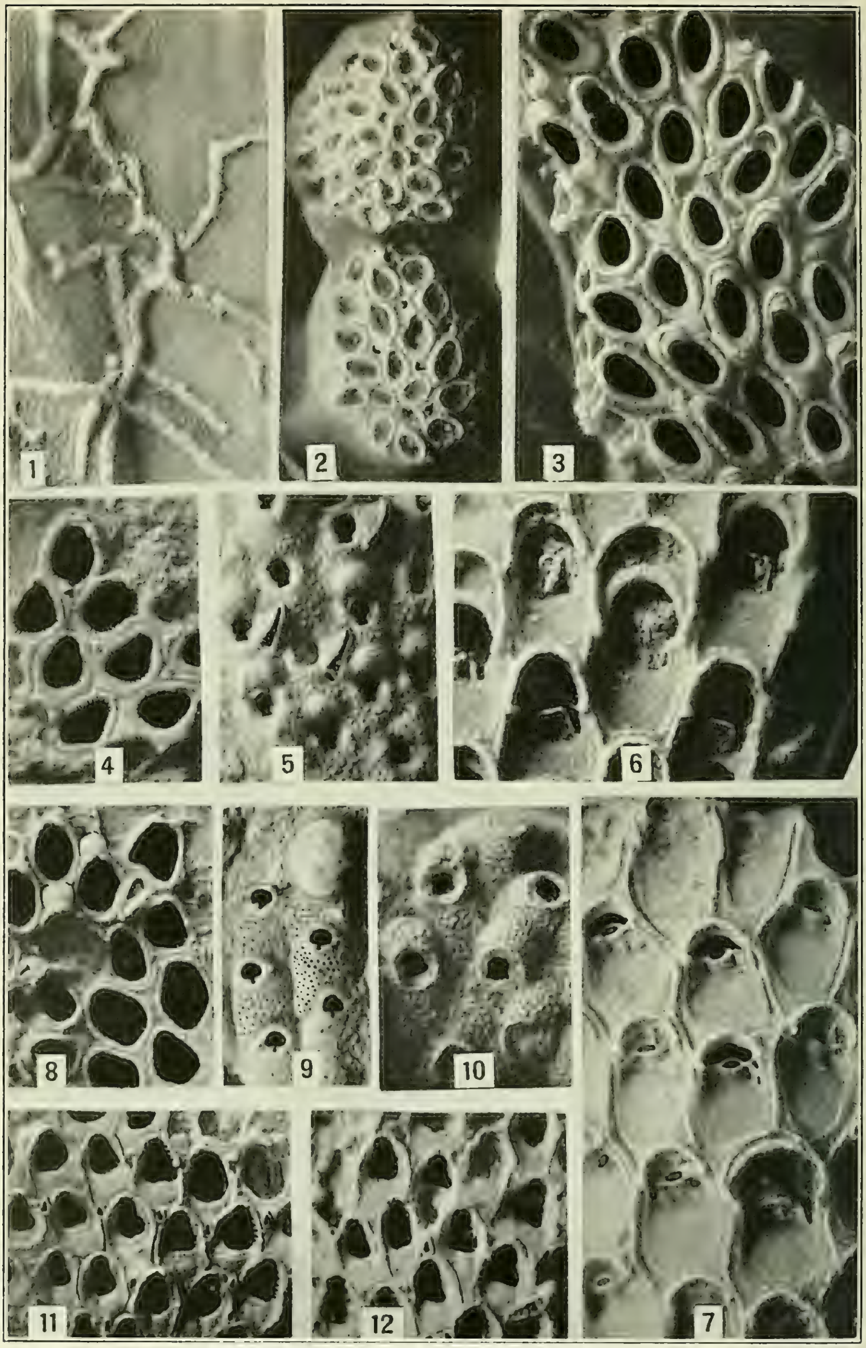
Plate 31

		Page
Fig. 1.	*Mecynoecia deflexa* Smitt, 1872	160
	A young zoarium, × 6, showing the expanded base.	
	Albatross Station D. 2405. Gulf of Mexico.	
2.	*Oncousoecia arcuata,* new species	158
	An ovicelled specimen: × 12.	
	Albatross Station D. 2639. Straits of Florida.	
3–5.	*Diaperoecia radicata* Kirkpatrick, 1888	160
	3. Fragmentary zoarium, natural size.	
	4. Extremities of the branches of the same colony; ×12.	
	Gulf of Mexico. Egmont Key, Fla.	
	5. An idmoneiform ovicelled branch, × 12, with five longitudinal rows of tubes.	
	Albatross Station D. 2405. Gulf of Mexico.	
6–9.	*Peristomoecia floridana,* new species	158
	6. An ovicelled flabellate incrusting example; × 12. The oeciopore is visible in the middle of the ovicell at the upper end of the expansion.	
	7. An example with linear branches; × 12.	
	8. Initial branch; × 25. The protoecium is broken.	
	9. A linear branch, × 12, with very salient fine peristomes.	
	Albatross Station D. 2639. Straits of Florida.	
10.	*Plagioecia dispar,* new species	159
	The incrusting zoarium, × 12, with ovicell.	
	Albatross Station D. 2639. Straits of Florida.	
11.	*Diplosolen obelium* Johnston, 1838	161
	The incrusting zoarium; × 12.	
	Albatross Station D. 2319. North of Cuba.	



BRYOZOA OF THE GULF OF MEXICO REGION

FOR DESCRIPTION SEE PAGE FACING



Bryozoa of the Gulf of Mexico Region

For description see page facing

Plate 32

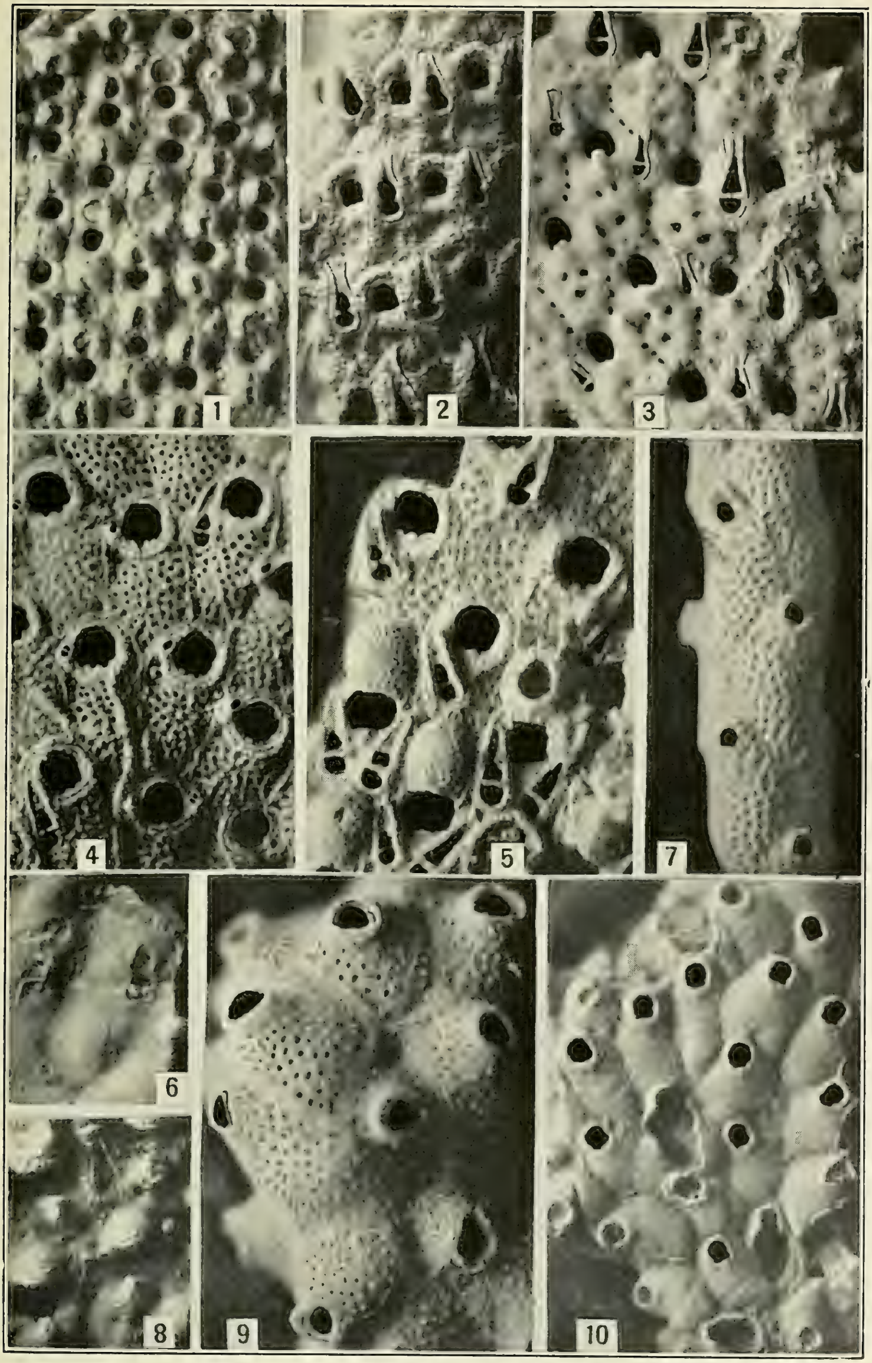
All the specimens here illustrated are magnified 20 diameters and are from the Pliocene of Bocas Island, Almirante Bay, Panama.

		Page
Fig. 1.	*Aetea truncata* Landsborough, 1852	51
2.	*Vibracellina laxibasis*, new species Two examples completely incrusting small pebbles.	23
3.	*Alderina pyriformis*, new species Surface of the unilamellar zoarium, with pyriform zooecia.	28
4.	*Alderina irregularis* Smitt, 1873 The Pliocene specimen, referred to this species.	27
5.	*Hippoporina cleidostoma* Smitt, 1873 Surface of ovicelled specimen.	104
6.	*Steganoporella magnilabris* Busk, 1854 Zooecia of the Pliocene species.	64
7.	*Steganoporella brevis*, new species The unilamellar type specimen, illustrating the short zooecium.	67
8.	*Callopora curvirostris* Hincks, 1861 Portion of ovicelled zoarium.	32
9.	*Stylopoma spongites* Pallas, 1766 Several zooecia and the characteristic ovicell.	91
10.	*Hippodiplosia pertusa* Esper, 1794 Zoarium with ovicelled zooecia.	106
11, 12.	*Dacryonella typica*, new species Two zoarial surfaces.	57

PLATE 33

All the specimens here illustrated are magnified 20 diameters and are from the Pliocene of Bocas Island, Almirante Bay, Panama.

		Page
FIG. 1.	*Lepralia fissurata*, new species	110
	The incrusting zoarium with ovicelled zooecia.	
2.	*Tremogasterina granulata*, new species	45
	Surface of the Pliocene form of the species.	
3.	*Tremogasterina sparsiporosa*, new species	50
	The unilamellar type specimen.	
4.	*Petraliella bisinuata* Smitt, 1873	78
	Zooecia.	
5, 6.	*Petraliella bisinuata grandis*, new species	80
5.	Zooecia.	
6.	Inferior surface, exhibiting the radicular pores.	
7.	*Tubucellaria cereoides* Ellis and Solander, 1786	113
	Portion of a segment.	
8.	*Tremogasterina malleolus*, new species	48
	Ovicelled zooecia.	
9.	*Coleopora granulosa*, new species	82
	The incrusting type specimen.	
10.	*Tremoschizodina anatina*, new species	132
	Surface of the type an incrusting zoarium.	



BRYOZOA OF THE GULF OF MEXICO REGION

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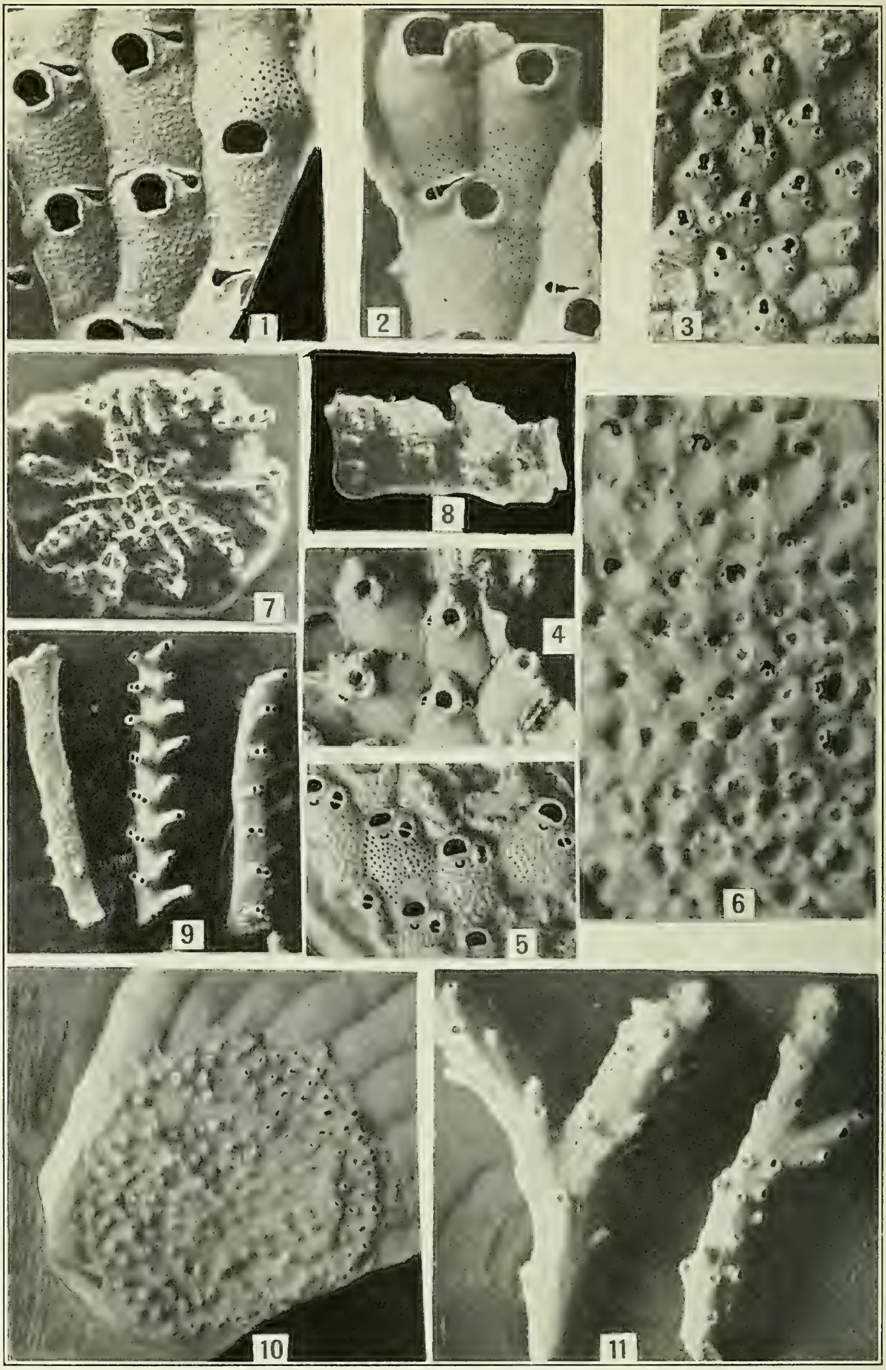

BRYOZOA OF THE GULF OF MEXICO REGION

FOR DESCRIPTION SEE PAGE FACING

PLATE 34

All the specimens here illustrated, unless otherwise stated, are magnified 20 diameters and are from the Pliocene of Bocas Island, Almirante Bay, Panama.

		Page
FIGS. 1, 2.	*Hippopodina feegensis* Busk, 1880	133
	Zoarial surfaces with one ovicelled zooecium in Figure 1.	
3.	*Crepidacantha poissonii* Savigny-Audouin, 1826	136
	Specimen with an ovicelled zooecium. The irregular arrangement of the avicularia is shown.	
4.	*Mastigophora pesanseris* Smitt, 1873	133
	Ovicelled zooecia.	
5.	*Microporella normani*, new species	112
	The incrusting zoarium with zooecia bearing large avicularia.	
6.	*Rhynchozoon corniger*, new species	123
	The incrusting zoarium with the salient avicularian umbo and two small pedunculate avicularia.	
7, 8.	*Lichenopora buskiana*, new species	164
	Superior and lateral views of the type specimen, × 12.	
9.	*Idmonea atlantica* Forbes, 1847	165
	Front, lateral and back views of fragments, × 12.	
10.	*Plagioecia sarniensis* Norman, 1864	159
	The incrusting zoarium, × 12, with ovicells developed.	
11.	*Entalophora proboscideoides* Smitt, 1872	160
	Several fragments, × 12.	

THE AUSTRALIAN LAND SHELL, THERSITES BIPARTITA, AND ITS ALLIES

By William B. Marshall

Assistant Curator, Division of Mollusks, United States National Museum

Recently Mr. C. Walton of Peterhead, Port Adelaide, South Australia, presented the United States National Museum with a number of land shells of northeastern Australia and islands in Torres Strait. All of the specimens received belong in the group *Thersites* (*Hadra*) *bipartita* Ferussac. They present a great variation in size and form, and the color varies from bipartite (whitish spire, chocolate base) to specimens which are entirely pale straw color, and to others which are entirely dark chestnut, and to others which are chestnut above, darker, sometimes nearly black below. Most of them have a white or pale spiral band at or near the periphery, and a dark band just below the suture. When the mass of material now in the Museum collection is arranged in geographic sequence, many characteristics which hitherto have escaped attention become evident, and show plainly that specialization has taken place along certain definite lines, and requires the recognition of additional species and subspecies to properly understand the problem presented. Pilsbry in his first study of *Thersites bipartita* [1] placed it in the genus *Camaena*, subgenus *Hadra*, section *Hadra* s. s., and gave the following note:

> The main feature distinguishing *Hadra* from *Chloritis* is that the apex in the former is neither concave, notably flattened, nor sculptured. This group seems more justly regarded as a subgenus of *Chloritis* than as a separate genus. Hedley suggests to me that the microscopic sculpturing of Hadra is a reminiscence of the hair granules of Chloritis.

Later in his analysis of the *bipartita* group [2] he places it in the genus *Thersites*, subgenus *Thersites*, section *Hadra* and uses the following names:

bipartita Ferussac+*semibadia* Albers
    form *unicolor* Cox
    form *minor* Pilsbry
    var. *semicastanea* Pfeiffer+*funiculata* Pfeiffer
forsteriana Pfeiffer+*hetaera* Pfeiffer
    form *major* Dohrn
darwini Brazier.

[1] Manual of Conchology, vol. 6, p. 276, 1892.
[2] Man. Conch., vol. 2, p. 132, 1894.

Dr. James C. Cox[3] treated *Thersites bipartita* and *semicastanea* as distinct species, but under the latter he says:

> This species, unquestionably a modified H. bipartita, is so variable that a dozen well-marked varieties might easily be selected from among the hundreds of specimens now before me. I haye taken the preceding description from a Lizard Island specimen.

He also treats *funiculata* as a distinct species, but under *semicastanea* he says: "*H. funiculata*, described elsewhere, I would refer to this head without hesitation. * * *."

The land shells from the Northeastern coast of Australia and adjacent islands, the largest of which heretofore have been called *Thersites bipartita* Ferussac and the smaller ones either positively or doubtfully subspecies of that species, have been analyzed in this paper. It should be remembered that the region includes not only the mainland of northeastern Australia but some of the islands off the east coast of Queensland and the islands of Torres Strait. Torres Strait is about 80 miles across and crowded with reefs, shoals, and islands. Isolation and environment undoubtedly have been effective causes producing the characteristics of the various subspecies of mollusks living on these islands.

Restricting ourselves now to specimens known or believed to come from islands in Torres Strait, we find that so far as known they may be divided into two great groups, one of which is characterized by being large, pale, angular at the periphery and with the spire but little lighter than the base. This group includes two species, both new, described in this paper under the names *Thersites waltoni* and *Thersites dalli.* The second group, characterized by being smaller, the spire dark reddish in color, the base much darker, sometimes nearly black, and with the periphery rounded, or at least less angular. This group includes three species, namely: *T. semicastanea* Pfeiffer, *T. bartschi* Marshall, and *T. funiculata* Pfeiffer. The first two are divided into two or more subspecies. Shells from Lizard Island on the east coast of Queensland resemble these dark shells from the islands in Torres Strait, which, however, are easily distinguishable by their very dark colors and unctuous appearance.

In the group of *Thersites bipartita* we now recognize the following species and subspecies:

THERSITES (HADRA)

bipartita bipartita Ferussac.
bipartita minor Pilsbry.
bipartita unicolor Cox.
semicastanea semicastanea Pfeiffer.
semicastenea alma, new.
funiculata Pfeiffer.
lizardensis lizardensis, new.

---

[3] Monograph of Australian Land Shells, p. 56, 1868.

lizardensis suma, new.
lizardensis rada, new.
bartschi bartschi, new.
bartschi mobiagensis, new.
bartschi yamensis, new.
bartschi oma, new.
bartschi mura, new.
bartschi nesia, new
bartschi paulensis, new.
bartschi murrayensis, new.
bartschi fama, new.
bartschi elfa, new.
bartschi diva, new.
bartschi cepa, new.
waltoni, new.
dalli, new.
forsteriana forsteriana Pfeiffer.
forsteriana major Pfeiffer.
forsteriana ada, new.
darwini Brazier.

At the present time this arrangement makes possible a satisfactory classification of all the material of this group in the collection of the United States National Museum. We believe, however, that when specimens from others of the multitude of islands in Torres Strait are collected, that the list of subspecies will have to be materially enlarged.

THERSITES (HADRA) BIPARTITA BIPARTITA Ferussac

Plate 1, fig. 3

Helix bipartita FERUSSAC, Histoire Naturelle des Mollusques, vol. 1, p. 176, pl. 75*a*, fig. 1.

Shell large, globosely turbinate, thick. Whorls slightly more than seven, slightly rounded and convex, each appearing to be a little sunken into the succeeding one, giving a somewhat beehive appearance to the spire. Sculpture of many retractive growth riblets which are strongest on the body whorl. Upper whorls with microscopic reticulations, which on the body whorl become minute pittings. Base very convex, widely umbilicated, the face of the umbilicus somewhat flattened. Aperture oblique, whitish but indistinctly showing the bipartite coloring of the exterior. Peristome white, reflected, partially concealing the umbilicus. Parietal wall with a rather thick callus which extends as a glaze some distance within the shell. Periphery rounded, showing no sign of an angle. Suture well impressed, irregularly crenulated by the upper ends of the growth riblets. Body whorl slowly descending about 7 mm. as it approaches the aperture. Color very conspicuously bipartite, the spire pale straw color, the base chocolate, a white spiral line dividing the colors of the spire and base.

The suture marked by a faint band of chestnut below it. The figured specimen, United States National Museum, Cat. No. 100058 measures: Greater diameter, 64 mm.; lesser diameter, 56 mm.; height, 59 mm. It comes from northeast Australia and was received from R. E. C. Stearns, who obtained it from Dr. J. C. Cox. The collection contains also 15 other specimens, 5 of which are labeled Cape York; 6 Australia; 1 northeast Australia; 1 north Australia; 1 Queensland; and 1 Gulf of Carpentaria. Probably all these specimens came from Queensland. Pilsbry cites the following localities: Cape York, Cape Direction, Cape Grenville, Daintree River, and Albany Island, northeast Australia. Albany Island is so close to the mainland that it may be regarded as a part of it. All the localities mentioned are in Queensland.

Specimens at hand vary considerably in size and other features. The specimen figured is the largest; the smallest of all is a specimen labeled Australia (Cat. No. 321077) which measures: Greater diameter, 50 mm.; lesser diameter, 40 mm.; height, 36.5 mm. Four other specimens, part of this same lot, are much smaller than the specimen figured. One labeled Gulf of Carpentaria, North Australia (Cat. No. 333790, U.S.N.M.), received from Mr. Walton, measures: Greater diameter, 51 m.; lesser diameter, 43 mm.; height, 41 mm.

With more material available and with definite locality data, this subspecies as now considered may have further subdivisions.

THERSITES (HADRA) BIPARTITA MINOR Pilsbry

1890. *Euhadra* (*Hadra*) *bipartita minor* PILSBRY, Man. Conch., vol. 6, p. 126, pl. 21, f. 44.

Like typical *bipartita* in all respects but size, which Pilsbry gives as diameter, 31 mm.; altitude, 26 mm. No mention is made of its distribution.

THERSITES (HADRA) BIPARTITA UNICOLOR Cox

1892. *Chloritis* (*Hadra*) *bipartita unicolor* Cox, in Pilsbry's Man. Conch., vol. 8, p. 276.

Similar to the typical *bipartita* in size, form, sculpture and thickness, but of a nearly uniform yellowish color. All four of the specimens in the Museum collection have the white or whitish band which, in typical *bipartita*, marks the division between the yellowish color of the spire and the chocolate color of the base. The distribution of *unicolor* is apparently the same as that of typical *bipartita*, and it may be only a partially albinistic manifestation instead of a zoogeographic race.

THERSITES (HADRA) LIZARDENSIS LIZARDENSIS, new subspecies

Plate 2, fig. 7

Shell globosely conical, rather elevated, moderately thick. Whorls 6½, slowly increasing in size, a little convex. Base convex;

body whorl round, its upper edge descending near the aperture. Sculpture of many retractive fine growth striae and a microscopic reticulation. Sutures moderately impressed, emphasized by a crenulated edging to each whorl, and by a narrow white margin below which is a reddish narrow band. Umbilicus wide, partly concealed by the reflected columellar lip. Parietal wall glazed. Aperture broadly rounded; peristome white, reflected. Color bipartite, the spire light chestnut and the base much darker, rich, glossy chestnut. A distinct white band at the periphery between the two shades of color. Interior showing the exterior colors softened by a glaze.

The type (Cat. No. 317035, U.S.N.M.) measures: Greater diameter, 41 mm.; lesser diameter, 36 mm.; height, 32 mm. It and a paratype (Cat. No. 333791, U.S.N.M.) are in the Henderson collection, and came from Lizard Island off east coast of Queensland. This is the species figured by Cox as *Helix semicastanea* on Plate 5, Figure 10.[4] His specimen came from Lizard Island. It seems to stand midway between *Thersites bipartita* and *T. semicastanea*, partaking of the characters of each and yet distinct from both. Cat. No. 317032, U.S.N.M. includes two specimens from Lizard Island of much lighter colors. Cat. No. 317034, U.S.N.M. includes two specimens labeled Islands of northeast coast of Australia. These probably come from Lizard Island. Cat. No. 321080, U.S.N.M. includes one specimen labeled "Australia." This, too, probably came from Lizard Island. Cat. No. 100032, U.S.N.M. labeled "Northeast Australia," from Dr. J. C. Cox, in the Stearns collection, also are so like specimens from Lizard Island that it seems likely they came from that island.

THERSITES (HADRA) LIZARDENSIS SUMA, new subspecies

Plate 1, fig. 2

Similar to *T. lizardensis lizardensis* but larger, more elevated, and differently colored, the spire being fawn color, the base light chocolate with a chestnut tinge, the white line dividing the colors of base and spire very prominent.

The type (Cat. No. 99944, U.S.N.M.) measures: Greater diameter, 48 mm.; lesser diameter, 41.5 mm.; height, 35 mm. It and a paratype (Cat. No. 333792, U.S.N.M.) form part of the Stearns collection. They are labeled ?Borneo. No similar shells have been found in Borneo, and it seems from their resemblance to Lizard Island specimens that they probably came from some island in its immediate vicinity, and probably belong to a subspecies of *T. lizardensis*.

THERSITES (HADRA) LIZARDENSIS RADA, new subspecies

Plate 2, fig. 4

Shell similar to *Thersites lizardensis lizardensis* but much smaller, more elevated, with the umbilicus largely concealed by the reflected

[4] Monograph of Australian Land Shells, 1868.

columellar lip, the peristome thicker and less expanded, a heavy callus across the parietal wall joining the two ends of the peristome. Colors much lighter but distinctly bipartite, the spire pale yellowish white, the base faded chestnut.

The type (Cat. No. 317033, U.S.N.M.) measures: Greater diameter, 33 mm.; lesser diameter, 28.5 mm.; height, 22.5 mm. It and a paratype (Cat. No. 333793, U.S.N.M.) are part of the Henderson collection and come from Lizard Island on the east coast of Queensland, Australia.

While the condition of the interior of these two specimens show that they were "living" shells when collected, the pale colors of the spire and base seem to be due mostly to loss of nearly all the periostracum, though a few remaining vestiges of periostracum show that the shell was naturally of very light colors. At first glance this subspecies bears a resemblance to *T. bipartita*, but careful comparison with that species and with *T. lizardensis* shows that it is more closely related to the latter.

THERSITES (HADRA) SEMICASTANEA SEMICASTANEA Pfeiffer

Plate 2, fig. 5

1849. *Helix semicastanea* PFEIFFER Zeitsch. fur Malak., vol. 6, p. 77; in Chemnitz Conch. Cab. ed. 2, Helix, no. 319, plate 56, figs. 3–5 (title page dated 1846, but the species is quoted from the Zeitschrift for 1849, thus showing that it was described in that year).

Shell small, rather thin, depressed conic, whorls from 5½ to 6 in number, slowly increasing, slightly convex, body whorl rounded, but just in front of the aperture it is somewhat angular showing that the concealed periphery of the earlier whorls was angular. Surface with numerous retractive growth striae and surface minutely reticulate, with faint indications here and there of spiral striae. Base convex, umbilicus rather narrow. Aperture rounded, scarcely oblique. Peristome thin, reflected, its columellar portion partially concealing the umbilicus. Parietal wall glazed. Color reddish, the base darker than the spire and glossy, a spiral white or whitish band at the periphery. Interior showing the two shades of the exterior and the white line dividing them. Sutures well impressed, irregularly crenulated, marked by a dark line below and a whitish line above. A very slight descent of the body whorl at the aperture.

The figured specimen (Cat. No. 169124, U.S.N.M.) measures: Greater diameter, 34.5 mm.; lesser diameter, 30 mm.; height, 23 mm. Another specimen with the same catalogue number, exactly like the type but smaller, measures: Major diameter, 28 mm.; minor diameter, 24 mm.; height, 19.5 mm. They are labeled "Queensland, Australia," and were presented by Mr. S. W. Jackson. Cat. No. 100033, U.S.N.M., includes two specimens received from R. E. C.

Stearns, who obtained them from Dr. J. C. Cox. These are labeled "Northeast Australia." They are dark reddish chestnut, much darker than the type. In one the light peripheral band is quite marked; in the other it is faint. Apparently the localities "Queensland" and "Northeast Australia" supplied by Jackson and Cox would lie on the mainland, but it seems probable that these localities being general would include islands in Torres Strait. Pfeiffer's type locality "Nova Hollandia?" would include both mainland and islands.

Cox and also Pilsbry say "Islands of Torres Strait, Australia, from Lizard Island to Stephens Island." Doctor Cox in describing and figuring specimens from Lizard Island apparently did not deal with *Thersites semicastanea*, but with larger and differently colored shells. The specimen figured by Cox on Plate 5, Figure 10,[5] is not *T. semicastanea* but rather *bipartita minor* Pilsbry. The specimen figured on Plate 20, Figure 3,[5] is *T. semicastanea semicastenea.*

THERSITES (HADRA) SEMICASTANEA ALMA, new subspecies

Plate 3, fig. 8

Similar to *Thersites* (*Hadra*) *semicastanea semicastanea*, but much smaller, more fragile, slightly less depressed and with the peristome thin and but slightly reflected. The body whorl does not descend near the aperture. It has 5½ whorls.

The type (Cat. No. 100034, U.S.N.M.) measures: Greater diameter, 25.5 mm.; lesser diameter, 22 mm.; height, 15 mm. It comes from Cape York, Queensland, Australia, and was received from R. E. C. Stearns, who obtained it from Legrand.

THERSITES (HADRA) FUNICULATA Pfeiffer

1854. *Helix funiculata* PFEIFFER, Proc. Zool. Soc., p. 147.

Shell umbilicated, depressed, thin, often rudely granulated, somewhat shining, reddish; spire obtusely conic; suture subcanaliculate; whorls 6, somewhat convex, slowly increasing; body whorl rounded, a white band above the periphery and with a cord-like carina, descending anteriorly; base convex, umbilicus moderate, deep, aperture oblique, subangularly lunate; peristome simple, margins scarcely converging; above straight, a little reflected at the base, upper end of columella dilated.

Greater diameter, 29 mm.; lesser diameter, 24 mm.; height, 14 mm.

Habitat.—Torres Strait, Australia.

This may be a subspecies of *Thersites semicastanea* Pfeiffer, but the presence of a cordlike keel at the periphery makes it somewhat doubtful. Unfortunately a definite locality was not cited. Torres Strait includes a multitude of islands.

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[5] Monograph of Australian Land Shells, 1868.

THERSITES (HADRA) BARTSCHI BARTSCHI, new subspecies

Plate 2, fig. 1

Shell rather thin, depressed, whorls 6½, somewhat round, slowly descending, each appearing to be a little immersed in the succeeding whorl. Base convex, about as deep as the spire is high, umbilicus moderate, partly concealed by the reflected columellar lip. Body whorl large, with rounded periphery, its anterior upper edge slightly descending at the aperture. Sculpture of numerous retractive growth lines and microscopic reticulations; sutures deeply impressed, crenulated by the ends of the growth striae. Color rich, dark chestnut fumed with darker color, especially along the suture. Base very dark, nearly black, the colors of the spire and base separated by a very distinct white line. Aperture nearly horizontal, widely rounded with the lip moderately reflected. Interior livid purplish. Parietal wall thinly glazed.

The type (Cat. No. 333794, U.S.N.M.) measures: Greater diameter, 44 mm.; lesser diameter, 36 mm.; height, 28.5 mm. It and two paratypes come from Darnley Island, and were presented by Mr. C. Walton.

THERSITES (HADRA) BARTSCHI MOBIAGENSIS, new subspecies

Plate 1, fig. 1

Similar to *Thersites bartschi bartschi*, but thinner, slightly more depressed and less highly colored.

The type (Cat. No. 333797, U.S.N.M.) measures: Greater diameter, 44 mm.; lesser diameter, 37.5 mm.; height, 28.5 mm. It comes from Mobiag Island in Torres Strait, and was presented by Mr. C. Walton. (Cat. No. 333798, U.S.N.M.) contains three specimens from the same island sent by Mr. Walton. One of these is young, but when grown apparently will be quite like the adult. The other two specimens are very thin, more elevated, and have a tendency to globoseness. One is nearly adult. Its sutures do not lie accurately along the periphery of the preceding whorls. The other specimen is adult. The suture of its whole body whorl and part of the penultimate whorl fall below the periphery of the preceding whorl. This irregularity of growth probably accounts for the departure from usual form.

THERSITES (HADRA) BARTSCHI YAMENSIS, new subspecies

Plate 1, fig. 4

Shell similar to *Thersites bartschi bartschi* but larger, more depressed, whorls less rounded, growth riblets more marked, body whorl angulated at the periphery (the angle more appreciable to touch than to sight), base slightly less convex; aperture smaller, less flaring, with the outer lip indistinctly angulated by the angle of the periphery; the whitish line above the nearly black color of the base less distinct but wider.

The type (Cat. No. 333799, U.S.N.M.) measures: Greater diameter, 48 mm.; lesser diameter, 44 mm.; height, 32 mm. It and three paratypes (one of them juvenile) come from Yam Island in Torres Strait and were presented by Mr. C. Walton.

The angulated periphery, the less convex base and the smaller, less flaring aperture distinctly differentiate this subspecies from *Thersites bartschi bartschi*.

One of the paratypes is juvenile, another varies from the type in form, being depressed and each whorl slightly sunken into the succeeding whorl, due to the fact that the suture does not fall along the periphery but is attached a trifle above it.

THERSITES (HADRA) BARTSCHI OMA, new subspecies

Plate 3, fig. 2

Shell thin, inflated, whorls 6¼, well-exserted, rounded; body whorl rounded, inflated, its upper edge descending near the aperture. Base very convex, umbilicus rather wide, but little concealed by the expanded columellar tip. Sculpture of rather indistinct lines of growth and microscopic reticulations. Sutures well impressed, irregularly crenulated by the upper ends of the growth lines. Color nearly uniformly rich dark chestnut, the color of the base very little darker than the spire except near the aperture where it is several shades darker. In place of the whitish line dividing the colors of the spire and base this shell has a narrow band of chestnut darker than that of either base or spire. Suture obscurely margined below by dark chestnut. Aperture horizontal, widely rounded, peristome thin, reflected, parietal wall glazed. Interior violaceous; by transmitted light distinctly divided by a dark line, into two parts, the upper of which is much lighter in color than the lower.

The type (Cat. No. 333801, U.S.N.M.) measures: Greater diameter, 38.5 mm.; lesser diameter, 30 mm.; height, 26 mm. It comes from Yam Island, Torres Strait, and was presented by Mr. C. Walton.

THERSITES (HADRA) BARTSCHI NURA, new subspecies

Plate 3, fig. 7

Shell small, about one-half the size of *Thersites bartschi bartschi* similar to it in other respects but with characters less pronounced. The band at the periphery is yellowish-white, the peristome very little reflected, interior violaceous, the upper part lighter than the lower, a clear-white band between them.

The type (Cat. No. 333802, U.S.N.M.) measures: Major diameter, 31 mm.; minor diameter, 28 mm.; height, 21 mm. It comes from Yam Island, Torres Strait, and was presented by Mr. C. Walton.

Another specimen (Cat. No. 333803, U.S.N.M.) of this subspecies is larger but somewhat abnormal in that the whorls at places do not attach themselves accurately to the periphery of the preceding whorl, thus making the shell a little more elevated than it should be for its diameter. It measures: Major diameter, 34 mm.; minor diameter, 33.5 mm.; height, 25.5 mm.

This subspecies resembles a typical *Thersites bartschi bartschi* very much reduced in size. It resembles also *Thersites bartschi oma* but is smaller, the whorls less rounded, the aperture very much less flaring and with a light peripheral band instead of a dark chestnut-colored one.

THERSITES (HADRA) BARTSCHI NESIA, new subspecies

Plate 3, fig. 5

Shell very small, thin; whorls 5½, rather flattened. Base very convex, its depth exceeding the height of the spire; umbilicus moderate, but little concealed by the reflected columellar tip. Sculpture of many fine retractive growth lines and microscopic reticulations. Body whorl sloping, periphery rounded except in front of the aperture where it is sharply angulated. Sutures not deeply impressed, crenulated by the upper ends of growth lines. Aperture very oblique, peristome white, slightly reflected. Color dark chestnut brown, the base somewhat darker than the spire, the sutures margined by an irregular darker band at the top of each whorl, the colors of the base and spire divided by a narrow yellowish band at the perphery. Interior dark brown below, whitish mottled with chestnut above and a clear white band marking the periphery.

The type (Cat. No. 333804, U.S.N.M.) measures: Major diameter, 25.5 mm.; minor diameter, 22.5 mm.; height, 20 mm. It comes from Yam Island, Torres Strait, and was presented by Mr. C. Walton.

The small size, the deep base, and the oblique aperture distinguish this shell from all others of the group. Its nearest relative is *Thersites bartschi nura*.

THERSITES (HADRA) BARTSCHI PAULENSIS, new subspecies

Plate 3, fig. 10

Similar to *Thersites bartschi bartschi*, but smaller, whorls a trifle more rounded, base slightly more convex, aperture less flaring. Color nearly uniform dark rich chestnut, a little darker on the base, darkest just behind the aperture. The peripheral band is not whitish but light chestnut. Interior sharply divided into upper lighter and lower darker portions by a very distinct white band.

The type (Cat. No. 333805, U.S.N.M.) measures: Greater diameter, 41 mm.; lesser diameter, 35 mm.; height, 28.5 mm. It and three paratypes (Cat. No. 333806, U.S.N.M.) come from St. Paul's Island, Torres Strait, and were presented by Mr. C. Walton.

Material at hand from Murray Islands is divisible into two species, namely, the large whitish form described herein as *Thersites waltoni;* and the smaller, dark forms. The latter are divided in this paper into the five subspecies of *Thersites bartschi* which are described below. As Murray Islands are a group of islands, it is probable that these five subspecies come from separate islands, or perhaps in some cases from the same island but from different locations.

THERSITES (HADRA) BARTSCHI MURRAYENSIS, new subspecies

Plate 1, fig. 5

Shell large, rather thick, conic. Whorls 6½ but little rounded. Base moderately convex, umbilicus large, partly concealed by the reflected columellar lip. Body whorl angled at the periphery, the angle more appreciable to touch than to sight, abruptly descending at the aperture. Sculpture rather crude, of many prominent, retractive growth riblets, and with microscopic reticulations, which have a tendency to spiral arrangement, especially on the body-whorl. Aperture moderate, slightly oblique, peristome white simple at its upper part, reflected from the periphery around to the umbilicus. Parietal wall with a transparent glaze. Sutures crenulated by the upper ends of the growth riblets, not deeply impressed, but emphasized by a faint dark line below. Color of spire light chestnut, deepening to dark chestnut on the last two whorls. Base very dark, nearly black, an irregular whitish line suffusing the periphery and dividing the colors of the spire and base. Interior bipartite in color, the upper part nearly white, the lower part light violaceous.

The type (Cat. No. 333807, U.S.N.M.) measures: Greater diameter, 46 mm.; lesser diameter, 41 mm.; height, 28.5 mm. It comes from Murray Islands, Torres Strait, and was presented by Mr. C. Walton.

THERSITES (HADRA) BARTSCHI FAMA, new subspecies

Plate 3, fig. 9

This is somewhat smaller than *Thersites bartschi murrayensis* with the whorls more rounded and more exserted, the sutures more deeply impressed, the colors less pronounced and lighter, the peristome more expanded and the periphery less angulated.

The type (Cat. No. 333809, U.S.N.M.) measures: Greater diameter, 43 mm.; lesser diameter, 35.5 mm.; height, 31 mm. It and a paratype (Cat. No. 333810, U.S.N.M.) come from Murray Islands, Torres Strait, and were presented by Mr. C. Walton.

THERSITES (HADRA) BARTSCHI ELFA, new subspecies

Plate 3, fig. 3

This is a dwarfed form very like *Thersites bartschi fama*, which it approaches in all features but size.

The type (Cat. No. 333811, U.S.N.M.) measures: Greater diameter, 30 mm.; lesser diameter, 25 mm.; height, 21 mm. It and a paratype (Cat. No. 333812, U.S.N.M.) come from Murray Islands, Torres Strait, and were presented by Mr. C. Walton.

THERSITES (HADRA) BARTSCHI DIVA, new subspecies

Plate 2, fig. 2

More elevated than *Thersites bartschi fama*, the whorls still more rounded and more exserted, the base more convex, and the colors lighter and less pronounced, the body whorl rounded, with no angle at the periphery except just in front of the aperture.

The type (Cat. No. 333813, U.S.N.M.) measures: Major diameter, 41.5 mm.; minor diameter, 35.5 mm.; height, 31.5 mm. It comes from Murray Islands, Torres Strait, and was presented by Mr. C. Walton.

THERSITES (HADRA) BARTSCHI CEPA, new subspecies

Plate 3, fig. 1

Resembles *Thersites bartschi diva*, but smaller, whorls not quite so rounded, colors still less pronounced, the body whorl very faintly angulated at the periphery, the angle more appreciable by touch than by sight.

The type (Cat. No. 333814, U.S.N.M.) measures: Greater diameter, 38 mm.; lesser diameter, 32 mm.; height, 29 mm. It and a paratype (Cat. No. 333815, U.S.N.M.) come from Murray Islands, Torres Strait, and were presented by Mr. C. Walton.

THERSITES (HADRA) WALTONI, new species

Plate 2, fig. 3

Shell rather large, thin, much depressed, whorls 6½, flattened, slowly increasing. Body whorl abruptly descending near the aperture, periphery rather sharply angulated. Sculpture of many slightly retractive, nearly obsolete lines of growth, and a microscopic reticulation which has a tendency to spiral arrangement. Sutures not deeply impressed, crudely crenulated by the upper ends of the growth lines. Base convex, its depth nearly equal to the height of the spire. Umbilicus wide, but largely concealed by the reflected columella. Peristome simple at its upper portion and not reflected there. At the peripheral angle the peristome begins to expand and is broadly reflected, especially at its junction with the parietal wall which is covered with a thin glaze. Color of spire pale tawny, base slightly darker, the darker shade more pronounced just behind the aperture; periphery marked by a fairly broad white spiral band.

The type (Cat. No. 333816, U.S.N.M.) measures: Major diameter, 62 mm.; minor diameter, 46 mm.; height, 35 mm. It comes from

Murray Islands, Torres Strait, and was presented by Mr. C. Walton, in whose honor the species is named.

Mr. Walton presented seven other specimens of this species from the same locality (Cat. No. 333817 and 333820, U.S.N.M.). Three of these are immature; one is abnormal in that it has the whorls rounded, and each slightly sunken into the succeeding whorl, has the periphery rounded instead of angular, and is distinctly spirally striate on the body whorl near the suture; the other two specimens are similar to the type but smaller.

The pale colors, flattened whorls, angular periphery and peculiar peristome, sharp at its upper portion and widely reflected from the peripheral angle to the umbilicus, make this one of most distinct species of the fauna of Torres Strait.

THERSITES (HADRA) DALLI, new species

Plate 2, fig. 8

Shell turbinate-conical, thin, rather elevated; whorls 6½, slightly convex, each appearing to be a little sunken into the succeeding whorl. Body whorl suddenly bent down near the aperture; periphery moderately angulated on the back of the body whorl, strongly angulated in front of the aperture, the outer lip showing scarcely any sign of being affected by the angle of the periphery. Sculpture of many slightly retractive growth riblets and a microscopic reticulation of fine lines. Sutures well impressed, somewhat crenulated by the upper ends of the growth riblets. Base convex, its depth slightly less than the height of the spire. Umbilicus wide, largely concealed by the reflected columellar lip. Aperture rounded, upper portion of the peristome simple, scarcely reflected; beginning to expand at the periphery until at the columella it is very broadly reflected and conceals a large part of the umbilicus. Parietal wall with a moderately thick glaze. Color of entire shell tawny, the base very slightly darker than the spire; an indistinct whitish band marking the periphery.

The type (Cat. No. 100176, U.S.N.M.) measures: Greater diameter, 44 mm.; lesser diameter, 38 mm.; height, 30.5 mm. It and a paratype (Cat. No. 333818, U.S.N.M.) were received from R. E. C. Stearns to whom they were sent by Dr. J. C. Cox, with the label "*Helix* (*Camaena*) *semicastanea* Pfeiffer; northeast Australia." These specimens show the wide range of variation allowed by Doctor Cox in his identifications of *Thersites semicastanea*. They bear but little resemblance to that species. They are closely related to *Thersites waltoni* Marshall in color, texture, and general form, but differ from it in being smaller, less angular at the periphery, more elevated, with the whorls slightly more rounded, and in having the aperture rounded with no sign of an angle in the outer lip to mark the angle of the periphery.

Doctor Cox's locality "northeast Australia" seems to indicate that these specimens came from the mainland. More likely it is simply a general locality and as such would include the islands in Torres Strait. Because of their close relationship to *Thersites waltoni* of Murray Islands which are quite distant from the coast it seems almost certain that they came from an island and not from the mainland.

THERSITE (HADRA) FORSTERIANA FORSTERIANA Pfeiffer

Plate 2, fig. 6

1854. *Helix forsteriana* Pfeiffer, Proc. Zool. Soc., p. 254.
1846–53. *Helix forsteriana* Pfeiffer, Conch. Cab., p. 373, pl. 140, figs. 9–10.
1860. *Helix hetaera* Pfeiffer Proc. Zool. Soc., p. 134.

Shell small, depressed-conic, moderately thick; whorls 6, slightly convex, body whorl narrowly rounded, scarcely descending in front; base moderately convex, umbilicus rather small, partly concealed by the reflected columella. Sutures well impressed, crenulated. Sculpture of fine, slightly retractive growth lines and microsopic reticulations or granulations finer and more plentiful than in other species of the group. Aperture sublunate, peristome thin, reflected at its lower part and broadly reflected at the columella. Color of spire pale yellowish with three spiral bands of light chestnut, one below and one above the periphery and one at the suture. A whitish peripheral band. Base very pale straw color much lighter than the spire. Columella with a tint of chestnut at its upper end. Interior whitish with the three exterior bands showing as tints of lavendar, the peripheral white band very distinct, peristome margined inside with pale lavendar.

The specimen figured (Cat. No. 317037 U.S.N.M.) measures: Greater diameter, 21.5 mm.; lesser diameter, 18.5 mm.; height, 15 mm. It forms part of the Henderson collection and is labeled "Lizard Island, Northeast Australia."

The same lot contains two other specimens in the same collection and from the same place. They are almost exactly like the figured specimen.

This species, although belonging in the group of *Thersites bipartita*, has a different color pattern and has a spire lighter than the base. The granulation or reticulations of the spire while finer and more plentiful than in other species is essentially of the same kind.

Pfeiffer himself [6] says that his *Helix hetaera* is the same as his *Helix forsteriana*.

[6] Monographia Heliceorum Viventium, vol. 5, p. 377, 1868.

THERSITES (HADRA) FORSTERIANA MAJOR Pfeiffer

Plate 3, fig. 6

1859. *Helix forsteriana major* Pfeiffer, Monographia Heliceorum Viventium, vol. 4, p. 174. (Not *Helix forsteriana major* Pfeiffer, Monographia Heliceorum Viventium, vol. 5, p. 377, 1866.)

Similar to *Thersites forsteriana forsteriana* but somewhat larger, with lines of growth more prominent and with the periphery obscurely angulate, and with colors less delicate.

The figured specimen is one belonging with four others under Cat. No. 100188, U.S.N.M. It measures: Major diameter, 24.5 mm.; minor diameter, 21 mm.; height, 17 mm. They belong to the Stearns collection and came from Dr. J. C. Cox, who labeled them "*Helix* (*Camaena*) *forsteriana* Pfeiffer" and quoted the locality as northeast Australia.

It seems almost certain that Pfeiffer described specimens like these as var. *major*. Later he gave another description of *major*[7] which was for a much larger shell and which Dohrn figured.[8] These are not subspecies *major*, but belong to the new subspecies described below.

THERSITES (HADRA) FORSTERIANA ADA, new subspecies

Plate 3, fig. 4

1866. *Helix forsteriana major* Pfeiffer, Monographia Heliceorum Viventium, vol. 5, p. 377. (Not *Helix forsteriana major* Pfeiffer, Monographia Heliceorum Viventium, vol. 4, p. 174, 1859.)
1879. *Helix forsteriana major* Dohrn, Conch. Cab., pl. 171, figs. 8–10.

Shell similar to *Thersites forsteriana forsteriana*, but very much larger, more depressed and the body whorl more descending in front. The type (Cat. No. 317036, U.S.N.M.) comes from Lizard Island, off the east coast of Queensland, and belongs in the Henderson collection. It measures: Greater diameter, 31 mm.; lesser diameter, 27 mm.; height, 18 mm. A paratype (Cat. No. 333819, U.S.N.M.) agrees in all respects with the type. Probably the specimens used by Pfeiffer in his second description of "var *major*"[9] were from the same locality as the specimens used here. He cites Cape Flattery, Australia. Lizard Island lies just off Cape Flattery on the east coast of Queensland. The specimens figured by Dohrn as *Helix forsteriana major* were from the same lot as those used by Pfeiffer in his second description of *major*, though he gives no definite locality. Dohrn's figures agree exactly with our specimens of *Thersites forsteriana ada*.

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[7] Monographia Heliceorum Viventium, vol. 5, p. 377, 1868.
[8] Conch, Cab., pl. 171, figs. 8, 9, 10, 1879.
[9] Mon. Hel. Viv., vol. 5, p. 377, 1868.

THERSITES (HADRA) DARWINI Brazier

1871. *Helix* (*Hadra*) *darwini* Brazier, Proc. Zool. Soc., p. 639.

Having no specimens and no illustrations to which to refer, the best that can be done for this species is to reproduce Brazier's original description and remarks.

Shell umbilicated, depressedly globose, very thin, finely granulated and radiately striated; spire moderately elevated, obtuse; whorls 5, slowly increasing, convex, last roundly convex, slightly descending in front, dirty yellow; base convex, sculptured the same as the upper surface; umbilicus rather small, deep; aperture diagonal, ovately lunate; peristome very little reflected, white; margins approximating and joined by a thin callus, columellar margin reflected and half covering the umbilicus.

Diam. maj. 7, min. 5½, alt. 4 lines.

Habitat: North coast of Australia (coll. Brazier). I received two specimens of this species from a friend who collected them in the far north of Australia, but the precise locality was not sent with them. It is allied to *Helix forsteriana* Pfr., from Northeast Australia.

EXPLANATION OF PLATES

(All figures natural size)

Plate 1

Fig. 1. *Thersites* (*Hadra*) *bartschi mobiagensis*, new subspecies.
2. *Thersites* (*Hadra*) *lizardensis suma*, new subspecies.
3. *Thersites* (*Hadra*) *bipartita bipartita* Ferussac.
4. *Thersites* (*Hadra*) *bartschi yamensis*, new subspecies.
5. *Thersites* (*Hadra*) *bartschi murrayensis*, new subspecies.

Plate 2

Fig. 1. *Thersites* (*Hadra*) *bartschi bartschi*, new subspecies.
2. *Thersites* (*Hadra*) *bartschi diva*, new subspecies.
3. *Thersites* (*Hadra*) *waltoni*, new species.
4. *Thersites* (*Hadra*) *lizardensis rada*, new subspecies.
5. *Thersites* (*Hadra*) *semicastanea semicastanea* Pfeiffer.
6. *Thersites* (*Hadra*) *forsteriana forsteriana* Pfeiffer.
7. *Thersites* (*Hadra*) *lizardensis lizardensis*, new subspecies.
8. *Thersites* (*Hadra*) *dalli*, new species.

Plate 3

Fig. 1. *Thersites* (*Hadra*) *bartschi cepa*, new subspecies.
2. *Thersites* (*Hadra*) *bartschi oma*, new subspecies.
3. *Thersites* (*Hadra*) *bartschi elfa*, new subspecies.
4. *Thersites* (*Hadra*) *forsteriana ada*, new subspecies.
5. *Thersites* (*Hadra*) *bartschi nesia*, new subspecies.
6. *Thersites* (*Hadra*) *forsteriana major* Pfeiffer.
7. *Thersites* (*Hadra*) *bartschi nura*, new subspecies.
8. *Thersites* (*Hadra*) *semicastanea alma*, new subspecies.
9. *Thersites* (*Hadra*) *bartschi fama*, new subspecies.
10. *Thersites* (*Hadra*) *bartschi paulensis*, new subspecies.

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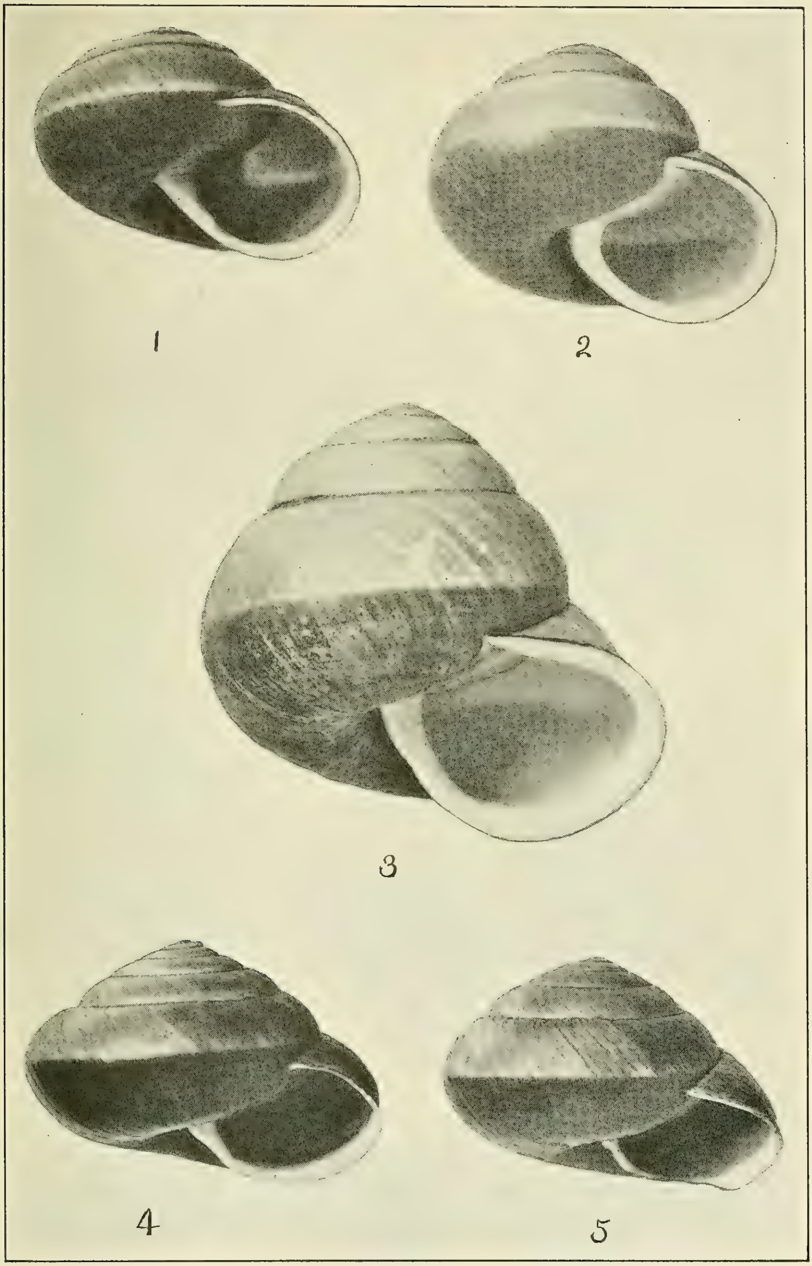
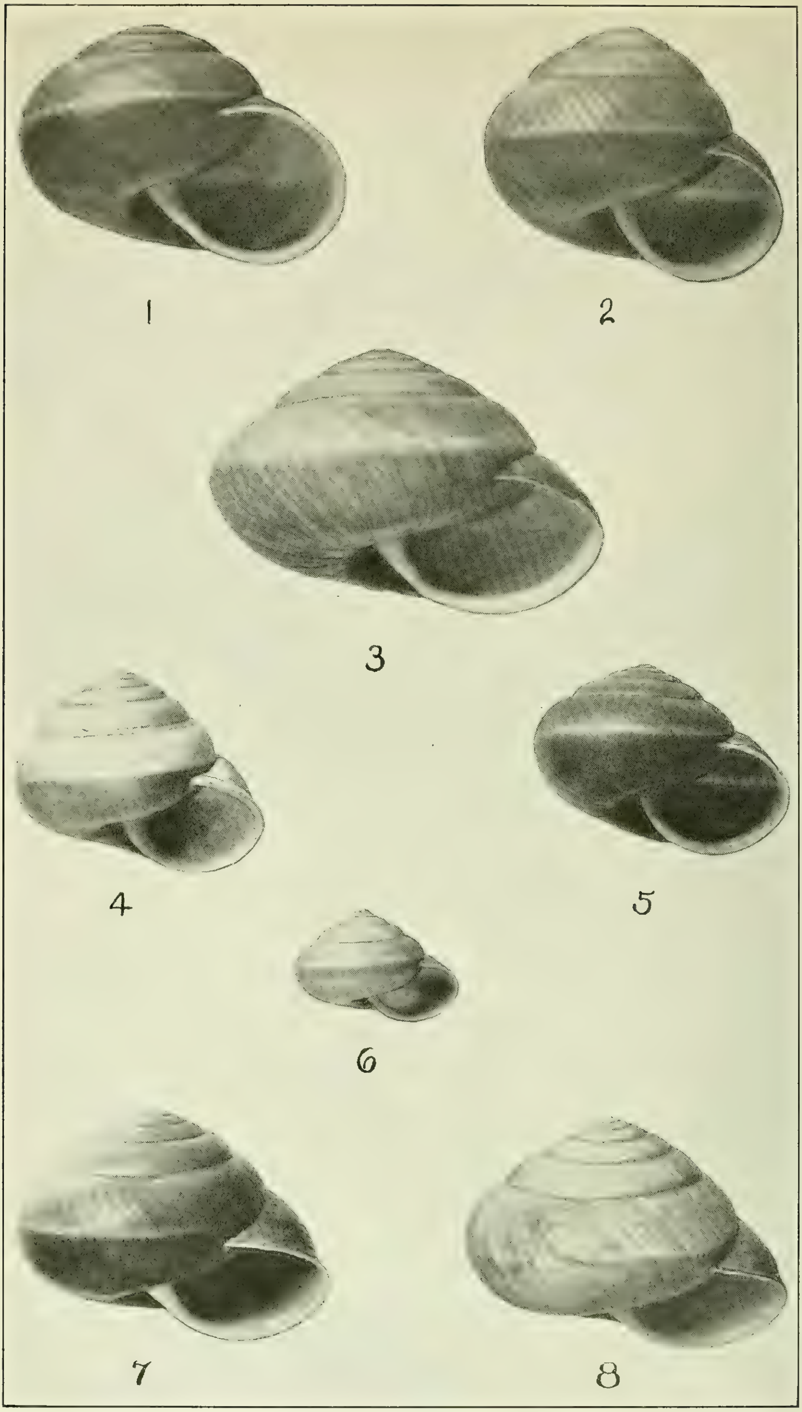


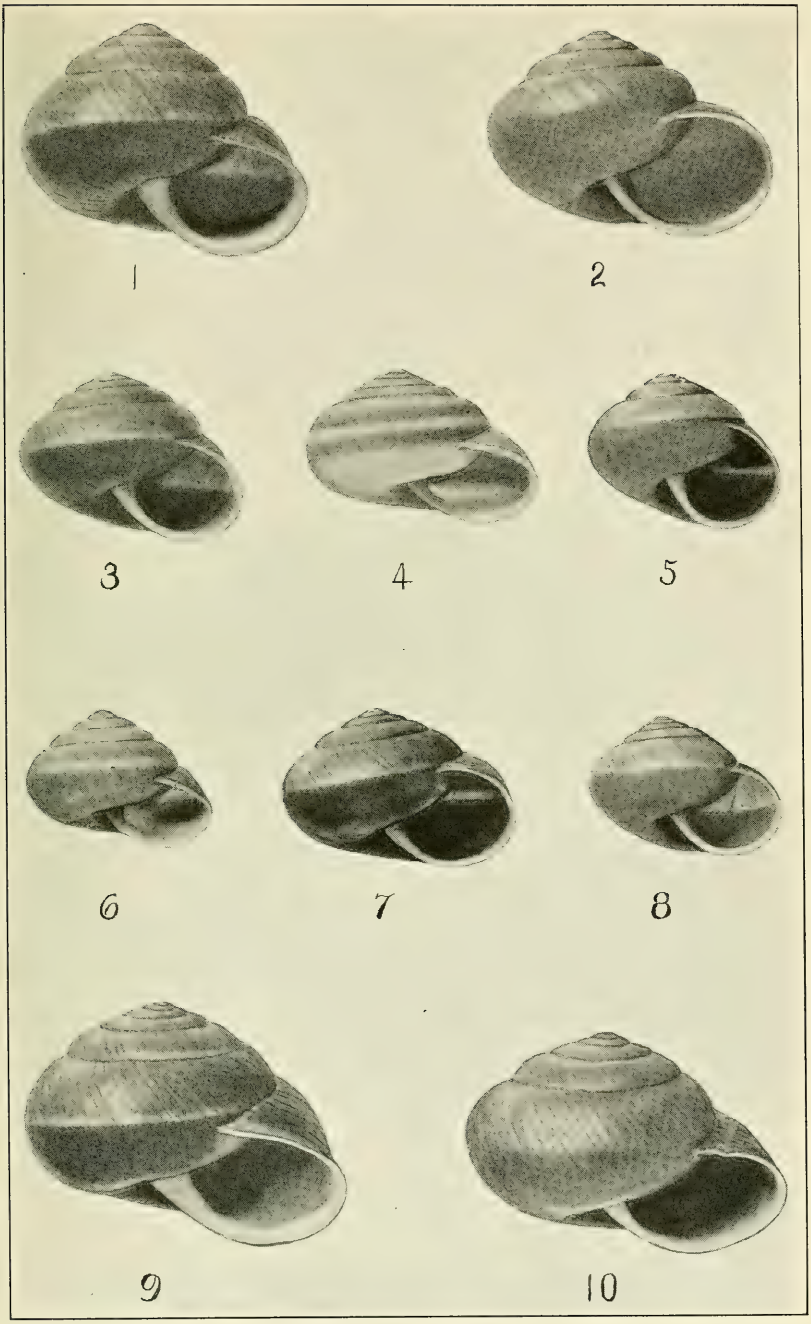
AUSTRALIAN LAND SHELLS

FOR EXPLANATION OF PLATE SEE PAGE 16



Australian Land Shells

For explanation of plate see page 16



AUSTRALIAN LAND SHELLS

FOR EXPLANATION OF PLATE SEE PAGE 16

THE RODENTS OF THE GENUS PLAGIODONTIA

By GERRIT S. MILLER, Jr.
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In 1836 Frederic Cuvier published[1] the description of a large rodent which Alexander Ricord had discovered 10 years before[2] in Haiti. He called the animal *Plagiodontia ædium*, the generic name alluding to the oblique folds of enamel on the molar teeth, the specific name suggested by the local appellation "Rat-Cayes," meaning house rat. In addition to a detailed technical account and a carefully prepared plate showing the external appearance, the skull and the teeth, Cuvier gave a short paragraph on the habits of the "Plagiodonte" taken from notes furnished by the collector. The animals frequented human habitations. They were very good to eat and the Haitians were even then, a century ago, hunting them to the verge of extermination.[3] Two specimens were brought to France by Ricord, the type, and an individual described by Paul Gervais in the first volume of the Histoire Naturelle des Mammifères, 1854 (pp. 346–347). Gervais figures the teeth (p. 346), and it is evident that his drawing is not a copy of Cuvier's.

The accounts written by Cuvier and Gervais long remained the sole basis of our knowledge of *Plagiodontia*. For it was not until February, 1916, that any further specimens were recorded. I then published[4] a short note on some bones, including a mandible with all its cheek teeth, found by W. M. Gabb in a kitchenmidden on San Lorenzo Bay (south shore of Samana Bay), Dominican Republic, in 1869–1871.[5] These specimens had lain for years unnoticed in the

[1] Ann. Sci. Nat., ser. 2, vol. 6, pp. 347–353, pl. 17.

[2] See Mulsant et Verreaux, Hist. Nat. des Oiseaux-Mouches, vol. 2, p. 76, 1875, for date of Ricord's work in the Antilles.

[3] Ces animaux portent à Saint-Domingue le nom de Rat-Cayes, c'est-à-dire Rat des habitations, d'où nous avons tiré le nom specifique que nous leur donnons; ils se rapprochent en effet des lieux habités, mais pendant la nuit seulement, car ils fuient la clarté du jour. Le mâle et la femelle se quittent peu Leur nourriture principale consiste en racines et en fruits, et, comme tous les rongeurs frugivores, ils sont ort bons à manger, et les Haïtiens, qui en sont très friands, les recherchent si soigneusement, qu'ils ont fini par rendre ces animaux très rares (p. 351).

[4] Proc. Biol. Soc. Washington, vol. 29, p. 47, Feb. 24, 1916.

[5] See Gabb, Trans. Amer. Philos. Soc., new ser., vol. 15, pp. 146–147, 1873.

No. 2712.—PROCEEDINGS U. S. NATIONAL MUSEUM, VOL. 72, ART. 16.|
55224—27

ethnological collections of the National Museum. Later in 1916 I recorded[6] bones which probably represented about six individuals unearthed by Theodoor de Booy[7] at San Pedro de Macoris on the south coast of the island about 60 kilometers east of Santo Domingo City, and other material, probably representing three individuals, which Dr. W. L. Abbott had recently dug from the same deposits at San Lorenzo Bay that had been examined by Gabb 46 years before.

While material for verifying the accuracy of F. Cuvier's diagnosis of the genus *Plagiodontia* was supplied by these discoveries it remained an open question whether or not the animal's extinction, apparently threatened at the period of Ricord's visit, had actually taken place. Vague accounts of a living rodent which might be either a *Plagiodontia* or an introduced agouti[8] have not infrequently been brought back by visitors to the island, but it has been impossible to verify any of them, and the identity of the animal to which they referred could never be determined.

At last through the persistent efforts of Doctor Abbott, who systematically explored both the Haitian and the Dominican Republics during the years 1916 to 1923,[9] it has been shown that the genus *Plagiodontia* still retains its place in the living fauna of the West Indies. On December 2, 1923 Doctor Abbott wrote me from Jovero, southeast of the entrance to Samana Bay:

> Have at last had luck with the Hutia (Plagiodontia?). Up to the present have secured 13, besides 3 embryos. There are skins and skeletons of 10 adults and 3 young in formalin. I was at Guarabo, a settlement in Savannas 10 miles east of this place, and an old man, stimulated by an offer of $5 apiece, brought me 11. He caught them with dogs in hollow trees down near a lagoon near sea shore. Females all pregnant, one fetus at a time. It was miserable at Guarabo, mosquitoes awful, mud and rain most of the time, so we came back here. Another brought me two Hutias last night from about 3 miles west of Jovero. The Hutias must still be abundant in some districts. The Dominicans don't seem to eat them but some dogs hunt them. They can climb to some extent. They are doomed with the coming of the mongoose. Their slow breeding will probably help their extinction.

Though it was evident from this letter that an important discovery had been made the possibility remained that the Hutia of the Samana Province might prove to be an *Isolobodon* and not a *Plagiodontia*. No living member of the genus *Isolobodon* has yet been found, but the flesh of *I. portoricensis* is known to have been used as a com-

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6 Smithsonian Misc. Coll., vol. 66, No. 12, Dec. 7, 1916.

7 An account of the deposits in which these bones were found was published by de Booy in 1919: "Santo Domingo Kitchen-Midden and Burial Mound," Indian Notes and Monographs, vol. 1, No. 2 (New York Heye Foundation).

8 The Brazilian *Dasyprocta aguti* has been successfully established on St. Thomas, Virgin Islands (Miller Proc. U. S. Nat. Mus., vol. 54, p. 508, Oct. 15, 1918).

9 For brief accounts of Doctor Abbott's work in this region see Smithsonian Misc. Coll., vol. 66, No. 17, pp. 36–39, 1917; vol. 72, No. 1, pp. 34–36, 1920; vol. 22, No. 6, pp. 43–47, 1921; vol. 72, No. 15, pp. 44–47, 1922; vol. 74, No. 5, pp. 62–63, 1923; vol. 76, No. 10, pp. 43–47, 1924.

mon article of food by the natives in Porto Rico, the Virgin Islands, and the Dominican Republic during late pre-Columbian times.[10] Both Gabb and Abbott obtained the remains of this animal together with those of *Plagiodontia* in the kitchenmiddens at San Lorenzo Bay, while Mr. de Booy found it to be by far the most abundantly represented rodent in the large mound which he worked out at San Pedro de Macoris. With the arrival of Doctor Abbott's specimens in Washington the generic identity of the animal with the one described by Cuvier was immediately established; but a comparison of this material with that from San Lorenzo Bay and Macoris suggested the possibility that two species might be represented, and raised the further question as to the exact determination of the animal collected by Ricord. In the hope of obtaining enough specimens to put these doubts to rest I have delayed publication until the present time.

The material now at hand convinces me that the genus *Plagiodontia* includes two species. Unfortunately it is necessary to decide somewhat arbitrarily as to the one which shall bear the name *ædium*. The descriptions given by Cuvier and Gervais are not sufficiently detailed to be conclusive; they might perhaps have been based on either animal. In 1904 I examined the type skin in Paris. The skull could not be found; and I have recently been informed by Mr. J. Berlioz that it is still missing. The skin is mounted and its color is obviously faded from long exposure to light. The notes which I then made are as follows:

Mounted specimen in fair condition, though somewhat faded and with end of tail broken off. Tail naked, smooth, the scales small and not imbricated, irregular in arrangement and form, but tending to be rounded-pentagonal; 30 mm. from base of tail they are scarcely more than 1 mm. in diameter. General color a faded grayish buff, much darkened by blackish and dark broccoli-brown hair tips, but the lighter color everywhere a little in excess. Underparts light isabella-color. Feet indefinite dusky. Ears naked internally, thickly furred along edge and apparently on outer side also. Head and body, 380; tail, 120; hind foot with claws, 74, without claws 68.

On the basis of these notes in conjunction with the two descriptions and figures there appear to be three features which indicate that the animal collected by Ricord was not the one recently found by Doctor Abbott, namely: In the type specimen the tail seems more conspicuously scaled than in the species now occurring on the Samana Peninsula, the color as described by both Cuvier and Gervais and as represented on Cuvier's plate is more yellowish, and the mandibular teeth, as figured by both writers are less like those of the Abbott specimens than they are like those of one found by de Booy at San

[10] See Miller, Proc. U. S. Nat. Mus., vol. 54, pp. 507–508. October 15, 1918

Pedro de Macoris and a series of six jaws which I collected in Haiti in 1925. It is therefore to the species represented by these mandibles rather than to the one collected by Doctor Abbott that I have decided to apply the name *ædium*. If I am correct in so doing the original *Plagiodontia* remains unknown in the living state.

The characters of the two species, so far as it is now possible to summarize them, may be contrasted as follows:

Antero-posterier diameter of crown in m_1 and m_2, measured along the median axis of toothrow fully equal to and frequently greater than the transverse diameter measured in line perpendicular to this axis; reentrant enamel folds relatively wide and not excessively long; size larger: length of mandible to tip of angular process in adults exceeding 60 mm., mandibular toothrow (alveoli) in adults about 24 mm ---------- P. ædium

Antero-posterior diameter of crown in m_1, and m_2, measured along the median axis of toothrow distinctly less than transverse diameter measured in a line perpendicular to this axis; reentrant enamel folds relatively narrow and long; size smaller: maximum length of mandible to tip of angular process in adults about 55 mm. or less, mandibular toothrow (alveoli) in adults less than 21 mm ---------- P. hylæum

PLAGIODONTIA HYLÆUM, new species

Type.—Young-adult male (skin and skeleton) No. 239887, United States National Museum. Collected at Guarabo, 10 miles east of Jovero, Samana Province, Dominican Republic, November 23, 1923, by Dr. W. L. Abott.

Characters.—General appearance essentially as in *Plagiodontia ædium* but color probably darker and less yellowish, size slightly less, and mandibular teeth with crowns compressed along the axis of toothrow.

External features.—In size and external characters the animal is not unlike *Geocapromys browni* of Jamaica, but the color is lighter and more uniform, the entirely naked tail extends beyond the outstretched hind feet by about one-fourth or one-third of its length, the ears are so small as to be almost completely buried in the fur (in an adult preserved in alcohol, No. 239898, the ear measures: height from meatus 20, height from crown 12, width 12.6; the general depth of the surrounding fur is about 19, with longest hairs 29), the feet are heavier, with more robust, less curved claws, the claw on the thumb is decidedly better developed, and the surfaces of the palms and soles are less conspicuously and completely covered by minute tilelike thickenings of epidermis, these rarely assuming the definite subcircular or subpentagonal form which they commonly show in *Geocapromys browni*. A large area including the heel and much of the postero-external region of the sole is nearly or quite smooth. The tail is naked except that the fur of the body extends out on its extreme base for a distance of about 10 mm., and the rest of its surface is sprinkled with minute hairs (about 2 mm. in length) so sparsely spaced that they might readily escape notice. The epidermis of the tail is faintly and irregularly divided into tilelike plates about 1 mm. in diameter. In some individuals these plates are so poorly developed that, over large areas, their outlines practically disappear, in others they are rather definitely arranged in irregular rings the posterior edges of which are enough raised to suggest a slight inbrication. The fur is deeper and less coarse than that of *Geocapromys browni*, and the light rings on the dorsal hairs are less contrasted with the dark elements of the color.

Color.—General color throughout nearly the wood-brown of Ridgway (1912), darkening to buffy-brown on chest and belly, and paling to avellaneous on anterior part of throat; inner surface of hind legs and area between them and around base of tail tinged with prouts-brown. On the underparts the light brown is uniform; on the entire dorsal and lateral surface it is finely intermingled with dark brown, much less conspicuously than in *Geocapromys browni*, producing an effect of slight clouding but not of any obvious speckling. In certain lights the longer hairs reflect a silvery gloss. The hairs of the back are all light plumbeous at base (this color not appearing at the surface of the fur). The longer hairs have long dark brown tips, the shorter ones have each a wood-brown subterminal annulation about 5 mm. wide and a very short dark brown tip. On the sides and underparts the basal color tends to lose most of its plumbeous tinge and to become light wood-brown, so that the hairs of the belly are often practically uniform from base to tip.

Skull.—The skull (pl. 1, figs, 1, 1*a*, 1*b*) is slightly smaller than that of *Geocapromys browni*, but its general form is not very different. Its chief peculiarities as compared with the skull of the Jamacian animal are as follows. In dorsal aspect: The less breadth between lacrimals and at level of anterior zygomatic root as compared with that at the coronal suture and across posterior zygomatic region; the more anterior position (mostly in front of the middle of orbits) of the swellings caused by the frontal sinuses; the more sharply defined postorbital process. In lateral aspect: Less depth of rostrum as compared with that of braincase; antorbital foramen about as deep as orbit instead of much deeper than orbit, its upper, outer margin sloping obliquely forward instead of backward in relation to alveolar line; much more slender zygoma, the upper margin of which does not bear an orbital process; jugal slender, without posterior concavity and postero-inferior process; excessively long paroccipital process (its length about double the vertical diameter of auditory bulla instead of slightly less than diameter of bulla). In ventral aspect: Much smaller incisive foramina and narrower anterior zygomatic region; least longitudinal diameter of glenoid surface very slightly greater than transverse diameter instead of about three times as great as transverse diameter. Mandible: Narrow sigmoid flexure and high position of coronoid process, its tip almost reaching articular level; greater width and nearly horizontal border of masseter ridge, particularly in the region beneath m_2 and m_3; more conspicuous protuberance under root of pm_4; broader under surface of angular process; much less oblique symphysis; protuberance marking base of incisor situated at about middle of line connecting inner margin of alveolus of m_1 with posterior extremity of symphysis instead of entad to middle of m_3.

Detailed comparison with the skull of *Plagiodontia ædium* is impossible at present. Nothing is known as to the whereabouts of the two skulls collected by Ricord, and the only specimens which I am able to refer to the original species are mandibles. Cuvier's figure shows two characters which, if actually as represented, should be diagnostic, namely, there are no postorbital processes (these are always conspicuous in *P. hylæum*), and the vacuity formed by the combined orbit and temporal fossa, as viewed from above, is much smaller than in any of the skulls collected by Doctor Abbott. The mandible of *Plagiodontia hylæum* is smaller and more lightly built than that of *P. ædium*, but there appear to be no tangible peculiarities in form.

Teeth.—The teeth (pl. 1 figs. 1*a*, 1*c*; also Smithsonian Misc. Coll., vol. 66, No. 12, pl. 1, fig. 4, December 7, 1916) differ from those of *Plagiodontia ædium* as figured by Cuvier and Gervais and as represented by one mandible from San Pedro de Macoris, Dominican Republic (pl. 1, fig. 2) and six from San Michel, Haiti, in a general compression of the crowns along the axis of the toothrow, so that the grinding surface of each tooth and of the series of teeth taken as a whole is noticeably shorter in proportion to its width. In the specimen from San Pedro de Macoris the length of the entire mandibular grinding surface is 23.2 mm., greatest width transversely to longitudinal axis 5.4, ratio of width to length, 23.3. In the two largest specimens of *P. hylæum* (Nos. 239891 and 239893) the length is 21.0, the width 6.0, and the ratio of width to length 28.6. In the type the same measurements and ratio are 19.0, 5.2, and 27.1 The reentrant folds extending outward from the inner side of the teeth are very narrow and so long that the tip of the anterior fold in m_1 and m_2 pushes across to a position where it almost fills the apex of the anterior outer salient angle; the length of the posterior border of this fold is conspicuously greater than the transverse diameter of the crown measured in a direction perpendicular to the long axis of the folds. In *P. ædium* the tip of the first inner reentrant leaves free a definitely triangular dentine area in the apex of the anterior outer salient angle, and the length of the posterior border of this fold is not greater than the transverse diameter of the crown. The first and second salient folds on the lingual side of the teeth are usually truncate at the tip in *Plagiodontia hylæum*, while in *P. ædium* a lanceolate termination for all three folds appears to be normal, though the material is not in sufficiently good condition to show this is a reliable diagnostic character. In both species the enamel margin of the cheekteeth becomes thin and nearly or quite discontinuous for a varying distance along the anterior apex of pm_4 and along the anterior border of each of the molars in the region of its contact with the tooth in front of it. This process appears to be more pronounced in *P. hylæum* than in *P. ædium*.

No satisfactory comparison of the maxillary teeth with those of *P. ædium* is now possible.

Measurements.—For measurements, see accompanying table. "Head and body" and "tail" were measured by the collector. The "hind foot" includes the claws. All specimens with complete measurements are from Guarabo, Dominican Republic.

Remarks.—The series of ten adult skins is very uniform, such individual variation as occurs on the dorsal surface being confined to slight differences in the yellowness of the wood-brown element of the color, and to the greater or less abundance of dark tipped hairs on the back and sides. Ventrally there is slight variation in the tone of the buffy-brown, this assuming a faint drabby cast in some of the skins. An immature individual (No. 239894) is more grayish than the adults, but the difference is not conspicuous. The skulls and teeth are equally constant in all their characters. Perhaps the two most variable features of the skull are the exact size and form of the frontal swellings over the sinuses, and the outline, broadly or narrowly triangular or occasionally peglike, of the postorbital processes. The enamel pattern is very constant and is apparently not subject to variations due to age.

EXPLANATION OF PLATE

All figures natural size

FIG. 1. *Plagiodontia hylæum.* Skull and right mandible of type.

FIG. 2. *Plagiodontia ædium.* Right mandible from San Pedro de Macoris, Dominican Republic.

Measurements of Plagiodontia

Number	Sex	Head and body	Tail	Hind foot	Skull: Greatest length	Condylobasal length	Palatal length	Zygomatic breadth	Interorbital constriction	Mastoid breadth	Occipital depth	Median rostral depth	Nasal	Combined breadth of nasals	Diastema	Mandible	Mandibular symphysis	Maxillary toothrow (alveoli)	Mandibular toothrow
P. ædium:																			
217126 [1]	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	62+	28+	----	24.0
[2]	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	27.6+	----	23.4
P. hylæum:																			
239886	♂	348	127	70	72.4	64.2	36.4	39.0	16.6	26.4	16.8	15.0	23.0	8.0	15.8	51.0	21.4	18.8	18.6
239887 [3]	♂	372	140	72	74.0	66.4	38.2	40.6	18.8	26.0	16.6	16.0	24.6	9.0	16.6	52.6	23.0	19.2	19.4
239890	♂	380	130	74	74.8	68.0	40.4	42.6	20.2	27.4	16.8	17.0	24.6	9.6	17.2	53.8	23.4	20.2	20.2
239891	♂	363	137	71	78.2	70.2	40.8	44.0	19.8	29.2	17.4	16.8	25.8	10.8	17.6	54.4	25.2	21.0	20.6
239892	♂	386	146	72	75.0	67.8	39.2	44.4	19.2	27.2	17.2	16.4	23.6	9.8	17.2	55.0	25.0	19.8	19.6
239895	♂	405	130	74	74.2	65.4	38.2	43.0	19.0	28.0	17.8	17.8	25.0	10.2	16.6	52.0	24.2	18.8	19.4
239888	♀	384	143	74	77.2	67.8	38.0	42.8	20.0	26.8	17.2	15.6	24.0	9.8	16.2	55.2	24.0	20.4	20.2
239889	♀	387	140	70	72.8	60.6	37.8	42.6	19.0	27.0	17.0	15.8	23.4	9.0	16.2	54.2	24.6	19.8	20.0
239893	♀	365	140	74	76.0	61.2	38.8	39.8	19.0	27.2	16.6	16.0	24.8	9.8	16.6	55.2	25.0	20.6	20.6
239896	♀	360	143	71	74.0	64.0	37.0	40.8	17.6	26.8	16.8	17.0	25.4	9.6	15.4	52.6	23.8	20.0	19.8
200412 [4]	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	52+	24+	----	20.2
217112 [1]	----	----	----	----	----	----	----	----	18.8	----	----	16+	----	10.2	17.4	----	----	20.4	----
221023 [4]	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	52.4	22.6	----	19.0
221024 [4]	----	----	----	----	----	----	----	----	----	----	----	----	----	----	17.6	----	----	20±	----

[1] San Pedro de Macoris, Dominican Republic.
[2] San Michel, Haiti; not numbered.
[3] Type.
[4] San Lorenzo Bay, Dominican Republic.

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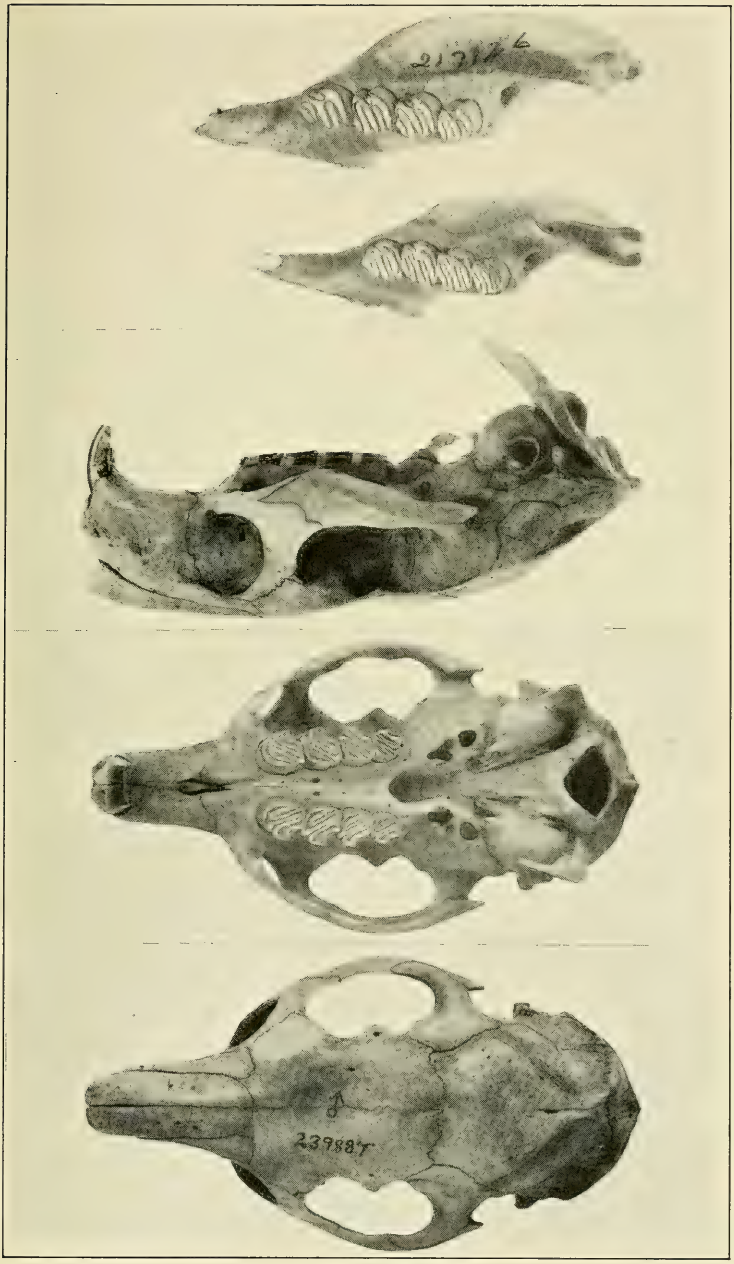

1 1a 1b 1c 2

RODENTS OF THE GENUS PLAGIODONTIA

FIG. 1.—SKULL AND MANDIBLE OF P. HYLAEUM, TYPE. FIG. 2.—MANDIBLE OF P. AEDIUM F. CUVIER

FOR DESCRIPTIONS OF PLATE SEE PAGE 8

ON SOME TERRESTRIAL ISOPODS IN THE UNITED STATES NATIONAL MUSEUM

By Hans Lohmander,

Of Lund, Sweden

Having devoted much time to the study of the Trichoniscidae of northern Europe, I desired also to know something of the species of this family of terrestrial Isopods that had been found in North America. Through the friendly assistance of Dr. Waldo L. Schmitt, curator of marine invertebrates, a series of specimens was sent to me for study from the United States National Museum. My examination of this collection has given rise to the following article.

In the North American collection I have found three species more or less widespread in Europe, *Trichoniscus pusillus* Brandt, *Trichoniscus pygmaeus* Sars, and *Haplophthalmus danicus* Budde-Lund, and two species foreign to Europe, *Trichoniscus papillicornis* Richardson and *Brackenridgia cavernarum* Ulrich.

It is reasonably certain that at least two of the species first mentioned, *Trichoniscus pygmaeus* and *Haplophthalmus danicus*, have been brought to North America from Europe with garden produce, etc. In the greater part of their European ranges these species also bear an obviously synanthropic character and are to be found most frequently in hothouses, gardens, graveyards, etc.

With respect to *Trichoniscus pusillus* it is more difficult to arrive at a definite conclusion. Its presence and distribution in North America is first to be carefully considered. It seems, however, remotely possible that this species—occurring over the whole of central and northern Europe and being the most common of all the terrestrial Isopods found in the Scandinavian countries—may also be indigenous in the eastern parts of North America.

Trichoniscus papillicornis Richardson, which thus far has been found only in the extreme northern portion of the Pacific Ocean (Bering Island and Cook Inlet) has on a close examination been found not to be a *Trichoniscus*. It belongs to the family Scyphacidae and is nearly allied to certain species of terrestrial Isopods which have hitherto been found only in antarctic regions. This species, therefore, is of unusually great zoogeographical interest, so I have given in the following pages a detailed description of it as well as a series of illustrations.

The specimens of *Brackenridgia cavernarum* Ulrich in the collection are in a very disjointed condition, and so I have refrained from a close examination of them. From Ulrich's description and illustrations (Richardson, 1905, p. 700), it is very doubtful whether this species belongs to the family Trichoniscidae (compare especially Richardson, 1905, fig. 740*d*). If it does, it occupies a very independent position. I leave it to my American colleagues to answer this question with the aid of fresh and better material.

So far as can be judged at present, it is rather uncertain whether North America possesses any terrestrial Isopods undoubtedly indigenous belonging to the family Trichoniscidae.

As a result of these studies *Trichoniscus papillicornis* (Richardson) is made the type of a new genus *Detonella;* the supposed identity of *Haplophthalmus puteus* Hay with the earlier species *H. danicus* Budde-Lund is confirmed, and a new variety of this latter, *H. danicus* var. *rotundatus*, is designated and briefly characterized.

Family TRICHONISCIDAE Sars, 1899

TRICHONISCUS PUSILLUS Brandt, 1833

Localities.—Niagara Falls, N. Y.; Haverford, Pa., H. Pratt, collector. On fern leaf from England, intercepted at New York City, January 22, 1924, Ivan Schiller, collector.

Remarks.—Richardson, 1905 (p. 695), mentions no definite North American localities for this species, but uses only the vague expression "North America." From the present collection no definite conclusion can be drawn. This species, which is very widespread, especially in the north of Europe, may very probably be indigenous at least in the eastern parts of North America. But it may also be possible that, as with so many other terrestrial Isopods and Diplopods, it was introduced from Europe and has since spread more or less independently. It is for North American zoologists to try to settle this question.

The European "*Trichoniscus pusillus*" has proved to constitute a collective species, containing a number of more or less nearly allied species and subspecies that are to be definitely distinguished only by means of the pleopods of the males. The greatest part of the European "*Trichoniscus pusillus*," however, comprises one species, the true *Trichoniscus pusillus* Brandt. This is definitely settled regarding western and northern Europe, and it is the most common of all the terrestrial Isopods in the Scandinavian countries. It is remarkable that the males of this species are usually much rarer than the females. Only in southern France do males and females appear in about equal numbers. In central France males are more uncommon and in the northern part very rare. (See Vandel, 1923, p. 793.) In the south of Sweden I have, on an average, found only 1 male to each 100–200 females. In northern Europe, consequently, parthenogenesis seems to be the general rule and the uncommon males can be of no great importance in the perpetuation of the species. It would be of interest to learn the corresponding facts for the tribe of *Trichoniscus pusillus* inhabiting North America.

Whether the North American *Trichoniscus pusillus* is identical with the true *Trichoniscus pusillus* Brandt of west and north Europe can be made certain only after the discovery of a male, as comparison of females alone can not decide this point.

TRICHONISCUS PYGMAEUS Sars, 1899

Locality.—On lily bulbs from Scotland, intercepted at New York City, October 4, 1923, I. Schiller, collector.

Remarks.—This species is not rare in southern Sweden, but occurs only synanthropically in hothouses, gardens, and graveyards, and in Norway, Germany, and England it is found in similar locations. It will, on closer investigation, certainly be found, at least in hothouses, in the eastern parts of North America. Because of its concealed habitation, usually down in the earth, under stones, rotten wood, etc., it is difficult to discover. Like other species of Trichoniscidae, it is most easily collected during the early spring and the late autumn. The males of this species are almost as common as the females.

HAPLOPHTHALMUS DANICUS Budde-Lund, 1879

1899 *Haplophthalmus puteus* HAY, Proc. U. S. Nat. Mus., vol. 21, p. 871, pl. 86, figs. 1–15.

1905 *Haplophthalmus puteus* RICHARDSON, Bull. U. S. Nat. Mus., No. 54, p. 697, fig. 739.

Localities.—Plummer Island, Potomac River, Maryland, from deep layer of old leaves, May 6, 1924, H. S. Barber, collector. From soil about roots of asparagus from Germany, intercepted at Philadelphia, Pennsylvania, November 4, 1924, R. S. Cogswell, collector.

In 1899, Hay described a terrestrial Isopod from wells in Indiana as new to science, under the name of *Haplophthalmus puteus.* Verhoeff later (1908, p. 189) demonstrated that this species was certainly identical with *H. danicus* Budde-Lund which is widely distributed in Europe. Verhoeff points out that there is only a single character that distinguishes one species from the other, namely, the shape of the telson, but accentuates at the same time that this difference is probably not real but caused by an error of observation by Hay.

The telson of *H. danicus* is thin and pellucid, and Hay had obviously regarded the internal edge of the basal parts of the uropoda as an acute-angled incision into the telson: "Terminal segment of abdomen notched behind." Though I have had no opporutnity to examine Hay's types, I admit without hesitation Verhoeff's construction.[1]

Richardson includes *H. puteus* Hay in her monograph on the Isopods of North America, but gives only a reprint of Hay's description and reproductions. She declares: "Although the types (two or three fragments) are in the United States National Museum, they have been so mutilated through dissection that I have found it more satisfactory to quote the above."

The figures that Hay has appended to his original description are numerous and fairly good and make certain the identity of *H. puteus* and *H. danicus*. They are, however, somewhat schematic and present some minor errors. As *H. danicus* has not been minutely described and figured (the figures in Sars, 1899, being rather schematic) I have given here short descriptions and sketches of the parts most significant as far as classification is concerned. The descriptions and figures are from the specimens from Plummer Island, Maryland, with the exception of the mandibles, which are from Swedish specimens, as the American micropreparations did not show the proportions very well.

Description.—Antennulae (fig. 1*a*) with the basal joint short and broad, the second joint somewhat longer than the first but much narrower, the terminal joint as long as the second but very much narrower, carrying at the end five sensory filaments, one of which is placed a little lower than the others.

Antennae (fig. 1*b*) with the basal joint short and very broad, transverse, the second joint longer but rather broad, the third joint somewhat shorter than the second, the fourth joint more than twice as long as the third, concave at the outer side, the fifth joint somewhat longer than the fourth, narrow at the base and abruptly thickening upwards. The second and third joints carry a few, the fourth and fifth joints numerous, pointed tubercles formed of short lamellar bristles, and arranged in longitudinal rows. Flagellum shorter than the last joint of the peduncle, three-jointed, the last joint terminating in a dense bunch of long delicate hair-like bristles; all the joints covered with short lamellar bristles, the second joint also carrying a few olfactory setae (*Leydigsche Borsten*).

Right mandible (fig. 1 *c*) with the outer cutting edge formed of two large teeth, the inner cutting edge being represented by a cylindrical, somewhat curved prominence, ending in a crown of small teeth at the base of which is a single curved plumose seta.

[1] Mr. C. R. Shoemaker, of the U. S. National Museum, has examined the cotypes of *Haplophthalmus puteus* Hay and writes that there is no incision in the telson.

Left mandible (fig. 1 *d*) with the outer cutting edge formed of four teeth and the inner of three. Near the base of the inner cutting edge are two curved plumose setae. The molar tubercle is large, prominent, and ridged.

FIG. 1.—HAPLOPHTHALMUS DANICUS BUDDE-LUND. *a.* ANTENNULA; *b.* ANTENNA; *c.* RIGHT MANDIBLE DRAWN FROM SWEDISH SPECIMEN; *d.* LEFT MANDIBLE DRAWN FROM SWEDISH SPECIMEN; *e.* FIRST MAXILLA; *f.* SECOND MAXILLA; *g.* MAXILLIPED; *h.* PENIS

First maxilla (fig. 1 *e*), outer lobe armed at the end with about six acute, curved teeth, the two external ones being the largest, the following gradually smaller. Between the teeth is a delicate curved seta, thickened at the end. Inner lobe with three brushlike setae, the inner one being much larger than the others, which are almost subequal.

Second maxilla (fig. 1 *f*) distinctly bilobed at the apex, the inner lobe being somewhat longer and twice as broad as the outer. Both lobes are covered with delicate long and short setae, most of which are arranged in short transverse rows; they also carry a few stouter setae, two at the inner apex of the outer lobe, and about five at the apex and five at the inner distal margin of the inner lobe.

Maxillipeds (fig. 1 *g*), palp with the ischium distinct and armed on the outer side with two short spines. The inner margin of the palp with lobes which bear numerous short and long, stout and fine setae, and the outer margin bearing a few stout setae. The terminal part of the palp is distinctly segmented, the segments being mostly marked only through the lobes at the inner and the stout setae at the outer margin. Masticatory lobe narrow, oblong, and ending in a great conical obscurely segmented, densely hairy appendage.

Legs (fig. 2 *a–b*); in the male the distal joints of the legs are shorter and broader than in the female, and the spines of these joints are arranged in a somewhat different way in the two sexes. The general shape of the joints and also the arrangements of the setae in the males can be best made out from the accompanying figures.

Pleopoda (fig. 2 *c–d*); in the male the first pleopod has the basal portion large and somewhat expanded laterally. The exopodite is lengthened triangularly, at the middle abruptly narrowing through a break on the lateral margin. The endopodite is two-jointed and slender, the terminal joint being somewhat longer and slenderer than the basal joint, almost linear and rather abruptly narrowing toward the apex.

The second pleopod has the basal portion much smaller than the first and triangularly produced at the postero-lateral angle. The exopodite is transversely rectangular with the posterior margin concave and the angles rounded. The inner and posterior margins are fringed with very fine short setae and near the inner posterior angle there is also a single stouter seta. The endopodite has the basal joint short and broad, broader at the base, the terminal joint being very long and gradually tapering toward the middle from a rather broad base, then forming a straight needle.

Remarks.—I have examined a great number of specimens of this species from various parts of south Sweden and find that the first and second pleopoda of the male are subject to a certain variability. Amongst the pleopoda I regard that form as typical which I have described and reproduced above. In rare cases I find, in the first pleopoda, a very short, rounded, heart-shaped exopodite, the back edge of which does not even reach the terminal joint of the endopodite. I designate this form as variety *rotundatus*, new variety.

Lundblad (Entomol. Tidskr. Stockholm, 1914) has described individuals of this species from Sweden with only four sensory filaments on the antennulae under a special varietal name, while Sars (1899, p. 169) gives six; but this variety can hardly be maintained, as the number of sensory filaments seems to vary between four and six. I have found that five is the most common number.

Haplophthalmus danicus is widely spread in Europe, including the Scandinavian countries. The species, however, can not be indige-

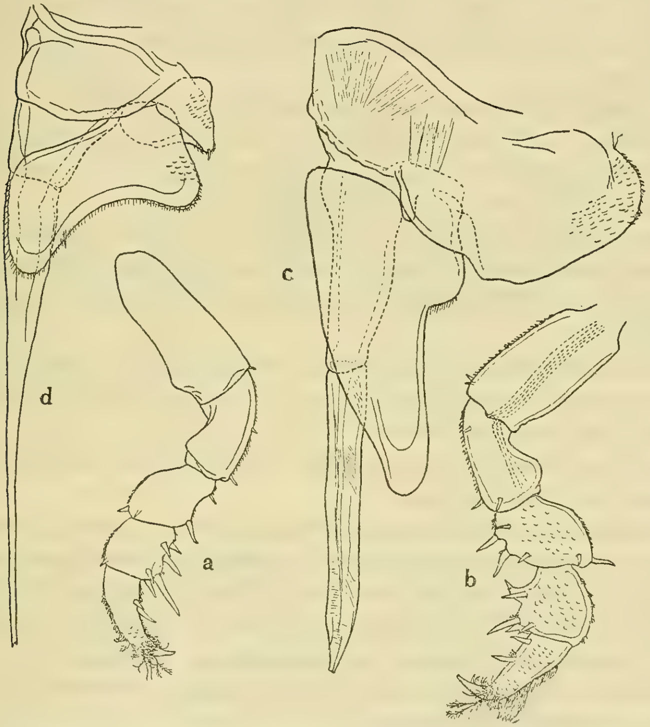

FIG. 2.—HAPLOPHTHALMUS DANICUS BUDDE-LUND. MALE: *a*. FIRST LEG; *b*. SEVENTH LEG; *c*. FIRST PLEOPOD; *d*. SECOND PLEOPOD

nous within the greater part of its European range but has certainly been introduced through the agency of man. It has been transported with garden produce, etc., and under favorable conditions has spread farther independently afterwards. It is often to be found under very natural conditions in Scandinavia.

The genus *Haplophthalmus* probably originated in the south of Europe as Verhoeff (1908, p. 195) has demonstrated. *H. danicus* has undoubtedly been introduced into North America in the same manner as into the northern parts of Europe, as with garden produce, etc. There will perhaps be found still another species of this genus in North America, *Haplophthalmus mengei* Zaddach. This species also is widely distributed in Europe which, in part at least, is due to the spread of culture, and in the south of Sweden the two species are not uncommonly to be found together. *H. mengei* is more fully discussed in Sars's excellent account (1899, pp. 167–168, pl. 72, fig. 1).

Family SCYPHACIDAE Chilton, 1901

DETONELLA, new genus

Body oblong oval, rather convex, epimera moderately developed. Pleon not abruptly narrower than pereion, last segment short, apex rounded. Dorsal surface with transverse rows of tubercles which are more developed in the male than the female. Head with large lateral lobes.

Eyes small but distinct and prominent, composed of few ocelli.

Antennulae with well-developed sensory plumose bristles at the second joint besides the usual sensory filaments at the third.

Antennae with four-jointed flagellum.

Mandibles with a bunch of stiff hairs at the base of the inner cutting edge, left mandible with three recurved brush-like setae and right with two. Molar process represented by a dense tuft of long plumose setae.

First maxillae with the outer lobe terminating in about 10 strongly chitinous spines, five of which are bifid, inner lobe bearing at the end two brush-like, subequal setae.

Second maxillae distinctly bilobed at the apex, outer lobe being much smaller than the inner.

Maxillipeds with palp longer than masticatory lobe. Palp lobed on the inner side, indicating that it consists of four joints, each lobe bearing a large number of stout setae. Masticatory lobe rectangular, rounded, truncate at the extremity, covered with fine setae and a few strong spines and bearing at its inner angle a plumose seta.

Legs rather short, increasing little in length posteriorly.

Penis bilobed at the apex.

Pleopoda simple, very different in shape and structure in male and female; in the former the inner dorsal surface of the exopodites bears a great number of long plumose setae which are lacking in the latter.

Uropoda produced, reaching considerably beyond the terminal segment, rami subequal in length but the inner one much the narrower.

Remarks.—The genus described above manifests in all essential characteristics so near an agreement with the genus *Deto* (Guérin) Chilton that I have created it only with some hesitation. Many differences, however, are to be found which seem to require the separation of the genus *Detonella*. It is also to be noted that all representatives of the genus *Deto* hitherto known have a subantarctic range—New Zealand; Australia; St. Pauls Island, Indian Ocean; South Africa; South America. (Chilton, 1914, p. 439.) Even if a close agreement between *Deto* and *Detonella* is indisputable, I find it rather difficult, because of the wide geographical difference in their ranges, to suppose a very near phylogenetic affinity between them. The species of the two genera seem to live under rather similar conditions and might be said to supply one another's places respectively in subarctic and subantarctic regions. Therefore it is not impossible that several conformities are convergences. *Detonella papillicornis* is found on the beach in the extreme northern portion of the Pacific Ocean, and Chilton says about the genus *Deto* (1914, p. 453): "All the species are strictly seashore inhabitants, probably not extending much above high-water mark or beyond the reach of the spray from the sea. In this respect as well as in many points of structure, they agree with the genera *Scyphax* and *Scyphoniscus*, and it is probable that their nearest affinities will be found to be with these two genera. *Scyphax* differs from *Deto* in the very large and well-developed eye with its rows of numerous ocelli, and *Scyphoniscus* in the peculiar structure of the end of the outer lobe of the first maxilla." In regard to these characteristics the genera in question differ also from *Detonella*.

The differences between *Deto* and *Detonella* will be best illustrated by the following comparison:

DETO [2]	DETONELLA
Length of adult specimens 11–24 mm. Eyes of moderate size, with numerous ocelli. Antennulae with the third joint large, extended, bearing sensory filaments in two rows distant one from the other, the second joint with only one biarticulate plumose seta. The outer lobe of the first maxilla with single-tipped teeth. The masticatory lobe of the maxillipeds with a very small rudimentary plumose seta; spines seem to be lacking. The exopodites of the pleopoda (2–5) in both sexes with well developed setae at the postero-lateral margins.	Length of adult specimens 3–4 mm. Eyes small, with few ocelli (about 6.) Antennulae with the third joint very small, rounded, the apex carrying three sensory filaments, the second joint with two articulate setae, at least one of which has a pencil bristle. About half of the teeth of the outer lobe of the first maxilla bifid. The masticatory lobe of the maxillipeds with a well-developed plumose seta, and some strong spines. The exopodites of the pleopoda (2–5) only in the male with plumose setae most of which are attached to the inner dorsal face near the median margin.

In her monograph Richardson admits only one representative of the family Scyphacidae from North America—that is, *Scyphacella arenicola* Smith. (Richardson, 1905, p. 672.) With *Scyphacella*, however, of which only the aforesaid species is known, *Detonella*

[2] Compare Chilton (1914, p. 348); and Wahrberg (1922, p. 80).

has but little in common. Aside from their widely separated ranges *Scyphacella* has large eyes with numerous ocelli, small lateral lobes and slender antennae. The mouth parts also seem to present a series of differences, but unfortunately they are so schematically reproduced by Richardson that no detailed conclusions can be drawn.

It thus appears that no near relative of *Detonella papillicornis* is known from the northern hemisphere. It seems, however, to be probable that upon closer investigation, other species of *Detonella* or related genera will eventually be found on the northern shores of the Pacific.

DETONELLA PAPILLICORNIS (Richardson)

1904 *Trichoniscus papillicornis* RICHARDSON, Proc. U. S. Nat. Mus., vol. 27, p. 670, figs. 18–22.

1905 *Trichoniscus papillicornis* RICHARDSON, Bull. No. 54, U. S. Nat. Mus., p. 695, figs. 734–738.

Localities.—Seldovia, Cook Inlet, Alaska (Harriman Alaska Expedition), a single specimen found on the beach, type, United States National Museum, Catalogue No. 28772 (Richardson, 1905, p. 698); Bering Island, 1897, 2 males, 2 females (G. S. Barrett-Hamilton, collector), United States National Museum, Catalogue No. 43645.

Description.—Length of male, 3 mm.; of female, 3.8 mm.

Body narrow, oblong, nearly three times as long as broad, dorsal surface rather strongly convex, covered with transverse rows of rounded tubercles.

Head with triangularly produced, broadly rounded median lobe. Lateral lobes large, directed somewhat downwards, roundish, rectangular. From near the center of the dorsal surface of the head at each side a row of large tubercles runs outwards and backwards to the posterior margin; in the center between these rows there are three smaller tubercles, and a row of small tubercles follows the posterior border. The front margin of the median lobe is well marked by two slightly S-shaped ridges meeting at the apex of the lobe. Laterally from these ridges at each side a strong elongated tubercle is to be found, forming a transition from the median lobe to the lateral one.

Eyes small but distinct and prominent, black, composed of about six ocelli, oblong, and situated on the lateral margins at the base of the lateral lobes.

Antennulae (fig. 3 *a-b*) with the basal joint large and broad, second joint as long as the first but much slenderer and gradually tapering, terminal joint very small, rounded, carrying three sensory filaments (*Leydigsche Organe*), the longest of which are more than twice as long as the terminal joint. At the extremity of the second joint are two long biarticulate setae, the basal joint of which is very short and at least one of which ends in four extremely delicate hairs.

Antennae (fig. 3 *c-d*) rather short. The basal joint is narrow, transverse, the second and third joints are subequal in length and twice as long as the first, the fourth is one and a half, and the fifth twice as long as the third. The last three joints have the inner margins beset with numerous strong tuberculiform papillae, each surmounted with a tuft of very short bristles. The fifth joint is produced at the outer distal angle into an acute process and carries at the inner angle a curved seta. Flagellum scarcely as long as the fifth joint of the peduncle (scapus), composed of four joints, the first of which is shortest, and the third longest. The last joint is tipped with a bunch of hairs. At the middle of the third joint there is a group of about four olfactory setae (*Leydigsche Borsten*).

In the female the antennae are relatively longer and much more slender than in the male but show otherwise about the same proportions.

Left mandible (fig. 6*j*) with the outer cutting edge formed of three very long, strongly chitinous teeth, one of which is bifid at the end. The inner cutting edge (*lacinia mobilis*) also ends in three large teeth near the base of which arise two curved plumose setae; next follows a single one, and then from a marked prominence a brushlike tuft of long plumose setae, the inner one of which is shortest, the others gradually increasing in length, the outermost one being very long (*seta inferior*).

Right mandible (fig. 6*k*) similar to left but the teeth of the outer cutting edge are much shorter and the inner cutting edge (*lacinia mobilis*) ends in a crown of numerous small pointed teeth of irregular size. Inner cutting edge attended by a bunch of stiff bristles, between which and the dense tuft of long plumose bristles are two large plumose setae.

Lower lip (fig. 3*e*) formed of two rounded lobes which have the extremities thickly covered with short fine setae and have on their dorsal side a small number of short spines. Between these lobes is a narrow tonguelike central lobe, hairy at the end.

First maxillae (fig. 3 *f–g*), outer lobe narrow lanceolate, inner margin fringed with few, outer margin with a great many fine, delicate setae which are arranged in short transverse rows (*Kammschuppen;* comb lamellae). The extremity of the lobe bears about 10 stoutly chitinous spines of different sizes, five of which are bifid. Inner lobe narrow and provided with two subequal brushlike setae.

Second maxillae (fig. 3*h*) distinctly bilobed at the apex, outer lobe shorter and very much more slender than the inner, both rounded and bearing delicate setae and a number of short stout blunt setae, three at the apex of the outer lobe and about a dozen in a single row at the extremity of the inner.

Maxillipeds (fig. 3*i*); epipodite narrow, oblong, with the end rounded. Outer margin of the basis moderately expanded and toward the distal end bearing a fringe of fine setae. Masticatory

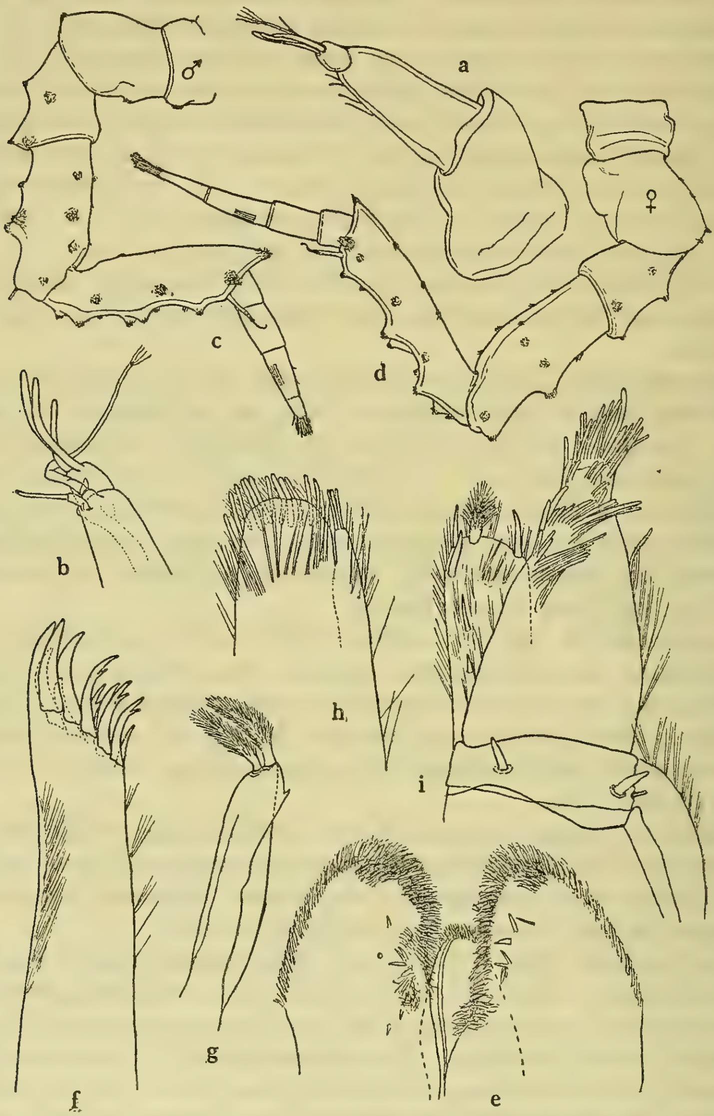

FIG. 3.—DETONELLA PAPILLICORNIS (RICHARDSON). *a*. ANTENNULA; *b*. ANTENNULA, THIRD JOINT AND EXTREMITY OF SECOND JOINT; *c*. ANTENNA OF MALE; *d*. ANTENNA OF FEMALE; *e*. LOWER LIP; *f*. FIRST MAXILLA, OUTER LOBE; *g*. FIRST MAXILLA, INNER LOBE; *h*. SECOND MAXILLA; *i*. MAXILLIPED

lobe (endite) large, more than half the length of the palp (endopodite), end roundly truncate and covered with fine setae, bearing also a number of spines and at the inner distal angle a rather large plumose seta. Ischium joint of the palp distinct, short, and on the ventral side armed with a few short spines. Terminal part of the palp formed of a single piece, which is lobed on the inner side,

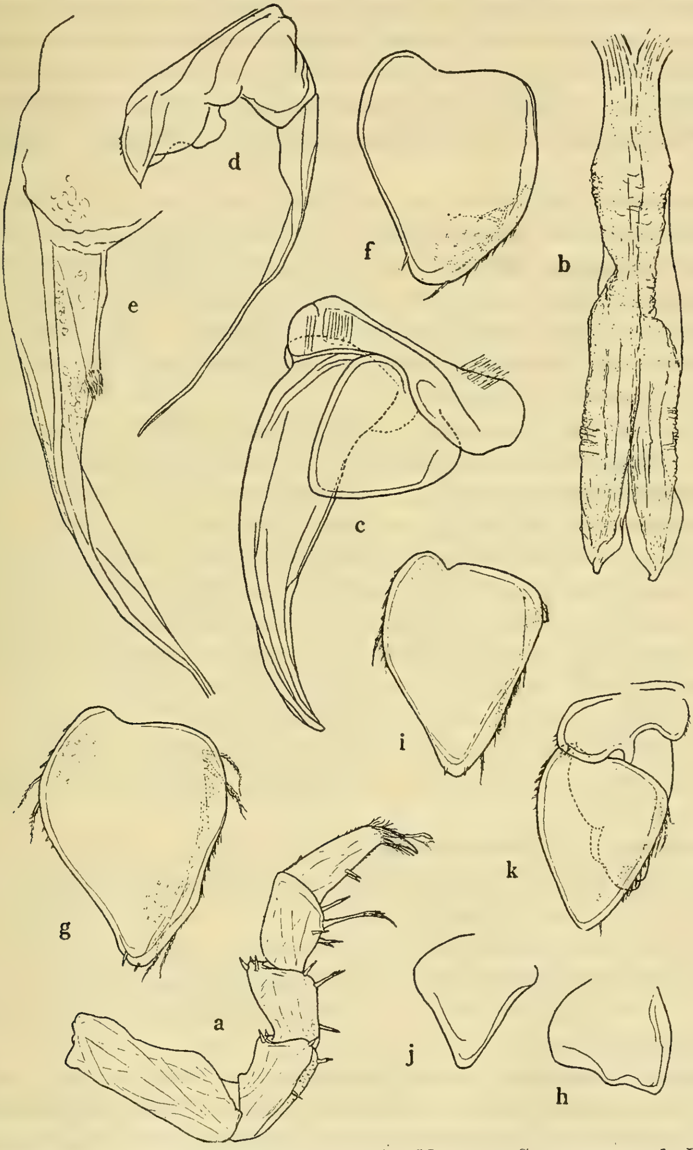

FIG. 4.—DETONELLA PAPILLICORNIS (RICHARDSON). MALE. *a.* SEVENTH LEG; *b.* PENIS; *c.* FIRST PLEOPOD; *d–f.* SECOND PLEOPOD; *g.* THIRD EXOPODITE; *h.* THIRD ENDOPODITE; *i.* FOURTH EXOPODITE; *j.* FOURTH ENDOPODITE; *k.* FIFTH PLEOPOD

indicating that it is composed of four joints each bearing many stout, short, and long setae. The outer and the inner margins of the palp fringed with fine setae, the outer margin bearing also one or two stout setae.

Peraeon, first segment slightly longer than the others which are subequal. Epimera rather undeveloped. The posterior margin of the first segment straight, the margins of the second and third slightly concave and those of the fourth to the seventh increasingly concave; postero-lateral angles broadly rounded in the first, slightly produced in the second to the fourth, and more and more acutely produced in the following segments, those of the seventh segment reaching as far as the posterior margin of the third segment of pleon.

The central parts of all the segments bear two transverse rows of rounded tubercles, one of which is close to the posterior margin. In the first segment the two rows are somewhat irregularly arranged, indicating a third row. On the epimera there is a single row of tubercles or, particularly on the last segments, rather an irregular ridge running obliquely outwards and backwards in the direction of the postero-lateral angle.

Legs somewhat increasing in length backwards, though all rather short. Basis nearly twice the length of the ischium, which is slightly expanded distally and one and a half times the length of the merus. The merus and the carpus are about subequal in length. The propodus is a little longer than either of the two preceding joints but considerably narrower. The dactylus is moderately stout and has the basal portion thickly covered with setae which are longer in the male than in the female and one of which is always much longer than the others. The terminal portion of the dactylus forms a rather slender claw, on the outside of the base of which in the male arises a long well developed seta having a slight club-like swelling toward its extremity, and arising from its side a delicate furcate feathery hair. (Fig. 5*d.*)

The inner side of the propodus, carpus, merus, and ischium, and the outer distal margin of the merus and ischium bear a number of rather short, stout, spiniform setae split toward the end. The carpus has also a single very long seta split and curved toward the end. The arrangement of the setae and the general shape of the joints of the legs can best be shown by the accompanying figures. (Figs. 4*a* and 6*a.*)

The inner margin of the propodus of the first pair of legs bears a row of very short spines and is also covered with very thin imbricated lamellae. (*Strukturschuppen*: Fig. 5*e.*) On the first pair of legs in the male I find a special sort of lamellae scattered upon the inner side of the carpus and merus, and the ischium distally; on the seventh pair they are present only upon the ischium and the adjoining part of the merus. (Figs. 5*c* and 4*a.*) These lamellae have the free edge serrated.

Penis bilobed at the end, as is shown in the figure. (Fig. 4 *b.*)

Pleon not abruptly narrower than peraeon; the first two segments covered laterally by the last peraeon segment, lateral angles of the third, fourth, and fifth segments well developed, terminal segment short, with the apex broadly rounded. The first and second segments bear a single row of rounded tubercles.

Pleopoda: In the male the first pleopod (fig. 4 *c*) has the basal portion short and broad, the outer margin rounded. The exopodite comparatively very small and triangularly heart-shaped. The endopodite is long, gradually tapering, slightly and evenly curved, with the end pointing outwards.

The second pleopod (fig. 4 *d–f*) has the basal portion similar to that of the first, the outer postero-lateral angle being produced slightly triangularly, pointed at the end and bearing a few short setae. Its exopodite is considerably larger than that of the first pleopod and more irregular in shape, its inner margin being fringed with fine setae and bearing on its inner dorsal surface a number of long plumose setae, as well as two short spiniform setae at the end, all of which are lacking in the first exopodite. The endopodite is two-jointed, the first joint being short and broadly rectangular, the second very long with the basal half curved and gradually tapering, the distal half forming a fine styliform process.

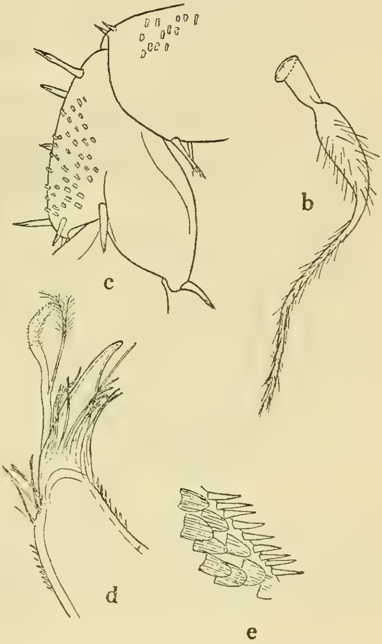

Fig 5.—Detonella papillicornis (Richardson). *b.* Plumose seta from the inner dorsal surface of the third exopodite of male; *c.* Merus and adjoining parts of the first leg of male, with lamellae; *d.* Dactylus of the seventh leg of male; *e.* Inner margin of the propodus of the first leg

The exopodites of the following pleopoda (fig. 4 *g–i–k*) are similar to those of the second but somewhat more elongated, the fourth and fifth becoming by degrees smaller and smaller. In the third exopodite the plumose setae are particularly well developed (fig. 5 *b*); besides those in an oblique row on the inner dorsal surface there are two setae at the outer margin (fig. 4 *g*). The proximal part of the outer margin is beset with short transverse rows of fine setae like the inner margin, those on the latter, however, being much longer. On the outer proximal and inner distal part of the dorsal surface there are a number of small transverse rows of fine setae (comb lamellae).

The endopodites of the third, fourth, and fifth pleopoda are roundly triangular, with the inner portion thickened, smaller than the exopodites, the fifth endopodite being the largest.

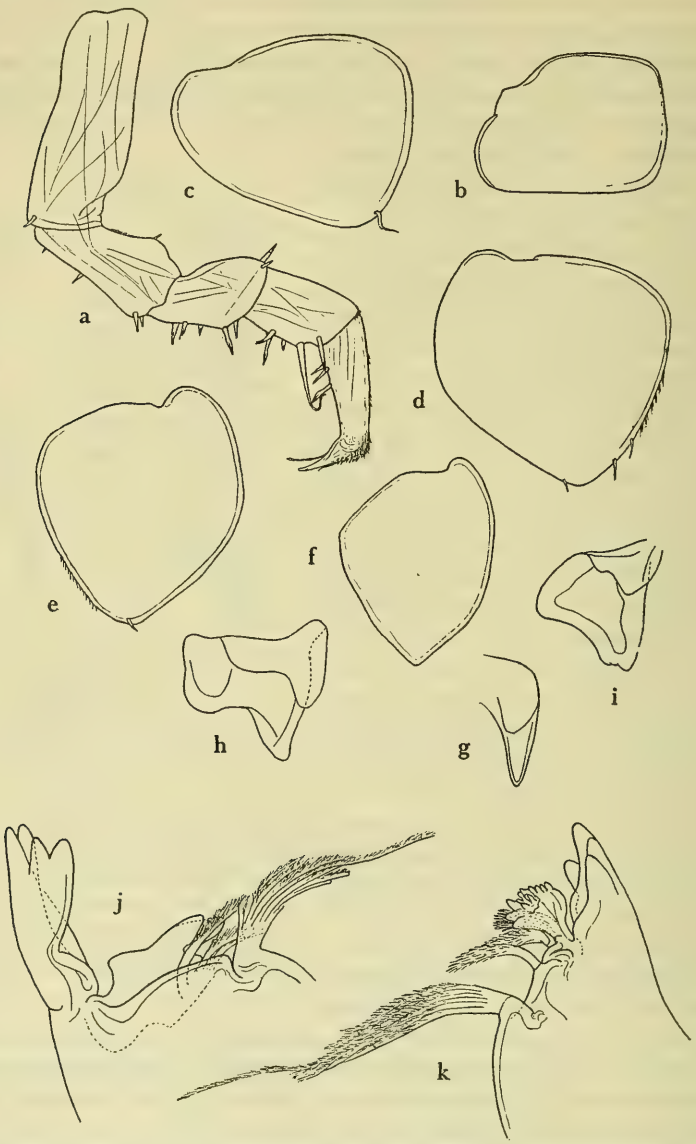

Fig. 6.—Detonella papillicornis (Richardson). Female. *a.* Seventh leg; *b.* First exopodite; *c.* Second exopodite; *d.* Third exopodite; *e.* Fourth exopodite; *f.* Fifth exopodite; *g.* Second endopodite; *h.* Third or fourth endopodite; *i.* Fifth endopodite; *j.* Left mandible; *k.* Right mandible

The pleopoda of the female differ considerably from those of the male. The first exopodite is almost transversely rectangular, the following exopodites gradually changing from a rectangular to a triangular shape. (Fig. 6 *b–f*.) The inner margins of the third and fourth exopodites are sparsely fringed with fine setae. The second and fourth exopodites each bear a short spiniform seta at the apex and the third exopodite bears three. Plumose setae are completely lacking. The first endopodite appears to be lacking, the second is small and narrow and the third to fifth are larger and subtriangular. (Fig. 6 *g–h–i*.)

Uropoda with bases large, and extending a little beyond the extremity of the terminal segment. Rami conical, the inner being nearly as long as the outer but much narrower throughout and both tipped with a few setae.

Remarks.—I have had no opportunity to examine the type specimen of *Trichoniscus papillicornis* from Cook Inlet. In fact, neither the description nor the reproductions of Richardson admit of any certain conclusion that the individuals from Bering Island and the single specimen from Cook Inlet belong to the same species. However, as the Bering Island individuals were determined by Richardson, the identity may be regarded as settled. On this presumption, Richardson's description of the antennae of *papillicornis* appears not to be quite correct, as she characterizes the flagellum as "composed of about seven articles" (1905, p. 696), while it is only four-jointed.[3] Otherwise I agree with Richardson's description of the species. Her reproductions are characteristic though somewhat schematic.

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[3] Mr. C. R. Shoemaker, of the United States National Museum, has examined the antennae of the type *Trichoniscus papillicornis* Richardson and finds that, owing to the fact that the type is a small, immature specimen, the exact number of articles in the flagella is rather obscure. As well as he is able to determine, there are four or possibly five articles, but the fifth is very obscure and uncertain.

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MILLIPEDS OF THE ORDER COLOBOGNATHA, WITH DESCRIPTIONS OF SIX NEW GENERA AND TYPE SPECIES, FROM ARIZONA AND CALIFORNIA

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INTRODUCTION

A special interest may be claimed for millipeds of the order Colobognatha as examples of interrupted or residual distribution, in widely separated regions which could not be reached by any method of transportation now at the disposal of these animals. The explanation for such facts of distribution is to be found by tracing back to former ages of the world when vegetation and surface conditions must have been widely different from those of the present time. The Colobognatha have greater environmental limitations than the members of most of the other orders, though the habits and living requirements are remarkably uniform through the whole class of millipeds.

From the general uniformity of habits at the present time it may be inferred that a similar uniformity existed in the past, and that the requirements for existence and survival have been much the same during the whole period of biological history of the group, or since their world-wide distribution was attained.

In comparison with most of the other millipeds, the Colobognatha are delicate, fragile, slow-moving creatures, unable to burrow in the soil or to withstand surface exposure. The legs and other appendages are very short and unspecialized, and restricted food habits are indicated by minute, rudimentary mouth parts.

The outstanding requirement for the existence of delicate humus animals is a continuous supply of moisture, not necessarily a regular supply, but one that is never completely interrupted, or the creatures at that place are exterminated. Thus the existence of humus fauna is an evidence of the moisture continuity of any locality, and may afford a better assurance regarding local conditions in the humus layer than is obtainable in any other way.[1]

[1] Cook, O. F. Notes on the distribution of millipeds in southern Texas, etc. Proc. U. S. Nat. Mus., vol. 40, pp. 147–167, 1911.

Species that lack the protection of a well-chitinized exoskeleton are more definitely confined to areas where the humus layer in which they live remains moist at all times and so furnishes food and continuous protection. Such areas are most commonly found in the Tropics where the rainfall is usually more abundant than in temperate regions. The greater differences between summer and winter climate in the temperate regions doubtless may also be considered as limiting factors of distribution, though the soil conditions appear to be much more important.

Humus faunas may be limited by the nature of the soil, as well as by the need of continuous moisture. The drying of the surface does not endanger the existence of a humus fauna where the conditions are such that its creatures can take refuge in a moist subsoil, but clays or colloidal soils do not afford such protection and are not adapted to the needs of a humus fauna. If the soil cracks in drying, the humus animals may enter, and may seek deeper levels as the season advances, but when the rain comes and water fills the crevices, the soil dissolves into soft mud and creatures buried in it have little chance to escape. Whether for this cause or others still to be recognized, the rule seems to be that the colloidal soils have little in the way of humus faunas, and often no animal life, even under conditions that in other respects may appear quite favorable. While humus faunas exist in many regions of colloidal soils, it is found in such regions that the animals live in the humus blanket, and are confined to the places where the blanket is thick enough to hold its moisture through the dry season. Under such conditions the animals may be said to live in the humus rather than in the soil, except as the character of the soil may be modified under a humus blanket.

As with other cosmopolitan orders of millipeds, most of the species of Colobognatha are tropical, but the few that have been found in temperate regions have been recognized as distinct genera or even as distinct families, not represented in the Tropics. From the United States only five species of Colobognatha have been known and in recent years this number has not been increased; three of the species were described from the Eastern States and two from the Pacific slope. One of the eastern species has been reported from several localities and belongs to the genus *Polyzonium*, that occurs also in Europe. The other eastern species, representing two very distinct genera, *Brachycybe* and *Andrognathus*, apparently are rare and local, no two species being reported from the same place. With the addition of the new forms described here, the preponderance in Colobognatha must now go to the Western States, where eight genera are represented from six separate districts. Only one genus in California is shared with the Eastern States.[2]

A genus *Hypozonium*, closely related to *Polyzonium*, was described in 1904 from Seattle, Wash. One of the new genera described on a later page was found by the writers in the fall of 1919, on Mount Tamalpais, near San Francisco, Calif. Three other genera were distinguished in a remarkable collection of millipeds from a small area in Plumas County, Calif., obtained in the winter of 1922–23, by H. S. Barber, of the Bureau of Entomology. Although this collection included only five species, four of them belonged to the Colobognatha. Three of the species had to be treated as distinct genera, while the fourth is referable to the genus *Brachycybe*, known also from the Eastern States. In October, 1924, another member of this order was collected in the Pinal Mountains of southern Arizona, the first specimen being secured by L. R. Lytton and others from the same locality by the writers. This animal belongs to a distinctly tropical family, Siphonophoridae, not previously known to exist in the United States.[3]

The species from Mount Tamalpais was found in loose stony soil under a layer of oak leaves on the western slope of the mountain not far from the redwood forest known as Muir Woods. Equable conditions are maintained in the coast districts by the breezes and fogs from the ocean. The survival of the redwood and giant sequoias in the coast belt of California show that climatic conditions have remained nearly the same for long periods, though the trees are reckoned as survivals of a former age of wider extension of forests, when the vegetation generally was more luxuriant if not more tropical in character. The forest fires and the periodical burnings of brushland and grasslands undoubtedly have been the chief restricting factor during the period of human occupation. Changes of climate have been alleged, but changes of vegetation may have been sufficient to localize such types as redwood trees and millipeds in the few places that have afforded continuous protection through the centuries.

Whether the humus fauna in California was derived from tropical America or from other land masses of the ancient world is hardly to be conjectured at present, but it is worthy of note that the nearest relatives of the milliped from Mount Tamalpais are in the Mediterranean region, not in other parts of America.

A southern origin or alliance may be claimed for the milliped from Arizona, which belongs to a family widely distributed in the Tropics

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[2] An additional genus, *Gosodesmus* Chamberlin, related to *Brachycybe*, was described in 1922 from southern California. Its characters are given at the end of this paper.

[3] Another member of this family was found still farther north in California, in November, 1926, while the paper was awaiting publication, so that two new genera of Siphonophoridae are included.

but not known previously in the United States The location might appear most unlikely for the survival of a tropical type—an elevated, exposed place where in cold periods the ground probably freezes to a depth of several inches. The vegetation is sparse, with scattered small junipers, shrubby oaks, and bushes. Probably the most essential feature of the environment is the very coarse, open soil formed of decomposing granite. The creatures were found under stones with clean surfaces underneath. In no case were millipeds found under stones where the surfaces were coated with dark colloidal material, which also discolors the gravel and doubtless represents a different condition of the soil. The place was in a divide a few miles from Miami, in the direction of Superior.

Though surrounded by very broken country, the spot was nearly level and with no through drainage or flooding of the surface. It seems that the humus faunas of colloidal regions are limited to spots where a humus blanket has accumulated above the soil, or where the surface is not flooded even in heavy rains. Thus the restriction of the new tropical milliped to the very small area in which it was found could be considered as a special and rather striking illustration of a general relation that had been observed in the study of the humus fauna.

From the distribution of the humus fauna it may be possible to throw light on the question of the natural conditions in the southwestern area before the period of human activity, or even further back. There can be little doubt that the surface conditions have been greatly changed during the human period, and the archeological indications of extensive and long-standing human occupation in this region are accumulating. Whatever the causes of the changed conditions, wider and more continuous distribution of the humus fauna in former times is hardly to be doubted.

CHARACTERS OF THE COLOBOGNATHA

The Colobognatha, as the name indicates, are millipeds with a restricted development of the mouth parts and other cephalic organs, except that the antennae are relatively large. The mouth parts especially are reduced or much less developed than in the other orders, and have been described as suctorial rather than manducatory, after the analogy of insects. The labral region of the head in most of the genera is narrow or is produced into a sharp beak. A remarkably divergent genus described in this paper has the head broadened below instead of narrowed.

The structure of the segments is primitive rather than specialized, with as wide a diversity of form as in any other order of millipeds. The segments of most of the genera are definitely flattened, in contrast with other long-bodied millipeds. But a few of the genera are rather short-bodied, and the broad lateral expansions, or carinae of the segments, are similar to those of some members of the order Merocheta.

The skeleton is weakly chitinized and the segmental sclerites are distinct or not so much fused as in most of the other orders. In all of the Colobognatha the pedigerous laminæ are free and the pleurae also may be free from the tergites or united by a lateral suture. A median suture appears in one of the suborders and is doubtless to be considered as a primitive character. Median sutures are found in several other orders, notably the Monocheta, Merocheta, and Anocheta, suggesting a fusion of two primitive sclerites to form the dorsal scutes of millipeds.

The Colobognatha differ from all other millipeds in having eight pairs of normally formed legs in front of the two pairs of specialized copulatory legs of the males. Also the copulatory legs, or gonopods, are much less specialized than in other orders and have the joints and claws distinct, as in the ambulatory legs. The posterior pair of gonopods is the more specialized and does not have the same position as the more specialized gonopods in the other orders, which are located on the seventh segment of the body. Where only one pair of legs is modified for copulatory purposes, as in the order Merocheta, they are the anterior legs of the seventh segment. In all of the orders where both pairs of legs on the seventh segment are modified, the specialization of the anterior pair is always much greater than that of the posterior pair.

But in the Colobognatha the more specialized posterior gonopods have been developed from the anterior pair of legs, not of the seventh segment, but of the eighth segment, where no similar modification occurs in any of the other orders. With this positional difference added to the structural differences, it is plain that the gonopods of the Colobognatha are not really homologous with those of the other orders of millipeds, but go back as a separate line of development to a remote ancestral stage when the appendages and segments of the body were unspecialized.

The different position of the gonopods affords an explanation of the fact that the Colobognatha have eight pairs of legs in front of the gonopods while other orders have only seven pairs. Before the different attachment of the gonopods was recognized it was customary to describe the Colobognatha as having an additional pair of legs on some of the anterior segments which in other orders are footless or are provided with only one pair. Some orders have no legs on segment 3 and some have two pairs of legs on segment 5, but in the Colobognatha each of the first 5 segments has a single pair of legs, while the subsequent segments have 2 pairs. Thus the attachment of legs in the order Colobognatha is the same as the order Anocheta, a large group of millipeds traditionally referred to the genus *Spirobolus.*

As a further consequence of the different position of the gonopods in the Colobognatha, it follows that an uneven number of pairs of unmodified legs will be found on the posterior part of the body, behind the gonopods, supposing that each of the segments has two pairs, except the last two segments, which are footless. The posterior pair of segment 8 renders the number uneven.

Pocock, writing in the Biologia Centrali Americana, reports an even number of post-copulatory legs in a species of *Platydesmus*, and on that account was unwilling to admit a different position for the gonopods. While Pocock undoubtedly was a very careful observer, accurate counting of the large numbers of legs on specimens of Colobognatha is not easy. The ventral plates are not united to the pleurae and the attachment of the legs to a particular segment often is difficult to determine. Since it is more feasible to count the legs accurately on photographs than on the specimens, photographs are submitted as evidence of the actual occurrence of uneven numbers of post-copulatory legs.

In addition to accidental abnormalities of the legs, there is a further possibility, as recognized by Pocock, that the last of the leg-bearing segments might have only one pair. This would be another way of explaining an even number of pairs behind the gonopods, but should not be taken for granted without proof.

Two suborders of Colobognatha are represented in America. In the suborder Polyzonoidea the head is narrowed in front and in some genera is produced into a slender beak. The mouth parts have been described as suctorial rather than manductatory, though the manner of feeding seems not to have been observed. The segments are convex or flattened, sharply angled at the junction of the scuta with the pleurae, but not produced into lateral carinae and lacking a median suture. In the suborder Platydesmoidea the head is not narrowed or produced, the segments have lateral carinae, and the median line of the segments is marked with a distinct groove or suture.

Three families are known to represent this order north of the Mexican boundary. The Siphonophoridae have the head suddenly constricted in front into a slender, sharp-pointed beak; the dorsum is pilose and tuberculate but lacks an impressed median sulcus. The Polyzoniidae have the dorsum without hairs, tubercles, or an impressed median sulcus, and are lacking in flattened or projecting lateral carinae but are provided with eyes. In the Andrognathidae the dorsum is either hairy or tuberculate or both, and there is a well-marked median sulcus, the lateral carinae are flattened or projecting and all of the species are without eyes.

Family SIPHONOPHORIDAE

The genus *Siphonophora* has been the only representative of this family in America. There are numerous tropical species, but until recently no member of this family has been reported in or near the United States. In 1923 a representative of the family was described from Sonora, Mexico, and in the autumn of 1924 another was discovered in the mountains bordering the northern edge of the southern Arizona desert. This Arizona species offers sufficiently distinctive characters to call for a generic recognition distinct from *Siphonophora*.

A second genus of Siphonophoridae was found in San Benito County, Calif., in November, 1926. This genus is remarkable because the mouth parts are not produced into a beak, because of the extreme slenderness of the body, and because of the very large numbers of segments, in this respect probably exceeding any other milliped.

SIPHONACME, new genus

Type.—*Siphonacme lyttoni*, a new species from Arizona.

Diagnosis.—Closely related to *Siphonophora* but differing in having the posterior gonopods very slender and the distal joint of both anterior and posterior gonopods nearly straight, as long or longer than the preceding joints taken together. Also the head is broadly oval and the beak relatively short, slender, and abrupt.

Description.—Body slender, from twenty to thirty times as long as broad, rather strongly convex.

Head subglobose-pyriform, abruptly contracted to a short slender beak. Antennae short, crassate, subclavate, a sense organ present near the margin, on the outer face of the fifth joint.

First segment oblong with anterior margin transverse or but slightly emarginate. Segments rather strongly convex; anterior and posterior subsegments tuberculate, the latter hirsute, with the hairs rising from between the tubercles.

Repugnatorial pores opening from a slight but abrupt prominence on the dorsal surface close to the lateral margin; the orifice of the pore surrounded by a fine rim bordered by a series of short, erect, closely placed hairs. On a few of the anterior segments the pore is near the front margin of the posterior subsegment, but on the other segments it is near the posterior margin and almost in the angle. Pleurae scarcely exceeded by the dorsal plates at the lateral margin.

Last segment with pleural and ventral sutures fused; the ventral suture open on the penultimate segment.

Preanal scale distinct.

Both pairs of gonopods simple, long and slender, the terminal joint of each pair nearly straight; anterior gonopods directed forward, with the last joint as long as all the preceding joints together; posterior gonopods longer and more slender and reaching forward between the anterior gonopods to their tips, the last joint longer than all the other joints together.

The type of *Siphonophora* is *S. portoricensis* Brandt. The original specimens are in the Berlin Museum and show a tapering conical head equaled or exceeded in length by a long slender beak. The antennae are moderately crassate with the joints gradually thicker from the base, joint 2 slightly longer than joint 3, joints 3 to 5 subequal in length, joint 6 about twice as long as joint 5, and joint 7 very short and scarcely projecting beyond joint 6; the first segment more than twice as long as the second and distinctly emarginate in the middle. The repugnatorial pores are borne on large rounded prominences which give the segments the appearance of being distinctly shouldered. A larger female specimen with 70 segments has the beak much longer than the head, and the head is smaller and more abruptly narrowed than in the male specimen, which has a shorter beak, scarcely longer than the head.

SIPHONACME LYTTONI, new species

Description.—Body small, very long and slender, twenty to thirty times as long as broad, scarcely tapering at the ends; the segments rather strongly convex. Motions in crawling very slow. Male with 78 segments, females with 88 and 121 segments. Length of male, 16 mm.; width 0.7 mm.; largest female 29 mm. long and 0.9 mm. broad.

Living colors.—Head, antennae, and first segment white; segments 2 to 4 with a longitudinal median band of dull pinkish abruptly broadened and divided at segment 5, becoming gradually paler to the middle of the body and finally disappearing so that the last segments also are white. The beak is a pale waxy yellow, and the large lateral sense organs of the antennae, on joint 5, appear as distinct orange-yellow spots.

Head subglobose-pyriform, abruptly contracted to a short, slender beak piliferous to the tip, less than one-third as long as the mass of the head; surface of head tuberculate and pilose, the beak smooth with scattered large and small hairs.

Gnathochilarium distinct, narrowly triangular, a group of large bristles at the apex as long as the slender apical portion of the beak; median groove present, basal angles rounded, very close to the insertion of the first pair of legs.

Antennae crassate, rather strongly clavate, joints 5 and 6 distinctly thicker than the others; joint 6 about twice as long as joint 5; joints 2 and 4 subequal, distinctly exceeded by joint 5; joint 7 distinctly projecting; a large, orange-yellow transversely-oval sense organ near the rim of joint 5 on the lateral face. In crawling the antennae are carried directly forward.

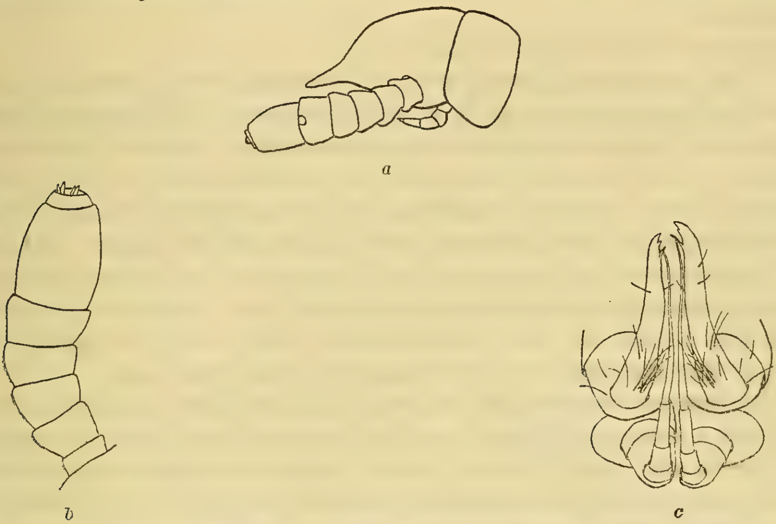

FIG. 1.—SIPHONACME LYTTONI. *a*. LATERAL VIEW OF HEAD. *b*. ANTENNA OF FEMALE, VENTRAL VIEW. *c*. GONOPODS, VENTRAL VIEW

First segment large, subelliptic, the anterior margin transverse or with a slight angular emargination; a transverse crescentic area in front of the middle of the segment slightly depressed or less convex than the surface behind it, forming a thin collar over the base of the head.

Segments rather strongly convex; the surface of the posterior division tuberculate and pilose, the hairs inserted between the tubercles, the posterior margin minutely and regularly serrate, supplementary margin not apparent; anterior subsegments beset with circular or oval flattened or broadly rounded tubercles like those of the posterior subsegments, but usually without hairs or with only a few near the posterior subsegment; pleural sutures at the lateral margins of the segments, the dorsal plates scarcely projecting beyond the pleurae.

Last two segments longer than any of the preceding, without legs or ventral plates; last segment with the pleural and ventral sutures completely fused; penultimate segment with the sutures open.

Last segment distinctly longer than the penultimate, gradually narrowed at the sides and rather broadly rounded at the apex; preanal scale distinct, the margin transverse, nearly straight; anal valves prominent, evenly convex, somewhat exceeding the posterior margin of the segment, the surface pilose but not distinctly sculptured.

Gonopods very long; the anterior pair extending forward beyond the basal joints of the two preceding pairs of legs, the terminal segment quite slender, slightly tapering, nearly straight, and as long or slightly longer than the other joints taken together; posterior gonopods longer than the anterior pair and more slender, the last joint simple, very long and slender and reaching the apex of the anterior gonopods.

Type.—Cat. No. 975, U.S.N.M.

Three specimens, a male and two females, were found by L. R. Lytton, in company with O. F. Cook, October 27, 1924, on slightly moist soil largely composed of loose decomposed granite, under large stones in an open dry place near the summit of a pass, 1¼ miles north of the monument marking the boundary of Gila and Pinal Counties, on the road between Superior and Miami, Ariz. The conditions appeared quite unfavorable for a humus fauna and even with much digging no other millipeds and no thread centipeds (Geophilidae and related families) were found. Only a few Scolopendridae and Lithobidae and a few specimens of *Japyx* were seen.

On January 28, 1925, after the region had been covered by snow and ice, a long and diligent search of the same locality by the writers was rewarded with but two living female specimens and two dead specimens, the sex of which was not determined. Other humus animals were much more plentiful than in October and four other species of millipeds were collected. The locality was visited again by Mr. and Mrs. Loomis on March 1, 1925, when four more specimens were found. Two of these were males with 98 and 108 segments, respectively.

SIPHONACME PSEUSTES (Chamberlin)

Siphonophora pseustes CHAMBERLIN, Proc. Cal. Acad. Sci., ser. 4, vol. 12, 1923, pp. 389–402.

From the drawings and description of *Siphonophora pseustes* Chamberlin [4] it seems probable that this species should be placed in *Siphonacme*, but *Siphonacme pseustes* apparently is distinct from *Siphonacme lyttoni* in having the beak and antennae longer, in the more deeply emarginate first segment, and the body with fewer segments, especially in the males. Possibly an examination of the gonopods of *Siphonophora globiceps* Pocock would show it should be included in *Siphonacme*.

ILLACME, new genus

Type.—*Illacme plenipes*, a new species from California.

Diagnosis.—Similar to *Siphonophora* and *Siphonacme* but readily distinguished by the triangular-cordate head, narrowed gradually

[4] On chilopods and diplopods from islands in the Gulf of California. Proc. Cal. Acad. Sci., ser. 4, vol. 12, pp. 389–407, 1923.

to an acute angle below, but showing no tendency to form a projecting beak.

Description.—Body extremely slender, moniliform, about fifty times as long as broad; composed of a very large number of segments, in the longest specimens approaching 200; dorsum strongly convex, nearly semicylindrical; the surface shining, moderately hirsute.

Head triangular-cordate in outline, resembling that of *Polyzonium* and without any suggestion of a beak, the sides continuous and sharply converging to a rather blunt angle, but not produced into a snout. Position of the head nearly vertical to the body, not reflexed under the body.

Antennae inserted at the sides of the head, abruptly capitate-clavate, subgeniculate; joints 1 to 4 very small, joints 5 and 6 abruptly thicker and larger, held parallel to the sides of the head; joint 6 the longest, but scarcely as broad as joint 5; joint 7 broad and short.

First segment slightly narrowed, about half again as long as the second; oblong, the lateral margins evenly rounded, anterior margin nearly parallel with the posterior; the surface nearly even, lacking the abrupt convexity of the posterior subsegments on the rest of the body; segments 2 to 4 shorter than the following, the transverse constriction with an irregular row of rounded tubercles on the anterior slope; surface of anterior subsegments rather coarsely reticulate, surface of posterior subsegments finely hirsute, each of the hairs subtended by a short sublunate transverse groove, giving the general effect of an indistinct network; supplementary margin distinct, with regular truncate divisions.

Repugnatorial pores difficult to detect, located on slight prominences near the posterior margins of the segments, not close to the lateral margins, pores of segment 5 in the same position as the others; lateral sutures open, bordered by slight parallel ridges; surface of pleurae with a rather open reticulation, sparsely hirsute along the posterior margins.

Last three segments somewhat longer than the preceding; the anal segment nearly as long as the penultimate, the sides converging to a broadly rounded apex, even with the valves, not projecting; surface of the anal valves rather strongly and evenly convex, the margins not prominent; preanal scale not distinct.

Legs rather short, scarcely exceeding the sides of the body, the basal joints prominent and swollen on the inner side, sometimes with an extruded membrane or exudate, nearly in contact on the median line.

This genus separates at once from *Siphonacme* and *Siphonophora* by the absence of a beak. The antennae are different from those of

Siphonacme in having joints 1 to 4 much narrower and more slender, while joint 5 is abruptly larger and more nearly equal to joint 6. Also the body is much more slender and the number of segments is much greater, approaching twice as many, and perhaps exceeding any other milliped. A diplopod with 192 segments, as counted on one of these specimens, has a total equipment of 750 legs, and may be the nearest approach to a literal "thousand legs."

ILLACME PLENIPES, new species

Body very slender and flexible, filiform, strongly and evenly convex, moderately pubescent on all of the exposed surfaces; number of segments attaining 192, with a length of 36 mm. and a width of 0.7 mm. in the largest female specimen; other individuals 26 to 29 mm. long, 0.5 to 0.6 mm. wide, with 136 to 152 segments.

Head rather narrowly triangular-cordate, the vertex more densely hirsute, the hairs rather short, the clypeus with longer and sparser hairs, nearly naked above the rather blunt-pointed labium; position of head nearly vertical, not strongly recurved under the body.

Antennae inserted at the sides of the head, moderately hirsute, abruptly capitate-clavate, subgeniculate, the terminal joints carried at the sides of the head, the second and third joints at the lateral margin of the first segment; joints 2 to 4 gradually thicker but much smaller and narrower than joints 5 and 6; joint 2 somewhat longer than joints 3 and 4, which are subequal and nearly as broad as long; joint 5 also about as broad as long, but much thicker than joint 4; joint 6 slightly narrower than joint 5, and distinctly longer, about one and one-half times as long as broad, cylindric-oval, slightly narrowed toward the end; joint 7 projecting as a rather broad frustum about one-sixth of the length of joint 6; olfactory cones not prominent.

First segment with the lateral margins evenly rounded and the anterior margin nearly parallel with the posterior; the surface more even than on other segments, which are abruptly convex behind the transverse constriction.

Penultimate segment without legs, the large pleura meeting in the middle and apparently united, but the sutures indicated by a fine median groove; last segment converging to a broadly rounded apex, not projecting beyond the margins of the valves, scarcely equal to the margin when viewed from the side.

Type.—Cat. No. 976, U.S.N.M.

Numerous specimens were collected by O. F. Cook in San Benito County, Calif., November 27, 1926, a short distance after crossing the divide between Salinas and San Juan Bautista. Only one colony was found, in a small valley of a northern slope wooded with oaks, under a rather large stone. The living animals were nearly white, moved very slowly, and rolled themselves into regular, close spiral coils when disturbed, the coils with three or four turns.

Family POLYZONIIDAE

ANALYTICAL KEY TO GENERA OF POLYZONIIDAE

Segments strongly depressed, the dorsum nearly horizontal; segments 20. **Platyzonium.**[5]

Segments strongly convex, 30 to 50 in number.

Sterna with a broad median groove separating the basal joints of the legs; head broadly rounded below; antennae and first two pairs of legs distinctly crassate ---------- **Buzonium**, new genus.

Sterna narrow, the basal joints of the legs nearly in contact; head narrowed below; antennae and first legs slender.

Body strongly narrowed in front from the fifth segment; first segment less than half as wide as the body; antennae long, extending beyond the sides of the body, joints 5 and 6 distinctly larger than the others. **Bdellozonium**, new genus.

Body moderately narrowed in front, the first segment more than half the body width; antennae short, the joints subequal.

Last segment covered and exceeded by the large, broadly rounded penultimate segment; segments 30 ---------- **Hypozonium.**

Last segment exposed and projecting beyond the distinctly emarginate posterior edge of the penultimate; segments variable in number, adults commonly with 40 to 50 ---------- **Polyzonium.**

BUZONIUM, new genus

Type.—*Buzonium crassipes*, a new species from California.

Diagnosis.—Head subquadrate, the clypeus widened below and the labrum broadly rounded; antennae robust, clavate, uncolored; first two pairs of legs of both sexes distinctly crassate.

Description.—Body small, moderately convex; body cavity about one and three-quarter times as broad as high.

Head small, subquadrate, narrowed between the antennae but the clypeus broad and convex and the labrum broadly rounded, the margin denticulate.

Eyes, two on each side, not prominent nor heavily pigmented, reddish or brownish.

Antennae not colored, robust, distinctly clavate, joints 5 and 6 longer and thicker than the others.

First segment scarcely half as wide as the broadest diameter of the body, crossed in front above the lateral angles by a distinct ridge from the lower edge of which the thin anterior margin is produced.

Subsequent segments somewhat polished, marked with fine longitudinal striations; dorsum margined by the extended plurae which are visible from above; pore of the fifth segment lower than on the following segments and located on the exposed posterior corner on the anterior subsegment.

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[5] *Platyzonium* is a European genus known only from Spain, originally described as a species of *Cryptodesmus*. See Cook, O. F., On Cryptodesmus Getschmannii Karsch. Zoologischer Anzeiger, No. 488. 1895.

Last segment subtriangular, exposed above.

Legs short and with large coxal joints, separated by the broad sterna which are narrower and more elevated behind; first and second pairs of legs conspicuously smaller and more crassate than those following, with the claws also reduced.

BUZONIUM CRASSIPES, new species

Number of segments from 52 to 72; length of largest specimen 21 mm., width 2.8 mm. Dorsum strongly convex; body cavity hardly twice as wide as high; body very abruptly rounded behind, more gradually in front.

Alcoholic specimens with the dorsum pinkish brown, the sides lighter, ventral surface pale. The semitransparency of the exoskeleton allows the internal organs to affect the color of the dorsum.

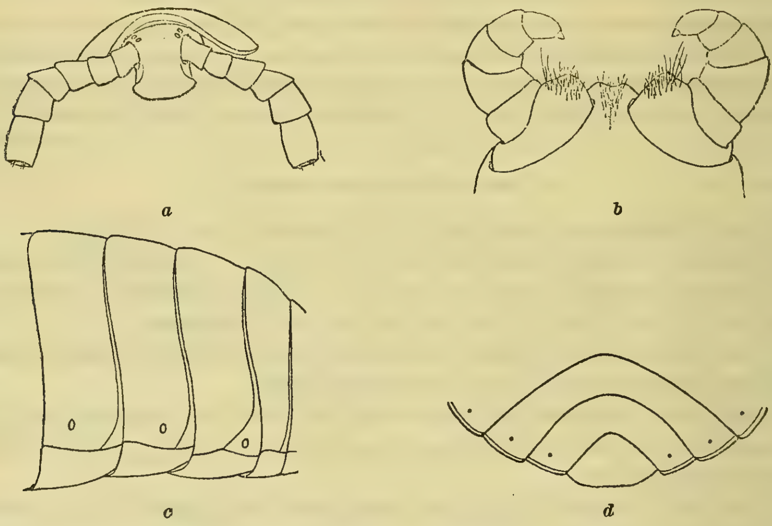

Fig. 2.—Buzonium crassipes. *a*. Head. Antennae and first segment, anterior view. *b*. First legs of male, posterior view. *c*. Segments 4, 5, 6, and 7, lateral view. *d*. Last three segments, dorsal view

Head with the clypeus and labrum greatly widened and rounded and with numerous very short, stiffly erect hairs; labrum considerably broader than the distance between the base of the antennae, the margin coarsely serrate on the sides, more finely in the middle; vertex and front roughened by rather deep and somewhat irregular lengthwise impressions; eyes very widely separated, not hidden by the first segment, composed of two ocelli each, placed quite obliquely; antennae subclavate and as long as the width of the first segment, first and second joints together equal in length to the sixth, which is the longest; sense cones 4.

First segment subreniform, slightly emarginate in front and behind; the lateral anterior margin thick, rounded, and carried up as a high ridge across the dorsal portion behind a thin, expanded margin produced from the lower edge of the ridge.

Subsequent segments slightly shining; posterior division impressed with many fine, short longitudinal striations much stronger at the middle of the dorsum near the anterior edge of the subsegment; plurae projecting slightly, forming a narrow raised lateral margin of the segments; pores of the fifth segment located low down on the enlarged caudal corners of the anterior subsegment, pores on subsequent segments higher and on the posterior subsegment.

Last segment exposed above, subtriangular; segments immediately preceding it sharply and deeply emarginate.

Legs not reaching the sides of the body; sterna broad, separating the legs, narrower and much more elevated behind; coxae of all legs at least half again as broad as the next joint, with the exception of the first two pairs of legs the coxae have a large oval pit at apex on the inner side; first and second pair of legs reduced in size and strongly crassate, more noticeable in the male, and with the claws shorter and less acute than on the other legs.

Type.—Cat. No. 977, U.S.N.M.

Six mature specimens collected beneath bark of oak logs near Seneca, Plumas County, Calif, December, 1922, and January, 1923, by H. S Barber, and two other specimens from same locality collected in March, 1924, by F. J. Silor.

BDELLOZONIUM, new genus

Type.—*Bdellozonium cerviculatum*, a new species from California.

Diagnosis.—Related to *Polyzonium* and *Hypozonium*, but with the clypeal portion of the head longer, the labral extremity broader and more rounded, the antennae much longer and the joints more equal, the anterior segments relatively smaller.

Description.—Body small, moderately convex, with the body cavity about three times as broad as high.

Head very small, subconic, the clypeus gradually narrowed, the apex obtusely angled in front; anterior surface pigmented.

Eyes of four ocelli on each side in an oblique row, prominent, heavily pigmented.

Antennae deeply colored, scarcely clavate, long, projecting beyond the sides of the body, joint 6 the longest; joints 3 and 5 subequal, longer than joints 2 and 4; joints 5 and 6 longer and slightly thicker than joints 2 to 4.

First segment very small, scarcely longer than segment 2 and about half as wide; anterior margin with a fine raised rim.

Segments flat underneath, moderately convex above, with a distinct transverse groove separating the subsegments; anterior subsegment smooth and even, more exposed than in *Polyzonium*; posterior subsegment somewhat inflated behind the groove, the surface minutely wrinkled, punctate or striate, especially in the groove. Repugnatorial pores on slight prominences in front of the middle of the posterior subsegment and rather remote from the margins on anterior segments, closer to the margin on posterior segments; pore of segment 5 much closer to the lateral margin than on the other segments, located on the anterior subsegment, with the transverse suture of the segment sinuate behind the pore, forming a small lateral elevation around the pore.

Penultimate segment slightly longer than the preceding, with a wide posterior sinus exposing the last segment.

Last segment small, with a broadly rounded apex concealing the anal valves.

Basal joints of the legs nearly in contact at middle, while in *Polyzonium* they are distinctly separated, especially on the anterior segments.

BDELLOZONIUM CERVICULATUM, new species

Number of segments 39 to 46. The largest specimen 16 mm. long by 3.3 mm. broad. Body rather strongly convex above, the posterior end more abruptly rounded than the anterior; body cavity about twice as wide as high.

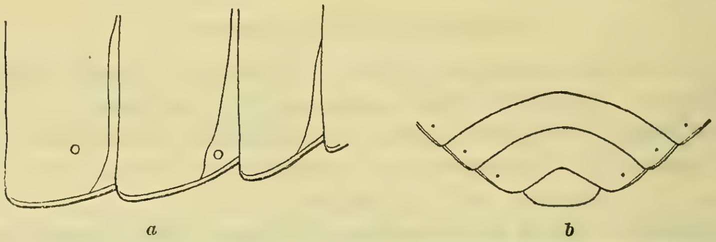

FIG. 3.—BDELLOZONIUM CERVICULATUM. *a*. LATERAL MARGINS AND REPUGNATORIAL PORES OF SEGMENTS 4, 5, AND 6. *b*. LAST THREE SEGMENTS OF BODY, DORSAL VIEW

Color of the dorsum salmon pink in living specimens, more brownish in alcohol, the side of the segments and the ventral surface pale; head and antennae light, mottled with purplish.

Antennae about one and a half times as long as the first segment is wide and reaching well beyond the sides of the body; joints 3 and 6 distinctly longer than the others. Ocelli 3 to 4 on each side in a very oblique row, 1 or 2 in each series usually being covered by the first segment. A low tubercle bearing a long hair above the lower ocellus of each series. Below the base of the antennae is a broad transverse depression in front of which the clypeus is somewhat inflated; labral area gradually narrowed, the apex somewhat rounded.

First segment very small, only one-third as wide as the full-sized segments, almost squarely truncate in front and with a narrow raised rim; posterior margin broadly and evenly rounded.

Body shining; anterior subsegments almost smooth, a few faint impressed longitudinal lines near the caudal margin; posterior subsegments more conspicuously impressed with similar lines, rather deep on the anterior third, fainter toward the middle, the hind margin smooth; exposed portion of the anterior subsegment usually about one-third the length of the posterior subsegment, the hind margin of the middle segments of the body slightly and broadly emarginate at middle; pores of the fifth segment on the anterior subsegment slightly above the posterior corner and near the transverse sulcus; other pores on the posterior subsegments, closer to the transverse sulcus than to the lateral margin; dorsal encroachment of the pleurae very slight but forming a narrow raised lateral margin to each segment.

Legs almost reaching the sides of the body, slightly separated from each other by the sterna which are elevated behind and on the sides and form a depression open in front; basal joints of the legs with rounded-oval pits.

Females with the first pair of legs very small and slender, much more reduced than those of the males, which also are smaller than the following pair.

Type.—Cat. No. 978, U.S.N.M.

Several specimens from Belden, Plumas County, Calif., collected by H. S. Barber, January 2, 1923. "It is numerous, in several sizes from about 4 mm. up, under bark and in splintered crevices of oak log near the mouth of Chipps Creek."

Genus HYPOZONIUM Cook

HYPOZONIUM ANURUM Cook

Hypozonium anurum Cook, Myriapoda of Northwestern America, Harriman Expedition, p. 63.

This species was described from Seattle, Wash. It has been reported also from Bremerton, Wash.[6]

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[6] Chamberlin, R. V., Can. Ent., p. 262, August, 1911.

Genus POLYZONIUM Brandt

POLYZONIUM BIVIRGATUM (Wood)

Octoglena bivirgata Wood, Proc. Phila. Acad. Nat. Sci., p. 186, 1864.
Petaserpes rosalbus Cope, Trans. Amer. Ent. Soc., vol. 3, p. 65, 1870.
Hexaglena cryptocephala McNeill, Proc. U. S. Nat. Mus., vol. 10, p. 328, 1887.
Polyzonium rosalbum Bollman, and others.

This species has long been called *Polyzonium rosalbum* (Cope) but that it resembled *Octoglena bivirgata* Wood has been known for many years and the likelihood of its being a synonym of *bivirgata* was also considered on the basis of Wood's drawings being poorly made and failing to show the true relation and shape of the head and anterior segments. Since no material has ever been found to prove the distinctness of the two species, it seems best to assume that *rosalbum* is a synomyn of *bivirgatum*, which is the older name.

Fig. 4.—Polyzonium bivirgatum. Lateral margins and repugnatorial pores of segments 4, 5, and 6

The species has been reported from Georgia, Tennessee, New York, Indiana, and Michigan and may be expected from many other of the Eastern States. A peculiarity of *Polyzonium* is that the repugnatorial secretion has a camphor-like odor, but whether this is true of other members of the family is not known.[7]

Family ANDROGNATHIDAE

The separation of this family from the tropical Platydesmidae is based on the structure of the sterna. The Andrognathidae have the basal joints of the legs almost in contact, but separated by a peculiar fungiform structure, while the Platydesmidae have the legs separated by broad sterna and are without the intercoxal projections.

ANALYTICAL KEY TO GENERA OF ANDROGNATHIDAE

Repugnatorial pores elevated on a short stalk or pedicel; fifth segment with lateral carinae deeply emarginate, bilobed; anal scale absent___**Andrognathus.**

Pores not elevated on pedicels; fifth segment not different from adjacent segments; anal scale present.

Body very slender, attaining a length more than twenty times the width; number of segments very large, sometimes more than 100; dorsum not tuberculate, evenly convex________________________________**Mitocybe**, new genus.

Body broader, less than fifteen times as long as wide; segments less than 70; dorsum tuberculate; lateral carinae longitudinal or depressed.

Body about twelve times as long as broad; loosely jointed, with anterior subsegments partly exposed; first segment not tuberculate, without lateral

[7] Cook, O. F. Camphor secreted by an animal, Science, new ser., vol. 12, pp. 516–521, 1900.

carinae, about twice as broad as long, scarcely wider than the head, following segments with lateral carinae rather narrow, nearly horizontal, not tuberculate -- Ischnocybe, new genus.

Body about eight times as long as broad, very compact, the anterior subsegments concealed; first segment with distinct tubercles and lateral carinae, much wider than the head; following segments with lateral carinae broad, sloping slightly, with rows of dorsal tubercles extending to near the lateral margin -- Brachycybe.

Genus ANDROGNATHUS Cope

ANDROGNATHUS CORTICARIUS Cope

Andrognathus corticarius Cope, Proc. Amer. Philos. Soc., p. 182, 1869.

Known from Virginia and Tennessee.

MITOCYBE, new genus

Type.—*Mitocybe auriportae*, a new species from California.

Diagnosis.—From the form and sculpture of the body, the lamination of the segments and the situation of the repugnational pores, this genus appears to be closely related to European *Dolistenus*, from which it differs at least in having a distinct preanal scale. The presence of a preanal scale, the location of the pores on the surface of the segments, and the normal formation of segment 5 distinguish *Mitocybe* from its closest American relative, *Andrognathus*.

Description.—Body slender, from fifteen to twenty-five times as long as broad; segments very numerous, in females exceeding 100.

Head cordate, not produced into a pointed snout nor covered by the first segment, turned under the body; antennae short and stout, widely separated at base; eyes lacking.

First segment subreniform, emarginate in front, the angles abruptly rounded and the anterior margin raised; median sulcus absent; surface not tuberculate but covered with fine, erect hairs.

Subsequent segments hirsute, not tuberculate; dorsum evenly convex, the lateral carinae thickened instead of being flattened or depressed; the repugnatorial pores on the caudal angles; sulcus present on all segments from the second to the penultimate.

Last segment hoodlike, rather long and with the apex truncate; no impressed median sulcus.

Anal valves visible beyond the last segment.

Preanal scale present, comparatively large and pilose.

Sterna produced into lobes which separate the coxae.

Legs short and slender, not reaching the sides of the body; coxae twice as thick as the other joints; in addition to the coxal joint there appear to be six other joints.

Males smaller and with fewer segments than the females.

The generic name alludes to the long, attenuate body contrasting with *Brachycybe* and associated genera.

MITOCYBE AURIPORTAE, new species

Segments variable in number, two males have 52 and 64 segments and four females have 80, 84, 108, and 110 segments; the specimens ranging in length from 14 mm. to 44 mm. and in width from 0.8 mm. to 1.6 mm. Dorsum evenly convex without flattened or depressed lateral carinae.

Color creamy white in living animals, suggesting a resemblance to some species of *Siphonophora*.

Head turned back under the body but not covered by the first segment, cordate; the labral region bluntly rounded; vertex slightly inflated on the sides above the base of the antennae; surface pilose, with longer hairs on the sides of the front; antennae short and thick, clavate, pilose; bases remote; joints increasing in thickness to joint 6; joint 2 longest; joint 3 equal in length to joint 7; joint 5 broader than long.

First segment subreniform, slightly emarginate in front; anterior margin raised; angles abruptly rounded; no impressed median line; surface evenly covered with fine, erect hairs.

Following segments with the anterior subdivisions glabrous; with a very fine raised median line from which four or five annual folds bend sharply back and then proceed around the segment, the folds intersected by many fine impressed lines. Posterior subsegments evenly convex; the lateral carinae thickened instead of being flattened or depressed; median sulcus present, broader and deeper in front than behind; surface with fine, erect short hairs rising from minute punctations which give the dorsum a granular appearance, the pubescence more abundant on the lateral carinae. Lateral margins of carinae parallel; front angles abruptly rounded; anterior margin of the subsegment with a broad, shallow emargination between the angles; hind angles rounded on several of the anterior segments, slightly produced backward; more strongly and sharply produced on the last few segments; hind margin of all segments rounded except on the last few segments which are broadly emarginate behind. Repugnatorial pores on the caudal angle of the carinae, surrounded by a narrow margin.

Last segment rather long, hood-like, the hind margin truncate. slightly exceeded by the small inflated and sparsely pilose anal valves; insertion of valves round; preanal scale present, comparatively large, elliptic, sparsely hairy.

Legs short and slender, not attaining the sides of the body; the large produced oval lobe of the sterna separating the coxae; coxal joint twice as thick as the others and with a pore near the end on the inner and posterior face; joint 2 very short and closely applied to the coxa; joint 3 as long as 7; joints 4, 5, and 6 subequal in length, together longer than the last joint with the claw included; last joint attenuated apically and with a long slender claw.

Type.—Cat. No. 979, U.S.N.M.

Two males and four females of this species were collected on Mount Tamalpais, near San Francisco, Calif., on November 23, 1919, by O. F. Cook and H. F. Loomis. They were found in Spring Valley in thick oak woods, scattered in the stony soil immediately beneath the surface layer of dead leaves. The females appear to have a conspicuously greater number of segments, as both male specimens were mature.

The evenly convex dorsum and thickened sloping carinae are further differences from *Dolistenus* Fanzago, where only the middle of the dorsum is convex and the carinae somewhat concave, with the margins rectangular and somewhat ascending.

According to Fanzago's descriptions and figures of *Dolistenus*,[8] the body is very slender with narrow, short, strongly carinate segments.

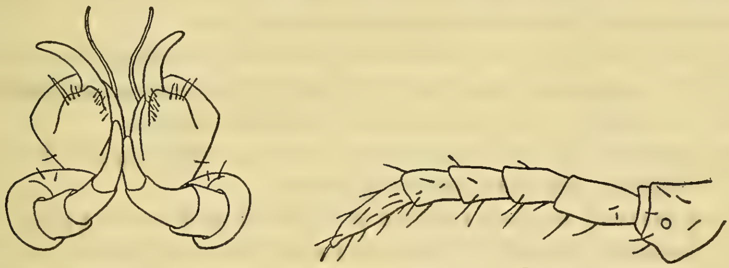

FIG. 5.—MITOCYBE AURIPORTAE. *a.* GONOPODS, VENTRAL VIEW. *b.* LEG, POSTERIOR VIEW

Antennae with rather short, thick, rounded joints, the second joint longer and more slender than the others, joints four to six gradually thicker, joint seven very small, surface of segments minutely pilose, with a distinct median suture and a transverse groove; first segment ovoid, without the longitudinal and transverse sulcus and with no trace of carinae. Posterior segments with carinae slightly produced, the last segment swollen and obtuse; legs very short, even in relation to the narrow body; length 23 to 36 mm., number of segments attaining 100.

ISCHNOCYBE, new genus

Type.—*Ischnocybe plicata*, a new species from California.

Diagnosis.—Somewhat intermediate between *Andrognathus* and *Brachycybe;* the body slender and narrow as in *Andrognathus*, but the repugnatorial pores not stalked and the segments with two rows of dorsal tubercles, as in *Brachycybe*.

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[8] Atti, Soc. Veneto. Trentino, vol. 4, p. 62, Oct. 1875.

Description.—Body slender and narrow, twelve times as long as broad, narrowed and rounded at the ends but the sides parallel; surface covered with short hairs.

Head small, broadly triangular-oval in outline; vertex inflated, the sides strongly converging but the labrum rounded or slightly truncate below; antennae inserted at the sides below the middle; vertex prominent, inflated.

Eyes wanting.

Antennae rather slender, distinctly clavate; joint 6 much the largest; joint 5 not greatly exceeding joint 4; joint 7 well developed, about half as long as joint 6, subconic, truncate.

First segment without carinae; much narrower than the second, scarcely wider than the head; surface not tuberculate, a distinct prominence near the posterior corner.

Segments gradually broader from the second to the fifth; carinae of anterior segments turned forward, five to six tubercles in the anterior row, three to four in the posterior; margins of carinae distinctly thickened, more strongly around the pore.

Repugnatorial pores on thickened posterior corners of the carinae; on anterior segments somewhat in front of the corner, on posterior segments directly at the apex of the produced carinae.

Last segment a closed cylinder projecting well beyond the produced corners of the penultimate segment.

Sterna narrow, the coxae nearly in contact; each ventral plate with median process directed obliquely forward, between the coxae of the preceding pair of legs.

Legs rather long and slender, extending somewhat beyond the sides of the body; coxa scarcely thicker than the femur; coxal aperture small, on a slight posterior prominence of the joint.

The generic name alludes to the more slender body with the carinae smaller and the anterior subsegments more exposed than in *Brachycybe.*

ISCHNOCYBE PLICATA, new species

Number of segments attaining 55. Length of largest speciment, 19 mm., width 1.5 mm. Body long and slender, gradually narrowed in front and behind; dorsum rather strongly convex and with depressed and outwardly somewhat upturned lateral carinae longer than in *Brachycybe* but not as broad.

Color a very distinct pink in living specimens but changing to a rather reddish brown when placed in alcohol.

Head completely visible in front of the first segment; pilose; broadly cordate, narrowing abruptly in front to an obtusely angular snout; vertex and front greatly inflated; eyes lacking; antennae placed on the sides of the head below the middle; rather long, exceeding the sides of the body; distinctly clavate; joints from 1 to 6 gradually thickened; joints 2 and 6 longer than the others, subequal; joint 7 less than half as long as 6.

First segment scarcely wider than the head, longer than the following segment; subhexagonal in shape, front margin longer than posterior, both squarely truncate, sides broadly angulate in advance of middle and without any trace of lateral carinae. Immediately behind the front margin and on either side of the middle the segment is very strongly inflated but lacks a true impressed median sulcus; surface pubescent but not tuberculate.

Second segment with strong, forwardly directed lateral carinae; a single transverse series of about six large raised tubercles across the middle.

Following segments have the anterior subsegments conspicuously exposed and widely separating the posterior subsegments so that the lateral carinae are not in as continuous a series as in *Brachycybe;* surface with several annular folds directed backward as they approach the impressed median line; edges of the folds crossed by short, closely placed flutings. Posterior subsegments with two transverse series of 8 to 12 rounded tubercles across the dorsum but not extending to the lateral carinae; between the series of tubercles is a curved furrow, directed backward on either side of middle; carinae of a few of the anterior segments curved forward, thereafter produced laterally and on the last few segments with the posterior angles more greatly produced backward; pores on the middle of the outer edge of the carinae on a few of the anterior segments behind which they are on the posterior angle.

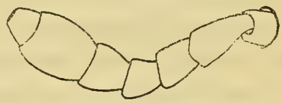

FIG. 6.—ISCHNOCYBE PLICATA. ANTENNA

Several segments before the last with the tubercles reduced in size or entirely lacking, with the transverse furrow visible.

Last segment cylindrical, as long as the two preceeding segments and extending beyond the caudal angles of the penultimate segment; posterior margin truncate; surface without tubercles, but pubescent and with several long hairs on the margin. Anal valves exceeding the last segment; strongly and evenly inflated and bearing a few stiff hairs in addition to smaller finer ones; margins meeting in a deep groove. Preanal scale present, located in an excision of the last segment; small, rounded in front and truncate behind, the hind margin continuous with that of the last segment; smooth.

Legs extending beyond the sides of the body; coxae closely placed, between them an erect, elongate, mushroomlike prominence with the apex produced forward; the first and second pairs of legs appear to be somewhat reduced in size and slightly crassate.

Type.—Cat. No. 980, U.S.N.M.

Several mature specimens "numerous with young under pile of rotting lumber" collected 14 miles up the north fork of Feather River from Belden, Plumas County, Calif., December 25, 1922, by H. S. Barber.

Genus BRACHYCYBE Wood

This genus has been treated by several writers as a synonym of *Platydesmus*, but not correctly. As pointed out by Pocock in the Biologia Centrali Americani, the closely placed coxae and large, erect intercoxal lobes of *Brachycybe* at once distinguish it from the tropical *Platydesmus*.

After Wood's description of *Brachycybe* in 1864, with *lecontei*, an eastern species, as the type, two other species were named from California—*B. rosea*, by Murray in 1877, and *B.* (*Platydesmus*) *californicus*, by Karsch in 1880. In 1893 Bollman, comparing specimens of *lecontei* with the descriptions of the two California millipeds, was not able to find that differences existed between any of the three species and so included the latter two as synonyms of *lecontei*.

While Murray's description was extremely short and lacking in details, nevertheless he seemed to imply that his species differed from Wood's in the number of segments, for he said of *rosea* "the segments numerous (in other species 47 in number)," Wood having given 47 segments as the number for *lecontei*. The larger number of segments indicated by Murray for his species seems sufficient to separate the Pacific coast form from the eastern *lecontei*, so that *rosea* may be recognized as a valid species, and a short description is included, from specimens collected by Mr. Barber in Plumas County.

The characters used by Karsch in describing his species are not sufficiently definite for the separation of his species from either *lecontei* or *rosea*, so that *californicus* is placed as a synonym under *rosea*.

BRACHYCYBE LECONTEI Wood

Brachycybe lecontei WOOD, Proc. Phila. Acad. Nat. Sci., p. 187, 1864.

This species is known from Georgia and Tennessee, and Bollman[9] reported it from Arkansas.

BRACHYCYBE ROSEA Murray

Brachycybe rosea MURRAY, Econ. Ent. Aptera, p. 21, 1877.
Platydesmys californicus KARSCH, Mitth. Munch. Ent. Ver., p. 144, 1880.

Description.—Number of segments from 62 to 66. Body of the largest specimen examined 23 mm. long and 3 mm. broad.

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[9] Ent. Amer., vol. 4, p. 1, 1888.

First segment considerably wider than the head; lateral carinae bent forward on either side with the dorsum produced slightly forward into a truncated lobe between the carinae, with six to eight tubercles in an irregular transverse row on either side of the middle, the outermost tubercles extending onto the lateral carinae; behind the lobe are two transverse rows of tubercles as on the segments following.

Segments, except a few at the ends of the body which have the number of tubercles reduced, with from 25 to 35 tubercles in the anterior row and from 18 to 30 in the posterior row which does not extend as near to the lateral margins as the anterior row.

Repugnatorial pores laterally placed on the edges of the carinae, near the middle of the carinae on a few of the anterior segments but almost at the posterior angle of the middle and posterior segments.

Last segment not exceeding the posterior corners of the penultimate segment; dorsal surface not tuberculate but with several small seta-tipped tubercles projecting from the hind margin on either side of the middle.

Anal valves projecting beyond the hind margin of the last segment.

Numerous fragments and several entire but dead specimens were collected by H. S. Barber from beneath bark of an old fir log at the Sunnyside mine, near Seneca, Plumas County, Calif., December 19, 1922.

ADDENDA

Genus GOSODESMUS Chamberlin

This genus was overlooked until the paper was in proof, but is readily distinguished from *Brachycybe* by the presence of two transverse rows of large oval cariniform tubercles forming longitudinal ridges on the dorsal surface of the segments.

The body is described as more slender than in *Brachycybe*, with the pores not stipitate, the lateral carinae horizontal, broadly rounded in front, with narrow thickened margins, straight or slightly sinuate near the middle, bearing minute pores near the rounded posterior corners, the corners somewhat produced on posterior segments, on the penultimate segment nearly attaining the broad apex of the last segment; dorsal tubercles rather widely spaced, the anterior row usually of 10 tubercles the posterior row six to eight, the first segment narrower and scarcely longer than the second, the tubercles rather short and irregular, six in each row. A transverse groove between the rows of tubercles is indicated on the drawing, as well as a median suture. Antennae slightly clavate, joint six much the largest, nearly twice as long as joint five; joint seven distinct, about half as long as joint five. The legs and sterna not described.

The tuberculate segments of *Gosodesmus* suggest the European genus *Fioria* Silvestri,[10] which also has two transverse rows of large tubercles, but not in the form of longitudinal ridges. *Fioria* was described as related to *Dolistenus*, but apparently is closer to *Brachycybe* and *Ischnocybe*. The segments have two transverse rows of large subconic dorsal tubercles, those of each side standing rather close together, and the rows interrupted by a strong median groove. First segment has 8 tubercles, the others 12 tubercles. Antennae with joint six the largest and joint seven unusually large, exceeding joint five, the other joints distinctly smaller. Anterior gonopods three-jointed, the posterior five-jointed. The body is very small, only 7 mm. long by 1 mm. wide, and with only 35 segments.

Chamberlin also refers to *Pseudodesmus* Pocock, from the Malay Peninsula as related to *Gosodesmus*, on account of the large dorsal tubercles, but not in the form of longitudinal ridges. *Fioria* was not with *Andrognathus* and *Brachycybe*. The head is covered by the expanded anterior segment and the body is strongly convex, each segment with a pair of large dorsal processes and large lateral carinae inserted very low, scarcely above the level of the legs. Also *Pseudodesmus* is a relatively large animal, 34 mm. long and 4.5 mm. wide, with 76 segments.

GOSODESMUS CLAREMONTANUS Chamberlin

Gosodesmus claremontanus CHAMBERLIN, Pomona College Journal of Entomology and Zoology, vol. 14, p. 9, with two figures, March, 1922.

The largest specimen measured 13 mm. by 1.2 mm., with 52 segments. The color is described as reddish or pinkish fulvous, paler underneath. The only locality is at Claremont, in southern California.

EXPLANATION OF PLATES

PLATE 1

Ischnocybe plicata, female, dorsal view. × 7.5 times.
Brachycybe rosea, male, dorsal and ventral views. × 6.5 times.

PLATE 2

Bdellozonium cerviculatum, male, dorsal and ventral views.
Siphonacme lyttoni, male, ventral view; female, dorsal and ventral views. Photographs × 10 times.

[10] Ann. Mus. Civ. St. Nat. Genova, vol. 38, p. 664, pl. 5, 1898.

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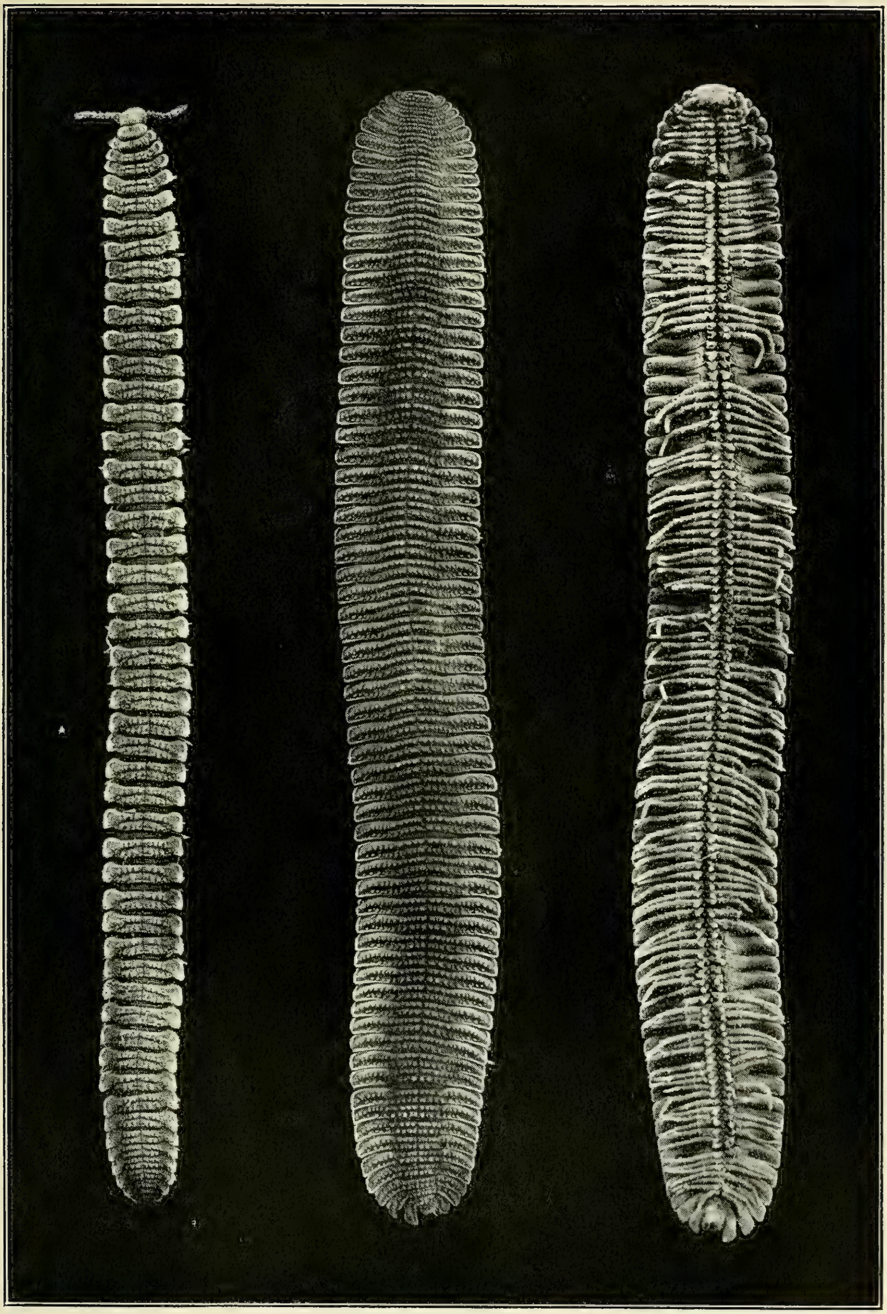
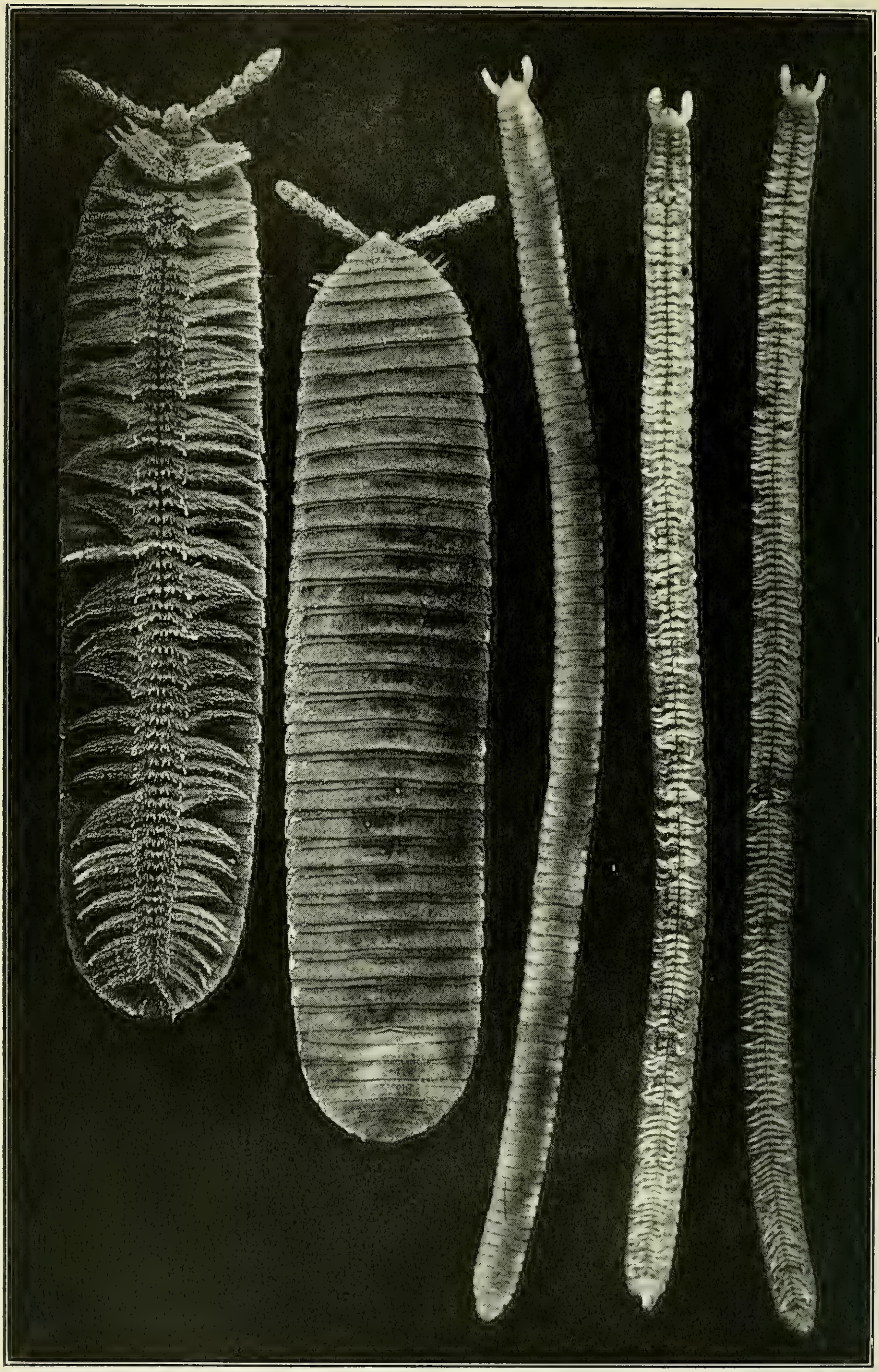


ISCHNOCYBE PLICATA AND BRACHYCYBE ROSEA

FOR EXPLANATION OF PLATE SEE PAGE 26



BDELLOZONIUM CERVICULATUM AND SIPHONACME LYTTONI

FOR EXPLANATION OF PLATE SEE PAGE 26

THE GREEN PIT VIPER, TRIMERESURUS GRAMINEUS, IN CHINA

By Leonhard Stejneger

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INTRODUCTION

The green bamboo pit viper, as a comprehensive species, extends over a vast area of southeastern Asia, from the Himalayas through India (not in Ceylon), Burma, Siam, Tonkin, Annam, Southern China, and Formosa, south through the Malay Peninsula to the Malay Archipelago. Various attempts have been made to subdivide the species, but on account of the great variability of the characters available for the discrimination of the geographic forms, none of these attempts has been generally accepted. In addition an erroneous nomenclature and absence of geographic correlation has caused great confusion.

Lack of sufficient data and material prevents a thorough investigation of the whole question in this connection, but enough is on hand to indicate the status of the species in China and adjacent territory.

Before examining into the question of the various forms occurring in China and the value of the characters by which they may be recognized, it seems best to review briefly and chronologically the previous efforts in the same direction.

Gray, who recorded the species under the name *Trimesurus viridis*, was the first (1842) to separate the South China specimens collected by Reeves as *T. albolabris* on the strength of a narrowness of the supraocular. In 1853 he made another addition by calling one of the specimens obtained by Hooker in Sikkim *T. elegans*, while referring the other to typical *T. viridis* (=*gramineus*). The distinction was again drawn from the "superciliary shield" (that is, supraocular), it being "large" in the latter, while "very small, rudimentary, linear" in the former in addition to smoother scales and certain color differences, namely, the narrowness of the lateral streak and the absence of the reddish-brown streak beneath it.

These distinctions, based as they were on a few specimens only, and on characters easily shown to be too variable, did not recommend themselves to contemporary herpetologists.

A second attempt at subdivision was made by Guenther who called attention to the existence of at least two forms. In fact, in his Reptiles of British India (1864) he treated them as two distinct species and gave figures to illustrate one of their structural differences. This according to him consisted in the presence of one or more small scales between the supranasals in the form he called *Trimeresurus gramineus*, while in the other, *T. erythrurus*, the supranasals are in immediate contact with each other. In addition he mentioned slight differences in coloration, underside pale greenish in the former, greenish-white combined with whitish upper lip in the latter. Unfortunately, as he was unable to appreciate any correlation between the specimens thus separated and their geographical distribution, he applied two names, the types of which undoubtedly belong to the same form. As a consequence Boulenger refused to recognize any distinction, and united them again.

Stoliczka, who collected both species and wrote four years after Guenther, recognized the distinctness of the two forms and accepted his nomenclature, but had apparently a better appreciation of their geographic relations, as he refers the Burmese and Malay Peninsula specimens to the so-called *T. erythrurus* and restricts the other form to the Khasi Hills and Assam. At the same time he casts doubt upon its being found in the interior of the northwestern Himalayas and especially the alleged occurrence in Ladak.

Accepting the above, including Guenther's erroneous nomenclature, Anderson[1] discussed the question of the distinction between the two forms in still greater detail. He recorded as *T. gramineus* several specimens from Ponsee, western Yunnan, one of which had 23 scale rows, while he listed the so-called *T. erythrurus* as from Upper Burma. In describing the distinguishing characters, however, he came to the conclusion that they are subject to considerable variation, but that the majority of the specimens conform to the accepted diagnoses.

Doctor Mell[2] also had an opportunity to study both forms in the field and observed certain differences in structure and coloration between specimens from the northern mountainous region of Kwantung and those from the southern lower regions of the same Province. Unfortunately, he also adhered to Guenther's application of the name *gramineus* to the northern subspecies. His choice of name for the southern form, which he calls *Lachesis gramineus albolabris* (Gray,

[1] Zool. Res. Exped. West Yunnan, 1879, pp. 828–832.

[2] Arch. Naturg., vol. 88, sec. A, pt. 10, 1922, pp. 126–128.

1842) in preference to *erythrurus*, given by Cantor three years earlier, is not explained.

Werner[3] likewise recognized the difference between specimens from Indo-China and Sumba Island (one of the lesser Sunda Islands) on the one hand and the traditional *T. gramineus* on the other, but relied for their distinction chiefly on the separation of the first supralabial from the nasal. However, he names this form *Lachesis fasciatus* (Boulenger), apparently because the latter was described from the island of Jompea [Djampea], one of the small islands between Celebes and Flores, assuming it to be identical with the Sumba form. Miss De Rooij,[4] however, who examined the type specimens from Djampea as well as specimens from Sumba [Soemba], regards the former as distinct and the Sumba specimens as conspecific with the typical *T. gramineus*. Therefore, if the Djampea form is distinct, the name *fasciatus* becomes inapplicable to the Sumba and Indo-Chinese form. But even if it is not separable, the name is inapplicable, because in that case it is synonymous with the typical *T. gramineus*.

The above review disposes of all the differential names given to the green bamboo pit viper up to 1924, with the exception of Gray's *Trimesurus elegans*[5] from Sikkim, which, however, is unavailable irrespective of the form to which it belongs, as his *Craspedocephalus elegans* of 1849 is a true *Trimeresurus*.[6]

In 1925 Karl P. Schmidt diagnosed briefly two Chinese *Trimeresurus* as *T. stejnegeri* and *T. yunnanensis*, respectively.[7] The former is plainly Guenther's and later authors' restricted, northern and mountain *T. gramineus*, but the use of this name is, of course, inadmissible as it is based solely on a specimen from Vizagapatam, on the coast of eastern continental India (Province Madras). Since all the other names belong to this same form, it follows that the one given by Schmidt is the only valid name for this form.

Trimeresurus yunnanensis is described as being distinguished by having only 19 rows of scales at mid-body. Thus far the recorded specimens from East Central Yunnan all seem to agree with this statement, but the number of specimens reported on is too small to assign a final status to this form. The specimens from the extreme western Yunnan do not belong to it as shown by Anderson's account.

The characters ascribed to the various forms, apart from possible color differences and the difference in the number of scale rows, are chiefly the following four:

1. Size of internasals and their contact or separation by intervening scales.

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[3] Sitz. Ber. Akad. Wiss. Wien, Math. Nat. Kl., sec. 1, vol. 133, 1924, pp. 47–48.
[4] Rept. Indo-Austral. Arch., Ophid., 1917, pp. 284–285.
[5] Ann. Mag. Nat. Hist., ser. 2, vol. 12, 1853, p. 391.
[6] See Herpet. Japan, 1907, p. 470.
[7] Amer. Mus. Novit., No. 157, Feb. 13, 1925, p. 4.

2. Fusion of the nasal shield with the first supralabial or their separation by a suture.

3. Presence or absence of one or more scales between the nasal and the shield bordering the pit anteriorly.

4. The size and arrangement of the gular scales whether in regular pairs bordering the mental groove or as less differentiated and irregularly placed scales.

It should be noted that the following discussion is based chiefly on Siamese, East China, and Formosan specimens as there are no specimens from India proper and the Himalayan region in the United States National Museum. The few records I have from that region I owe to the kindness of Dr. H. W. Parker, who kindly examined a number of specimens in the British Museum, which are of special interest in the present case. An examination of a much greater material is necessary to settle the status of the western forms.

1. SIZE OF INTERNASALS AND THEIR CONTACT OR SEPARATION BY INTERVENING SCALES

The internasals, or, as they are also often called, the supranasals, vary considerably in size. When relatively large they are usually broadly in contact along the median line; when small they are widely separated by several minute scales.

All the specimens from Formosa and Eastern China from Chekiang north and in the mountains farther south of which I have records—17 altogether—have the internasals thus separated, the usual number (in 11 specimens) being 2, exceptionally 1, 3, 4, or even 5. Four specimens from central Yunnan show the same condition, 2 in three cases, 3 in one. All the specimens from the Himalayan region which Doctor Parker examined for me (11) except one also have the supranasals separated by one (7) or two (3) scales. In one specimen from Darjeeling, which also differs in other respects from the other five from the same locality, the supranasals are in contact. In one from the Tack Plateau, Tenasserim, and another from the Lao Mountains, Cochin-China, they are also separated by one scale. Therefore in 33 specimens out of 34 from the north and from the higher mountain regions the supranasals are separated by one or more scales.

Of southern and lowland specimens I have examined a fine series of 22 specimens from Siam collected by Dr. W. L. Abbott and Dr. H. M. Smith; one from Cambodia, one from southern Fukien, one from Tenasserim, and one from Java. In addition Doctor Parker has furnished me data pertaining to two specimens from China (cotypes of *T. albolabris*), two from Hong Kong and one from the Langbian Plateau, Annam, all in the British Museum; altogether 31 specimens. In these the internasals are in contact in all but 5 specimens, 4 from Siam and 1 from Tenasserim. In these, one small scale is intercalated between the internasals. These, however, are in every instance relatively very large, so much larger than in the series of the northern form that a confusion with the latter in this particular is out of the question.

We thus find that the available material of 65 specimens falls into two groups according to the size of the internasals and their contact or separation by intervening scales, inasmuch as about 97 per cent of the northern and highland form have small internasals separated by intervening scales, while in the southern and lowland form 80 per cent have the large internasals broadly in contact and 20 per cent have them narrowly separated by a single small scale.

2. FUSION OF THE NASAL SHIELD WITH THE FIRST SUPRALABIAL OR THEIR SEPARATION BY SUTURE

The fusion of the nasal with the first supralabial is a rather exceptional condition in snakes. It is therefore, perhaps, not surprising that in the same series of 34 northern and highland specimens, including those from central Yunnan mentioned under the first heading, we find only one exception to the rule that the nasal and the first supralabial form distinct shields separated by a suture. This exception is the same specimen from Darjeeling, in the Himalayas, which was also exceptional in having the internasals in contact.

The southern and lowland series, on the other hand, is not so uniform. Of the 32 specimens recorded, 26 specimens have the nasal and the first supralabial fused (in 1, from Cambodia, only partly so) while in 6 they are entirely separated by a suture.

Consequently, the 66 specimens again fall into two groups with relation to the fusion of the nasal with the first supralabial, inasmuch as about 97 per cent of the northern and highland form have the two shields separate, while in 77 per cent of the southern and lowland form the two shields are fused into one.

3. PRESENCE OR ABSENCE OF ONE OR MORE SCALES BETWEEN THE NASAL AND THE SHIELD BORDERING THE PIT ANTERIORLY

In the genus *Trimeresurus* the shield bordering the pit anteriorly is usually fused with the second supralabial into one shield. This shield may be in direct and broad contact with the nasal without any scale between them, or they may be wholly or partly separated by one or two small narrow scales, of which the upper is usually the larger when two are present. Sometimes they are reduced in size to mere granules.

In the northern and highland series of 34 specimens (including those from central Yunnan) such intercalated scales are present in all except 1, namely, the same Darjeeling specimen in the British Museum which has been shown above to be an exception in the two previous characters.

In the southern and lowland series of 32 specimens, scales are present on both sides in only 8 specimens, while in 1 specimen, from Cambodia, a small granule is present on one side. In 2 of the 8 the intercalation is only indicated by a minute granule on both sides.

Expressed in percentages we thus find that in 97 per cent of the northern and highland form there is present one or two intercalated scales between the two shields, while in the southern and lowland form the two shields are adjacent the whole length without any intercalated scales or granules in 67 per cent of the series.

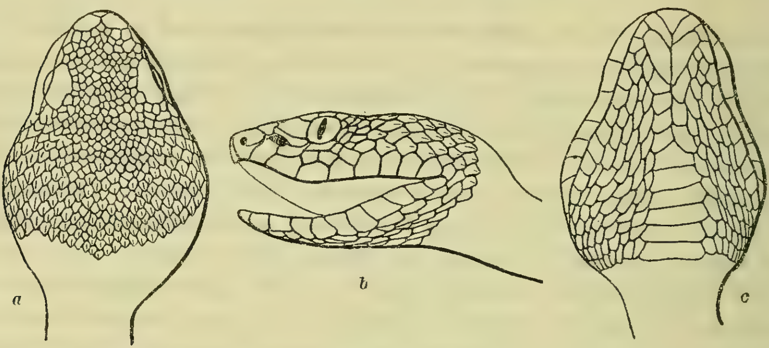

FIG. 1.—TRIMERESURUS GRAMINEUS GRAMINEUS, NAT. SIZE. *a*, TOP OF HEAD; *b*. SIDE OF HEAD; *c*. UNDERSIDE OF HEAD. NO. 70342, U.S.N.M. FROM NONG MONG, KRABIN, EASTERN SIAM, COLLECTED BY DR. HUGH M. SMITH.

4. SIZE AND ARRANGEMENT OF GULAR SCALES

In these snakes we find only the anterior pair of chin shields (genials) developed, while the posterior part of the mental groove is bordered by smaller scales. In some cases these scales are of the usual elongate shape of gulars, in others the scales forming the border of the groove are more or less modified into larger, broader, and more rounded scales arranged in more or less regular pairs. The typical arrangement of these two styles is well shown in the accompanying illustrations. (Figs. 1 and 2.) Most of the specimens in the two forms agree plainly with one or the other of the two styles thus figured. But there are many individuals in both groups which show intermediate features.

While in the southern and lowland form the paired style is recognized in all the 32 specimens, the pairs are recorded as "irregular" in 4, among them one of the types of *T. albolabris.*

In the northern and highland form, including specimens from central Yunnan, the special modification of the scales bordering the groove and their paired arrangement is the exception. Often some of the scales show a tendency toward such modification, especially posteriorly, and various specimens present intermediate stages between the two typical patterns. However, out of 32 specimens, 19 are unmistakably of the Formosan type figured (fig. 2), while 9 are clearly of the paired type and 4 more or less irregular. It is rather singular that all the six specimens from Darjeeling as well as one from Sikkim in the British Museum, according to Parker, have the gulars in pairs.

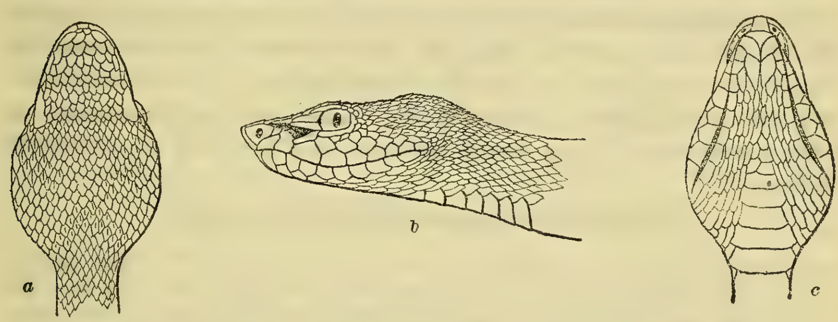

FIG. 2.—TRIMERESURUS GRAMINEUS STEJNEGERI, 1⅓× NAT. SIZE. *a*, TOP OF HEAD; *b*, SIDE OF HEAD; *c*, UNDERSIDE OF HEAD. NO. 2^a SCI. COLL. TOKYO FROM TAIPA, FORMOSA, COLLECTED BY T. TADA

The pronounced typical style of the northern and highland form is therefore present in more than 59 per cent of the specimens, while of the southern and lowland form about 88 per cent show the paired modification.

SUMMARY

It will thus be seen that the four characters alluded to do not trenchantly and in all cases separate the two forms. There is a considerable amount of overlapping. Nor are the characters of equal value, the gular arrangement being the least reliable. Nevertheless in nearly every instance it is possible to refer a specimen to its proper geographical series by a combination of the characters. The conspicuous exception is the Darjeeling specimen in the British Museum, repeatedly referred to above.

Under these circumstances it is hardly advisable to treat the two forms nomenclatorially as distinct species, and a trinominal appellation is therefore here adopted. The three forms may then be distinguished as follows:

a.[1] Internasals large and usually broadly in contact; nasal and first labial usually fused into one shield; nasal and anterior pit shield in contact, usually without any intercalated scales; gular scales bordering groove usually large, rather rounded, and arranged in pairs,
T. gramineus gramineus.

a.[2] Internasals small and separated by one or more scales; nasal and first labial nearly always separated by suture; usually one or two small scales between the nasal and the anterior pit shield; gulars, including those bordering groove, small and unmodified, scalelike in a majority of specimens.

b.[1] Scale rows around middle of body 21, rarely 23,
T. gramineus stejnegeri.

b.[2] Scale rows 19______________________ T. gramineus yunnanensis.

It remains to point out the possibility that further investigations of Indian material may reveal characters or combination of characters which can serve to diagnose other forms. In that case the Chinese lowland form may have to be known as *T. gramineus albolabris*, but not till then. Similarly the Himalayan specimens may require a new name if they should turn out to differ from *T. gramineus stejnegeri*.

TRIMERESURUS GRAMINEUS GRAMINEUS (Shaw)

1802. *Coluber gramineus* SHAW, Gen. Zool., vol. 3, pt. 2, p. 420 (type locality, Vizagapatam, India; based on Russell's Ind. Serp., vol. 1, pl. 9).—*Trimeresurus gramineus* GUENTHER, Rept. Brit. India, 1864, p. 385 (part: Pinang; Mergui).—BOULENGER, Fauna Brit. India, Rept. 1890, p. 429.—BOETTGER, Ber. Senckenberg. Nat. Ges., 1894, p. 135 (Hainan).—STANLEY, Journ. N. China Asiat. Soc., vol. 46, 1915, p. xiii (part: Swatow); vol. 47, 1916, p. xiv (Hoihow; Foochow).—MALC. SMITH, Journ. Nat. Hist. Soc. Siam, vol. 6, 1923, p. 205 (Hainan).—*Lachesis gramineus* BOULENGER, Cat. Snakes Brit. Mus., vol. 3, 1896, p. 554 (part: India, Burma, Siam, Hongkong, Sumatra, Java, Timor).—WALL, Proc. Zool. Soc. London, 1903, p. 99 (part: Hongkong).

1802. *Coluber viridis* BECHSTEIN, Lacépède's Naturg. Amph., vol. 4, p. 252, pl. 39, fig. 1 (type locality, Vizagapatam, India; based on Russell's Ind. Serp., vol. 1, pl. 9) (*not* of Meuschen, 1778).—*Trimeresurus viridis* LACÉPÈDE, Ann. Mus. Paris, vol. 4, 1804, p. 209.—*Bothrophis viridis* FITZINGER, Sitz. Ber. Akad. Wiss. Wien, Math. Nat. Kl., vol. 42, 1861, p. 411 (Hongkong).—*Trimesurus viridis* GRAY, Cat. Snakes Brit. Mus., 1849, p. 7 (India).

1839. *Trigonocephalus erythurus* CANTOR, Proc. Zool. Soc. London, 1839, p. 31 (type locality, Ganges Delta, India, type in British Museum; Cantor, collector).—*Trimeresurus erythrurus* GUENTHER, Rept. Brit. India, 1864, 386 (India, Siam, south China, Java).—STEINDACHNER, Reise Novara, Rept. 1867, p. 86 (Hongkong, Cochin China, Java).—STOLICZKA, Journ. Asiat. Soc. Bengal, vol. 39, pt. 2, 1870, p. 207 (Moulmein, Upper Burma, Penang, Wellesley Prov., Java).—ANDERSON, Zool. Res. Exped. West Yunnan, 1879, p. 830 (Upper Burma).—BOETTGER, Offenbach. Ver. Naturk., 24–25 Ber., 1885, p. 157 (Kwangtung).

1842. *Trimesurus albolabris* GRAY, Zool. Misc., p. 48 (type locality, China[8]; types in British Museum, Reeves, collector).
1870. *Trimeresurus mutabilis* STOLICZKA, Journ. Asiat. Soc. Bengal, vol. 39, pt. 2, p. 219, pl. 12, figs. 5–5*e* (type locality, Andaman and Nicobar Islands).
1922. *Lachesis gramineus albolabris* MELL, Arch. Naturg., vol. 88, sec. A. pt. 10, p. 126 (Southern Kwantung).
1924. *Lachesis fasciatus* WERNER, Sitz. Ber. Akad. Wiss. Wien, Math. Nat. Kl., sec. 1, vol. 133, 1924, p. 47 (Annam, Hainan) (not of Boulenger).

A typical specimen (U.S.N.M. No. 67601) of the barred form from Kuling, Fukien, was collected by Sowerby (No. 565). The first supralabial is fused with the nasal; the internasals are rather large but separated from each other by a very small scale. The postgenials are regular and large, forming a symmetrical series of five pairs. In these characters it agrees with southern specimens of the species and differs from those of northern localities and higher altitudes. The type of one of the names applicable to the latter subspecies is also from the Province of Fukien, having been collected at Shaowu, scarcely more than 140 miles away to the northwest, but presumably at a much greater altitude.

TRIMERESURUS GRAMINEUS STEJNEGERI (Schmidt)

1853. *Trimesurus elegans* GRAY, Ann. Mag. Nat. Hist., ser. 2, vol. 12, p. 391 (type locality, Sikkim; type in British Museum; Hooker, collector); (not *Craspedocephalus elegans* Gray. 1849=*Trimeresurus elegans* Gray).
1864. *Trimeresurus gramineus* GUENTHER, Rept. Brit. India, p. 385 (part: Khasya, Ladak[?], Sikkim, Ningpo; not of Shaw)—STOLICZKA, Journ. Asiat. Soc. Bengal, vol. 39, pt. 2, 1870, p. 216 (Khasi Hills and Assam.)—ANDERSON, Zool. Res. Exped. West Yunnan, 1879, p. 828 (Ponsee, Yunnan).—BOETTGER, Offenbach Ver. Naturk., 24–25 Ber., 1885, p. 157 Ningpo); Ber. Senckenberg. Naturf. Ges., 1888, Abh. p. 188 (South Formosa).—STEJNEGER, Herp. Japan, Bull. U. S. Nat. Mus., No. 58, 1907. p. 480, figs. 370–372 (Formosa); Proc. U. S. Nat. Mus., vol. 38, 1910, p. 113 (Formosa); vol. 66, art. 25, 1925, p. 101, (Moh-Kan-Shan, Chekiang).—BARBOUR, Proc. New England Zool. Club, vol. 4, 1909, p. 76 (Bankoro, Formosa).—OSHIMA, Annot. Zool. Japon., vol. 7, pt. 3, March, 1910, p. 207 (Formosa); Ann. Rep. Inst. Sci. Formosa, vol. 8, No. 2, 1920, p. 11, pl. 16.—STANLEY, Journ. N. China Asiat. Soc., vol. 45, 1914, p. 31 (part: Chekiang).—TAKAHASHI Japanese Ven. Snakes, 1923, pl. 3 (Formosa).—*Lachesis gramineus* BOULENGER. Cat. Snakes Brit. Mus., vol. 3, 1896, p. 554 (part: Ladak, Darjeeling, Sikkim, Khasi Hills, Ningpo, Formosa).—WALL, Proc. Zool. Soc. London, 1903, p. 99 (part: Formosa).—VOGT, Arch. Naturg., vol. 88, 1922, sec. A, pt. 10, p. 143 (part: [Northern] Kwangtung).—WERNER, Sitz. Ber. Akad. Wiss. Wien. Math. Nat. Kl., sec. 1, vol. 133, 1924, p. 48, Formosa.—*Lachesis graminea* BOETTGER, Kat. Schlang. Mus. Senckenberg., 1898, p. 139 (part: South Formosa).—*Lachesis* (*Trimeresurus*) *gramineus* STEIDNACHER, Denkschr. Akad. Wiss. Wein, Math. Nat. Kl., vol. 90, 1914, p. 357 (Formosa).

[8] Macao or Canton, according to Mell, Arch. Naturg., vol. 88, 1922, sec. A, pt. 10, p. 127.

1870. *Trimeresurus erythrurus* SWINHOE. Proc. Zool. Soc. London, 1870, p. 412 (Takow, Formosa) (not of Cantor, 1839).

1922. *Lachesis gramineus gramineus* MELL, Arch. Naturg., vol. 88, 1922, sect. A, pt. 10, p. 127 (Frontier mountains between Kwangtung, Kiangsi, and Hunan) (not of Shaw).

1925. *Trimeresurus stejnegeri* SCHMIDT, Amer. Mus. Novit., No. 157, Feb. 13, 1925, p. 4 (type locality, Shaowu, Fukien, China; type Amer. Mus. N. Y. No. 21054; Andrews and Heller, collectors).

Mr. A. de C. Sowerby has recently sent the Museum a fine specimen from Knatun, Fukien (U.S.N.M., Cat. No. 73140, Collector No. 1294), which is typical of this form in every respect. The internasals are small and separated by 4 scales. Body scale rows 21.

Through the courtesy of Dr. Thomas Barbour I have examined a Chekiang specimen collected by J. Wright in the Museum of Comparative Zoölogy (Collector's No. 1177) which clearly belongs to this subspecies and closely agrees with the two other Chekiang specimens in the United States National Museum already reported upon by me.[9] They all have several scales separating the internasals, distinct nasal and first labial, and intercalated scales between nasal and anterior pit scale, but the specimen collected by Mr. J. Wright (No. 1177) at Tunglu, Chekiang, has 23 scale rows as against the normal 21 in the others.

There are also in the collection belonging to the Zoological Museum of the University of Michigan and submitted to me by Dr. A. G. Ruthven for examination, two young specimens of this form. Unfortunately they are without precise locality but the probability is that they are from some place in Kiangsu. They agree with the above.

TRIMERESURUS GRAMINEUS YUNNANENSIS (Schmidt)

1925. *Trimeresurus yunnanensis* SCHMIDT, Amer. Mus. Novit., No. 157, Feb. 13, 1925, p. 4 (type locality Tengyueh, Yunnan, China; type, Amer. Mus. N. Y., No. 21058; Andrews and Heller, collectors).

Through the courtesy of Dr. Thomas Barbour I have been enabled to examine two specimens from Central Yunnan, namely, Mus. Comp. Zool. No. 14671, from Yunnan-fu, and No. 16734 from Fuchienhsien. Both have the internasals separated by scales, nasal distinct from first supralabial, and small scales in suture between nasal and anterior pit shield. The gular scales are of a somewhat intermediate character, but there can be no doubt that this form belongs to the highland type. The number of their scale rows is 19.

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[9] Proc. U. S. Nat. Mus., vol. 66, art. 25, 1925, p. 101.

FORAMINIFERA OF THE GENUS SIPHONINA AND RELATED GENERA

By Joseph A. Cushman
Of Sharon, Massachusetts

In 1850 Reuss erected the genus *Siphonina* and for its genotype described the species *S. fimbriata* Reuss from the Miocene of Austria. *Siphonina* is a genus related to *Epistomina* and others of the Rotaliidae. Most of the recent and fossil specimens have been referred by authors to the type species described by Reuss or to that of Czjzek. Brady in the *Challenger* Report placed Reuss' and Czjzek's species under the genus *Truncatulina*. For *Truncatulina* the older generic name of *Cibicides* given by Montfort must be used. In that genus the aperture comes over onto the dorsal side of the test which is usually attached. The specimens referred to *Siphonina* obviously can not be placed under *Truncatulina* or *Cibicides*. Reuss' genus *Siphonina* is not only well described and the type species of the Miocene of the Vienna Basin well known but the characters are well fixed and of generic importance. *Siphonina* has been recognized by later authors and its position is worthy of full recognition not alone on the basis of nomenclatorial rules but because of its structural characters.

In America the earliest known appearance of the genus is in the Upper Cretaceous from which a species has been recorded by Mrs. Plummer as *Siphonina prima* Plummer. This species has decidedly primitive characters. Like the species of the Midway and Wilcox Eocene, it is small and inconspicuous with the neck only slightly developed. In the Claiborne and Jackson Eocene of America the species are larger, and specimens often very abundant. Oligocene, Miocene, and Pliocene species continued the specialization and highly ornamented species occur. In the present oceans specimens are most abundant in the West Indian region and particularly the Indo-Pacific.

In the Claiborne Eocene of the United States there was developed a tendency to uncoil in the genus *Siphoninella* and another species is living in the West Indian region.

The globular forms referred to *Siphoninoides* need additional study to reveal their full characters. Specimens are rare, however, and sections have not been fully studied as they deserve to be.

That there are many distinct species will be seen by a study of the accompanying plates. The species have definite stratigraphic and geographic distributions as will be indicated.

Genus SIPHONINA Reuss, 1850

Siphonina REUSS (Type *S. fimbriata* Reuss), Denkschr. Akad. Wiss. Wien, vol. 1, 1850, p. 372.—TERQUEM, Mém. Soc. Géol. France, ser. 3, vol. 2, 1882, p. 84.—CUSHMAN, Smithsonian Misc. Coll., vol. 77, No. 4, 1925, p. 45; Contrib. Cushman Lab. Foram. Res., vol. 3, pt. 1, 1927, p. 77.
Truncatulina (part) of various authors.

Test free, trochoid, composed of numerous chambers arranged in a somewhat irregular spiral, usually biconvex; wall calcareous, perforate, the periphery often carinate and the carina fimbriate in some species; aperture in the adult just below the periphery on the ventral side, elliptical with usually a short neck and often a phialine lip.

SPECIES FROM THE UPPER CRETACEOUS

SIPHONINA PRIMA Plummer

Plate 2, figs. 4 *a–c*

Siphonina prima PLUMMER, Univ. Texas Bull. 2644, 1927, p. 148, pl. 12, figs. 4 *a–c*.

Test small, nearly circular, about equally biconvex but much compressed, periphery angled, sharply acute and delicately serrate, very slightly lobate; chambers usually five in the last-formed volution, very slightly inflated on the ventral side; sutures distinct, obliquely curved, marked by the serrate edges of the chambers of the dorsal side, not depressed; on the ventral side, more nearly radial, very slightly curved, somewhat depressed; wall smooth, distinctly and somewhat coarsely perforate, aperture a small, narrowly elliptical opening on the ventral side close to the periphery, the elongate axis in the axis of coiling without a definite neck.

Diameter up to 0.25 mm.; thickness 0.12 mm.

The types of this species are from the Midway Eocene of Texas where it is fairly common. To Mrs. Plummer I am indebted for the opportunity of studying material from the type locality. Mrs. Plummer has also recorded the species from the Upper Cretaceous, Ripley formation of Owl Creek, Mississippi, as well as at one locality in the topmost Navarro clays of Texas. Like many other genera which originated in the uppermost Cretaceous, the main development is in the Eocene. Mrs. Plummer also records its occurrence in the London clay of Southern England as well as at numerous localities in the Midway of Texas.

Siphonina prima Plummer represents the simple type of the genus from which the later more highly developed species have come.

SPECIES FROM THE EOCENE

SIPHONINA WILCOXENSIS, new species

Plate 2, figs. 1–3

Test small, nearly circular, biconvex but slightly more inflated on the ventral side, compressed, periphery angled, sharply acute and delicately serrate, slightly lobulate; chambers usually six in the last-formed volution, slightly inflated on the ventral side; sutures somewhat indistinct on the dorsal side, strongly oblique, slightly curved, somewhat marked by the serrate edges of the chambers, not depressed, on the ventral side very nearly radial, distinctly depressed; wall smooth, distinctly and coarsely perforate; aperture a small, elliptical opening on the ventral side close to the periphery, with a distinct lip but with the neck only slightly developed or wanting.

Diameter up to 0.30 mm.; thickness 0.16 mm.

Holotype.—(Cat. No. 369616 U.S.N.M.), from the Wilcox Eocene, Nanafalia formation, upper portion of Nanafalia Bluff, Tombigbee River, Ala. Similar specimens also occur in the Tuscahoma formation, Bells Landing, Alabama River, Ala., and Tuscahoma Landing, base of bluff, Tombigbee River, Ala. Less well marked specimens occur in the Hatchetigbee formation, McKay's marl bed, Souwashee Creek, 2 miles south of Meridian, Lauderdale County, Miss.

This species seems to be a derivative from the older *Siphonina prima* Plummer from which it differs in the somewhat larger size, more convex ventral side, more numerous and narrower chambers, and more strongly developed apertural characters.

SIPHONINA LAMARCKANA, new species

Plate 3, fig. 3

Test small, nearly circular, biconvex but more inflated on the ventral side, somewhat compressed, periphery angled, sharply acute and delicately serrate, slightly lobulate; chambers four in the last-formed volution, inflated on the ventral side; sutures very distinct, strongly oblique and curved on the dorsal side, slightly marked by the serrate edges of preceding chambers, not depressed, on the ventral side nearly radial, depressed; wall smooth with a few distinct scattered larger perforations in addition to the usual fine ones, aperture a comparatively large, broadly elliptical opening on the ventral side close to the periphery with a distinct lip and short neck.

Diameter, 0.40 mm.; thickness, 0.22 mm.

Holotype.—(Cushman Coll. No. 6725) from the interior matrix of a *Cerithium giganteum* from the Eocene, Calcaire grossier of Grignon, France.

It may be noted here that Terquem figures a species of *Siphonina* from the Eocene of the Paris Basin.[1] The measurements given are somewhat larger than our type. The figures given by Terquem are very evidently patterned after the type figures of Reuss but are reversed in drawing.

In Paris, through the kindness of Dr. G. Dollfus, I was enabled to examine the specimen figured by Terquem. It is a much smoother form than the figure indicates, and is not at all well drawn, a criticism that will apply to most of Terquem's figures with which I compared the original specimens.

In this Middle Eocene species there is an advance in the greater development of the apertural characters over those of the lower Eocene.

SIPHONINA HOWEI, new species

Plate 3, figs. 6 *a–c*

Test small, nearly circular, nearly equally biconvex, much compressed, periphery angled, sharply acute and with a distinctly serrate keel, lobulate, chambers usually six in the last-formed volution, the last few very slightly inflated on both sides; sutures distinct, depressed, slightly limbate, very slightly curved; wall distinctly spinose with short blunt spines and the periphery very serrate; aperture broadly elliptical, occupying nearly the whole height of the last-formed chamber, with a distinctly thickened lip and short neck.

Diameter, 0.30 mm.; thickness, 0.10 mm.

Holotype.—(Cushman Coll. 6726) from Lower Claiborne, Cane River formation at Natchitoches, Louisiana. The species is named for Dr. Henry V. Howe, who has done so much work on the paleontology of Louisiana.

This species is easily distinguished by its high degree of ornamentation and much compressed test.

SIPHONINA CLAIBORNENSIS, new species

Plate 3, figs. 5 *a–c*

Test small, nearly circular, nearly equally biconvex, somewhat compressed, periphery angled, sharply acute, with a very slightly developed keel, lobulate; chambers usually five in the last-formed volu-

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[1] Mém. Géol. Soc. France, ser, 3, vol. 2, 1882, p. 84, pl. 8 (16), fig. 16 *a–c*.

tion, slightly inflated on the ventral side; sutures distinct, strongly oblique, slightly curved, somewhat limbate on the dorsal side, on the ventral side nearly radial, depressed; wall smooth, very distinctly perforate; aperture elongate, narrowly elliptical, occupying the whole height of the chamber, with a distinct lip but no definite neck.

Diameter 0.35 mm.; thickness 0.15 mm.

Holotype.—(Cat. No. 369617, U.S.N.M.) from the Claiborne, Lisbon formation, 1 mile north of Washitubbee Station, N. O. and N. E. Railroad, Clarke County, Miss., collected by E. N. Lowe and C. Wythe Cooke.

It also occurs in the Lisbon formation at bridge over Falling Creek, 6 miles south of Quitman, Clarke County, Miss., and cut on Alabama and Vicksburg Railroad, 3¼ miles east of Newton, Newton County, Miss., and south bank of Tombigbee River at bend in river ¾ mile below Lock No. 1 and about 1 mile above St. Stephens Bluff, Washington County, Ala.

This is a very much smoother species than the preceding with a very slight development of the keel. It is a forerunner of such species as *Siphonina jacksonensis* Cushman and Applin.

SIPHONINA JACKSONENSIS Cushman and Applin

Plate 1, figs. 6 *a–c*

Siphonina jacksonensis CUSHMAN and APPLIN, Bull. Amer. Assoc. Petr. Geol., vol. 10, 1926, p. 180, pl. 9, figs. 20–23.

Test of medium size for the genus, nearly circular, nearly equally biconvex, much compressed, periphery angled, sharply acute, delicately serrate, lobulate; chambers usually five in the last-formed coil, the last ones inflated somewhat on both sides; sutures slightly depressed, oblique and curved on the dorsal side, nearly radial below, the umbilical region with clear shell material; wall slightly spinose throughout; aperture narrowly elliptical, nearly the whole height of the chamber, with a distinctly thickened lip but no definite neck.

Diameter up to 0.55 mm.; thickness 0.18 mm.

This species was originally described from the Jackson Eocene, 4 miles east of Diboll, Angelina County, Tex. It has proved to be a common species now known from the Upper Eocene of Louisiana, Mississippi, Alabama, and North Carolina. It also occurs in the Alazan clay of Mexico collected by Dr. T. Wayland Vaughan on Rio Tuxpan, 200 meters above the mouth of the Rio Pantepec, Vera Cruz, Mexico.

SIPHONINA JACKSONENSIS Cushman and Applin, var. LIMBOSA Cushman, new variety

Plate 4, fig. 2

Tests differing from the typical in the very limbate sutures and finer perforations of the wall.

Holotype of variety.—(Cat. No. 369618), U.S.N.M., from type locality of the Alazan clay, on Rio Buena Vista, Vera Cruz, Mexico, collected by Dr. T. Wayland Vaughan.

SIPHONINA ADVENA Cushman, var. EOCENICA Cushman and Applin

Plate 4, fig. 3

Siphonina advena Cushman, var. *eocenica* Cushman and Applin, Bull. Amer. Assoc. Petr. Geol., vol. 10, 1926, p. 180, pl. 9, figs. 16–19.

This variety differs from the typical form in the less prominent spiral suture on the dorsal side and the more nearly entire periphery; the chambers not showing as definitely as in the typical.

Diameter 0.40 mm.; thickness 0.22 mm.

The types of this variety are from the Jackson Eocene of Tar Kiln Creek, ½ mile above Neches River, Trinity County, Tex.

This variety is well distributed in the Upper Eocene of the Gulf Coastal Plain of the United States and occurs in the Alazan of Mexico in material collected by Dr. T. Wayland Vaughan on Rio Tuxpan, 200 meters above the mouth of the Rio Pantepec, Vera Cruz, Mexico.

SIPHONINA TENUICARINATA Cushman

Plate 4, fig. 1

Siphonina tenuicarinata Cushman, Journ. Pal., vol. 1, 1927, p. 166, pl. 26, figs. 11, 12.

Test nearly equally biconvex, periphery very acute and with a broad thin carina, the edge entire except where broken accidentally; chambers usually five in the last-formed volution, only slightly inflated on the ventral side; sutures on the dorsal side not very distinct, especially those of the earlier volutions, on the ventral side nearly radial, slightly depressed; wall smooth but distinctly perforate; aperture elongate elliptical with a wide lip and short neck.

Diameter 0.60 mm.; thickness 0.30 mm. or more.

Holotype.—(Cat. No. 369309 U.S.N.M.) from the typical Alazan on the Rio Buena Vista just south of crossing of Alazan to Moyutla road, collected by Dr. T. Wayland Vaughan, who also collected it at several other stations in the Alazan of Mexico. The figured specimen which has the keel less developed is from the *Ditrupa*-bed of Trinidad where the species is also well developed.

In some of the Mexican material the carina becomes very wide and is more or less wrinkled, giving it the appearance of being costate.

SPECIES FROM THE OLIGOCENE

SIPHONINA ADVENA Cushman

Plate 1, figs. 7 *a–c*

Siphonina advena CUSHMAN, U. S. Geol. Survey Prof. Paper 129, 1922, pp. 98, 137, pl. 22, figs. 1, 2; Prof. Paper 133, 1923, p. 42.

Test biconvex, the ventral side more convex than the dorsal, periphery subacute, with the keel not usually strongly developed; chambers usually five in the last-formed volution; sutures on the dorsal side flush with the surface, somewhat limbate, ventrally nearly radial, but slightly curved, very slightly depressed; wall smooth, very distinctly perforate, the perforations often in lines giving a distinctive appearance to the test; aperture elliptical, with a distinct neck and broad lip.

Diameter 0.50 mm.; thickness 0.20 mm.

This is an abundant species in all the members of the Lower Oligocene, Vicksburg, of the Gulf Coastal Plain of the United States occurring in the Byram calareous marl, Glendon limestone, Marianna limestone, Mint Spring marl, and Red Bluff clay in Mississippi, Alabama, and Florida. The figured specimen is an especially well-preserved one from the Byram marl.

Specimens apparently of this species were collected by Dr. T. Wayland Vaughan from the Oligocene of Mexico along the Transcontinental Railroad east of Los Naranjos.

SPECIES FROM THE MIOCENE

SIPHONINA RETICULATA (Czjzek)

Plate 1, figs. 1 *a–c*, 2 *a–c;* plate 3, figs. 4 *a–c*

Rotalina reticulata CZJZEK, Haidinger's Nat. Abh., vol. 2, 1848, p. 145, pl. 13, figs. 7–8.

Siphonina reticulata BROWN, Lethaea Geognostica, ed. 3, vol. 3, 1853–1856, p. 227, pl. 35, figs. 23 *a–c*.

Siphonina fimbriata REUSS, Denkschr. Akad. Wiss. Wien, 1849, p. 372, pl. 47, fig. 6.

Test nearly equally biconvex, somewhat compressed, periphery angled; usually four chambers in the last-formed volution, only slightly inflated; sutures depressed slightly on the ventral side, radial, on the dorsal side curved, strongly marked by the fimbriation of the periphery of the chambers; aperture elliptical, with a distinct lip and well marked, contracted neck.

Diameter 0.50 mm.; thickness 0.25–0.30 mm.

The type species of the genus is *Siphonina fimbriata* Reuss but this is obviously a synonym of the earlier described *S. reticulata*

(Czjzek) both of which are from the Miocene of Austria. Plate 3, Figures 4 *a–c* show a specimen from the Miocene of Kostej in the Banat region of Hungary which has the characters of this species. The much-curved dorsal sutures with the fimbriate border and the well-developed neck are apparent. It is evidently a species widely distributed in the Miocene of central Europe. The synonymy of this species contains many references which evidently should be placed under other species but without seeing the original specimens, it is not always possible to be sure of the exact position of these. Some of the more obvious ones will be noted especially under the living species.

SIPHONINA PULCHRA Cushman

Plate 2, fig. 5

Siphonina pulchra Cushman, Carnegie Inst. Washington, Publ. 291, 1919, p. 42, pl. 14, figs. 7 *a–c;* Publ. 311, 1922, p. 49, pl. 7, figs. 11, 12; Publ. 344, 1926, p. 42.

Siphonina reticulata Cushman (not Czjzek), Carnegie Inst. Washington, Publ. 291, 1919, p. 42.

Test nearly circular, about equally biconvex, periphery subacute or even somewhat rounded, compressed; chambers usually five in the last-formed volution, not inflated; sutures distinct not depressed, limbate; wall smooth, conspicuously perforate; aperture elliptical, with a distinct lip and short well-marked neck.

Diameter up to 0.65 mm.; thickness 0.30 mm.

The types of this species are from the Miocene of the gorge of the Yumuri River, Matanzas, Cuba. The species evidently persists and is now living in the general West Indian Region. It occurred at the Tortugas and also in collections from Porto Rico.

The young stages are much more like *Siphonina fimbriata* (Czjzek) but in the adult the specific characters are taken on making a very different test, the peripheral carina is largely lost and the sutures become more limbate. The species is evidently a derivative from *S. advena* Cushman of the Lower Oligocene and in the deeper waters of the West Indian region is also represented by *S. bradyana* Cushman, new species described on a later page.

SIPHONINA AUSTRALIS, new species

Plate 2, figs. 6 *a–c;* plate 3, figs. 7 *a–c*, 8 *a–c*

Test rounded, biconvex, usually slightly more convex on the ventral side, periphery subacute; chambers usually five in the last-formed volution, slightly inflated ventrally; sutures on the dorsal side limbate, marked by the crenulations of the margin of the earlier chambers, ventral sutures slightly curved, nearly radial, very slightly depressed; wall very coarsely perforate, peripheral carina also coarsely marked; aperture broadly elliptical with a very distinct thickened lip and prominent neck.

Diameter 0.50 mm.; thickness 0.22 mm.

Holotype.—(Cushman Coll. 6588) from the Balcombian, Lower Beds of Muddy Creek, Victoria, Australia, collected by W. J. Parr. I have material also from the Janjukian Miocene, green marls, Bird Rock Cliffs, Torquay, Victoria, Australia, collected by W. J. Parr and from the Miocene of the Filter Quarry, Batesford, near Geelong, Victoria, Australia, collected by A. C. Collins.

This is evidently the species recorded by Chapman and others from the Miocene of the Australian region. Like many other species of the Australian Tertiary and living Indo-Pacific forms, it shows close relationships with our Oligocene and Miocene species such as *S. advena* and *S. pulchra.* It is perhaps nearer to *S. reticulata* than any other of the species described.

Specimens from the Oligocene of Clifton Bank, near Hamilton, Victoria, Australia, also appear to belong here.

SPECIES FROM THE PLIOCENE

SIPHONINA TUBERCULATA (A. Silvestri)

Plate 3, figs. 1 *a–c*

Truncatulina reticulata (CZJZEK), var, *tuberculata* A. SILVESTRI, Mem. Pont. Accad. Nuovi Lincei, vol. 15, 1898, p. 300, pl. 6, figs. 11 *a–c*.

Test only slightly compressed, nearly equally biconvex, periphery acute, with a distinct, fimbriate carina; chambers indistinct due to the surface ornamentation which consists of numerous rather large tubercles in general following the lines of the sutures; aperture with a distinctly developed neck and slight lip.

Diameter 0.45 mm.; thickness 0.27 mm.

The types of this species are from the Pliocene about Siena, Italy. It is a distinct species.

SIPHONINA PLANOCONVEXA (A. Silvestri)

Plate 3, figs. 2 *a–c*

Truncatulina reticulata (CZJZEK), var. *planoconvexa* A. SILVESTRI, Mem. Pont. Accad. Nuovi Lincei, vol. 15, 1898, p. 300, pl. 6, figs. 12 *a–c*.

Test plano-convex, dorsal side flattened, ventral side strongly convex, periphery acutely angled, with a sharp peripheral carina; chambers with about five making up the last-formed coil, inflated on the ventral side; sutures of the dorsal side flush with the surface, marked by the fimbriate keels of the chambers, on the ventral side with a high secondary fimbriate keel along the suture; wall coarsely perforate; aperture elliptical, with a distinct contracted neck and thickened lip.

Diameter 0.40 mm.; thickness 0.15 mm.

The types of this species are from the Pliocene of Italy near Siena. I have excellent specimens from the Pliocene of Calabria and have collected it myself from the Pliocene of Coroncina, near Siena, Italy.

This is one of the most striking and most highly ornamented species of the genus, apparently very specialized and becoming extinct in the Pliocene.

LIVING SPECIES

SIPHONINA TUBULOSA Cushman

Plate 1, figs. 3 *a–c*, 5 *a–c*

Truncatulina reticulata H. B. Brady (not Czjzek), Rep. Voy. *Challenger*, vol. 9, 1884, pl. 96, figs. 5–7 (not fig. 8).

Siphonina tubulosa Cushman, Carnegie Inst. Washington, Publ. 342, 1924, p. 40, pl. 13, figs. 1, 2.

Test biconvex, slightly more convex on the ventral than dorsal side, periphery acute, with a distinct keel, developing into tubules; chambers usually five in the last-formed volution, very slightly inflated on the ventral side; sutures distinct, curved, slightly limbate; wall with the surface often developing distinct tubercles or with large perforations; aperture broadly elliptical with a distinct, contracted neck and phialine lip.

Diameter 0.50 mm.; thickness 0.20 mm.

The types of this species are from Samoa. Brady's figures according to Nuttall are from Bass Strait and from Fiji. The species has a distinctly Indo-Pacific distribution from the records. It may be best distinguished by the distinctly separated tubules of the periphery.

SIPHONINA PHILIPPINENSIS, new species

Plate 4, figs. 4 *a–c*

Test small, unequally biconvex, the ventral side more convex than the dorsal, periphery subacute, with a finely fimbriate keel; chambers usually five in the last-formed volution, not inflated; sutures curved, on the ventral side distinctly limbate and in the last-formed ones somewhat spreading on the surface or forming a secondary ornamentation; wall only slightly roughened along the sutures; aperture elongate elliptical, without a neck.

Diameter 0.30 mm.; thickness 0.15 mm.

Holotype.—(Cat. No. 20311, U.S.N.M.) from *Albatross* Station D5242, lat. 6° 51′ 53″ N.; long. 126° 14′ 10″ E.; in 215 fathoms off the Philippines.

In some respects, the small size, finely reticulate narrow keel and lack of neck this species most closely resembles the early Eocene species of America. This relationship of the living species of the Philippine region has been noted among many other genera and species of the foraminifera.

SIPHONINA BRADYANA, new species

Plate 1, figs. 4 *a–c*

Truncatulina reticulata H. B. BRADY (part) (not Czjzek), Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, pl. 96, fig. 8.

Test nearly equally biconvex, periphery acute with a broad thin carina somewhat fimbriate, but the fine tubules not reaching to the edge of the keel, the outer half of which is clear; chambers about five in the last-formed volution, not inflated; sutures distinct, limbate, not depressed; wall coarsely perforate, smooth; aperture elliptical, with a broad flaring lip but very short neck.

Diameter 0.60 mm.; thickness 0.28 mm.

Holotype.—(Cat. No. 20309, U.S.N.M.) from *Albatross* Station D2352 in 463 fathoms, Lat. 22° 35′ N.; long. 84° 23′ W.

Brady figured this species from Challenger Station 24 off the West Indies.

It is related to *Siphonina pulchra* Cushman but has developed a very wide keel among other characters. It is apparently limited to the West Indian region.

Genus SIPHONINELLA Cushman, 1927

Siphoninella CUSHMAN, Contrib. Cushman Lab. Foram. Res., vol. 3, pt. 1, 1927, p. 77, pl. 16, fig. 13 (Genotype *Truncatulina soluta* H. B. Brady).

Truncatulina (part) H. B. BRADY, Rep. Voy. Challenger, Zoology, vol. 9, 1884, p. 670.

Test in the early stages similar to *Siphonina*, in the later chambers becoming uncoiled, the aperture nearly terminal, slightly on the ventral side, with a neck and lip.

This genus is very evidently the attempt of the close coiled trochoid *Siphonina* to take on an uncoiled habit. The earliest known species occurs in the Claiborne Eocene of Louisiana and the other is now living off the West Indies.

SIPHONINELLA CLAIBORNENSIS Cushman and Howe

Plate 4, figs. 5 *a–c*

Siphoninella claibornensis Cushman and Howe, Contrib. Cushman Lab. Foram. Res., vol. 3, pt. 2, 1927, p. 120, pl. 24, figs. 8–10.

Test in the early portion trochoid, unequally biconvex, the ventral side more convex than the dorsal, in later growth uncoiled in the last two chambers; periphery of the earlier portion strongly carinate, the carina divided into tooth-like portions, usually coalescing and typically with an angle in each process, later chambers slightly rounded and without the keel; sutures somewhat limbate, flush on the dorsal side, very slightly depressed on the ventral; wall very coarsely perforate, especially on the dorsal side; apertural end with a distinct lip, a slightly constricted neck and narrow elongate aperture.

Length 0.35 mm.; breadth 0.25 mm.; thickness 0.10 mm.

The types of his species are from the Claiborne Eocene of Louisiana.

SIPHONINELLA SOLUTA (H. B. Brady)

Truncatulina soluta H. B. Brady, Rep, Voy. *Challenger*, Zoology, vol. 9, 1884, p. 670, pl. 96, figs. 4 *a–c*.

Siphoninella soluta Cushman, Contrib. Cushman Lab. Foram. Res., vol. 3, pt. 1, 1927, p. 77, pl. 16, fig. 13.

Test with all but the last two or three chambers trochoid, close-coiled, the last ones becoming uncoiled, periphery acute, with a distinct keel, tubulated; wall of the early chambers smooth, later with a few blunt spines with a row of spines along the sutures; aperture narrowly elliptical with a short constricted neck and distinct lip.

Length 0.38 mm.; breadth 0.25 mm.; thickness 0.10 mm.

The types of this species were from *Challenger* Station 24 off the West Indies.

In all its characters, this is a very distinct species from that of the Claiborne Eocene of Louisiana.

Genus SIPHONINOIDES Cushman, 1927

Siphoninoides Cushman, Contrib. Cushman Lab. Foram. Res., vol. 3, pt. 1, 1927, p. 77, pl. 16, fig. 15 (genotype *Truncatulina echinata* H. B. Brady).

Truncatulina H. B. Brady (part) Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 670, pl. 96, figs. 9–14.

Test globular, irregularly trochoid; wall calcareous, perforate; aperture generally circular with a short neck and flaring lip.

The species of this genus are known only from the Tertiary and Recent. In some of the characters, the genus resembles *Siphonina*, and in others *Sphaeroidina*. A study should be made of the very early stages as well as of sections of the test to determine the development especially in the microspheric form. Material has not yet been available in sufficient amount for this work.

SIPHONINOIDES LAEVIGATA (Howchin)

Plate 4, figs. 6 *a*, *b*

Truncatulina echinata H. B. Brady, var. *laevigata* HOWCHIN, Trans. Proc. Roy. Soc. So. Australia, vol. 12, 1889, p. 13, pl. 1, fig. 8.

Test subglobular; the chambers indistinct; wall smooth; aperture nearly circular with a slight lip but no neck.

Diameter about 0.35 mm.

Howchin's types came from the Tertiary, (Balcombian) from Muddy Creek, Victoria, Australia. I have topotype material through the kindness of W. J. Parr. The specimens seem sufficiently distinct from Brady's species to warrant giving it specific rank.

SIPHONINOIDES ECHINATA (H. B. Brady)

Plate 4, figs. 7 *a*, *b*, 8 *a*, *b*

Planorbulina echinata H. B. BRADY, Quart. Journ. Micr. Sci., vol. 19, 1879, p. 283, pl. 8, figs. 31 *a–c*.

Truncatulina echinata H. B. BRADY, Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 670, pl. 96, figs. 9–14.

Test subglobular, the chambers irregularly trochoid, sutures slightly depressed, often indistinct; surface covered with short blunt spines; aperture circular with a short neck and thickened lip.

Numerous specimens have been referred to this species by different authors not all of which may belong here. In the Muddy Creek beds of Victoria, Australia there are specimens similar to that figured (pl. 4, figs. 7 *a*, *b*) which may be referred to Brady's species which are all from the Indo-Pacific.

The specimen figured (pl. 4, figs. 8 *a*, *b*) from the Atlantic, off the Tortugas, may prove to be a distinct species. The projections of the surface are very few in number and the wall is thick and conspicuously perforate.

SIPHONINOIDES GLABRA (Heron-Allen and Earland)

Truncatulina glabra HERON-ALLEN and EARLAND, Trans. Zool. Soc. London, vol. 20, 1915, p. 711, pl. 52, figs. 41–47.

"Test nearly spherical, consisting of about two to three convolutions of chambers; three to four chambers in the last convolution, which is inclined at an angle to the axis of the preceding ones, so that the early convolutions are almost, or entirely, inclosed. Shell-wall somewhat thick, but much thinner than in *T. echinata* Brady and coarsely perforate. Sutural lines depressed. Aperture situated in a depression at the junction of the terminal chamber with the preceding convolution, usually a simple crescentic slit, sometimes furnished with a rim or a short neck as in *T. echinata.*"

The types are from the Kerimba Archipelago off Southeastern Africa, but the authors also record it from off Tahiti. Brady's *Challenger* material, according to Heron-Allen and Earland, is at least partially of this species and they refer *Challenger* Report (pl. 96, fig. 12) to their species.

EXPLANATION OF PLATES

(In all figures *a*, dorsal view, *b*, ventral view, and *c*, apertural view.)

PLATE 1

FIGS. 1 *a-c*. *Siphonina reticulata* (Czjzek). (After type figure of *Siphonina fimbriata* Reuss.)
2 *a–c*. *Siphonina reticulata* (Czjzek). (After type figure of *Rotalina reticulata* Czjzek.)
3 *a–c*. *Siphonina tubulosa* Cushman. (After H. B. Brady.)
4 *a–c*. *Siphonina bradyana*, new species. (After H. B. Brady.)
5 *a–c*. *Siphonina tubulosa* Cushman. Specimen from Samoa. ×65.
6 *a–c*. *Siphonina jacksonensis* Cushman and Applin. Specimen from type locality, 4 miles east of Diboll, Tex. ×65.
7 *a–c*. *Siphonina advena* Cushman. From Lower Oligocene, Byram marl, Byram, Miss. ×65.

PLATE 2

FIGS. 1 *a–c*. *Siphonina wilcoxensis*, new species. From Nanafalia Bluff, Tombigbee River, Ala. ×100.
2 *a–c*. *Siphonina wilcoxensis*, new species. From 2 miles south of Meridian, Lauderdale County, Miss. ×100.
3 *a–c*. *Siphonina wilcoxensis*, new species. From Tuscahoma Landing, Tombigbee River, Ala. ×100.
4 *a–c*. *Siphonina prima* Plummer. From shallow ditch at road corner southeast of New Corsicana reservoir on the road to Mildred, Navarro County, Tex. ×100.
5 *a–c*. *Siphonina pulchra* Cushman. Recent. Off Tortugas, Fla. ×65.
6 *a–c*. *Siphonina australis*, new species. Holotype. From Muddy Creek, Victoria, Australia. ×65.

PLATE 3

FIGS. 1 *a–c*. *Siphonina tuberculata* (A. Silvestri). From Pliocene of Siena region, Italy. (After A. Silvestri.) ×40.

2 *a–c* *Siphonina plano-convexa* (A. Silvestri). From Pliocene of Siena region, Italy. (After A. Silvestri.) ×37.

3 *a–c*. *Siphonina lamarckana* Cushman, new species. Holotype. From Eocene, Calcaire grossier, Grignon, France. ×60.

4 *a–c*. *Siphonina reticulata* (Czjzek). From Miocene of Kostej, Banat region of Hungary. ×65.

5 *a–c*. *Siphonina claibornensis*, new species. Holotype. From Lisbon formation, 1 mile north of Washitubbee station, N. O. & N. E. R. R., Clarke County, Miss. ×65.

6 *a–c*. *Siphonina howei*, new species. Holotype. From Claiborne Eocene, Cane River formation at Natchitoches, La. ×65.

7 *a–c*. *Siphonina australis*, new species. From Miocene of Filter Quarry, Batesford, Victoria, Australia. ×65.

8 *a–c*. *Siphonina australis*, new species. From Miocene, Janjukian, Bird Rock Cliffs, Torquay, Victoria, Australia. ×65.

PLATE 4

FIGS. 1 *a–c*. *Siphonina tenuicarinata* Cushman. Specimen from Brasso, Trinidad. ×65.

2. *Siphonina jacksonensis* Cushman and Applin, var. *limbosa* Cushman, new variety. Holotype. From Alazan clay, Rio Buena Vista, Vera Cruz, Mexico. ×65.

3 *a–c*. *Siphonina advena* Cushman, var. *cocenica* Cushman and Applin. From Jackson Eocene, Bridge Creek, 1½ miles above Angelina River, Tex. ×65.

4 *a–c*. *Siphonina philippinensis*, new species. Holotype. From Philippines, *Albatross* Station D5242. ×65.

5 *a–c*. *Siphoninella claibornensis* Cushman and Howe. Holotype. From Louisiana. ×100.

6 *a–b*. *Siphoninoides laevigata* (Howchin). From Muddy Creek, Victoria, Australia. ×65.

7 *a–b*. *Siphoninoides echinata* (H. B. Brady). From Muddy Creek, Victoria, Australia. ×65.

8 *a*[*c*]*–b*. *Siphoninoides echinata* (H. R. Brady). From Tortugas, Florida. ×65.

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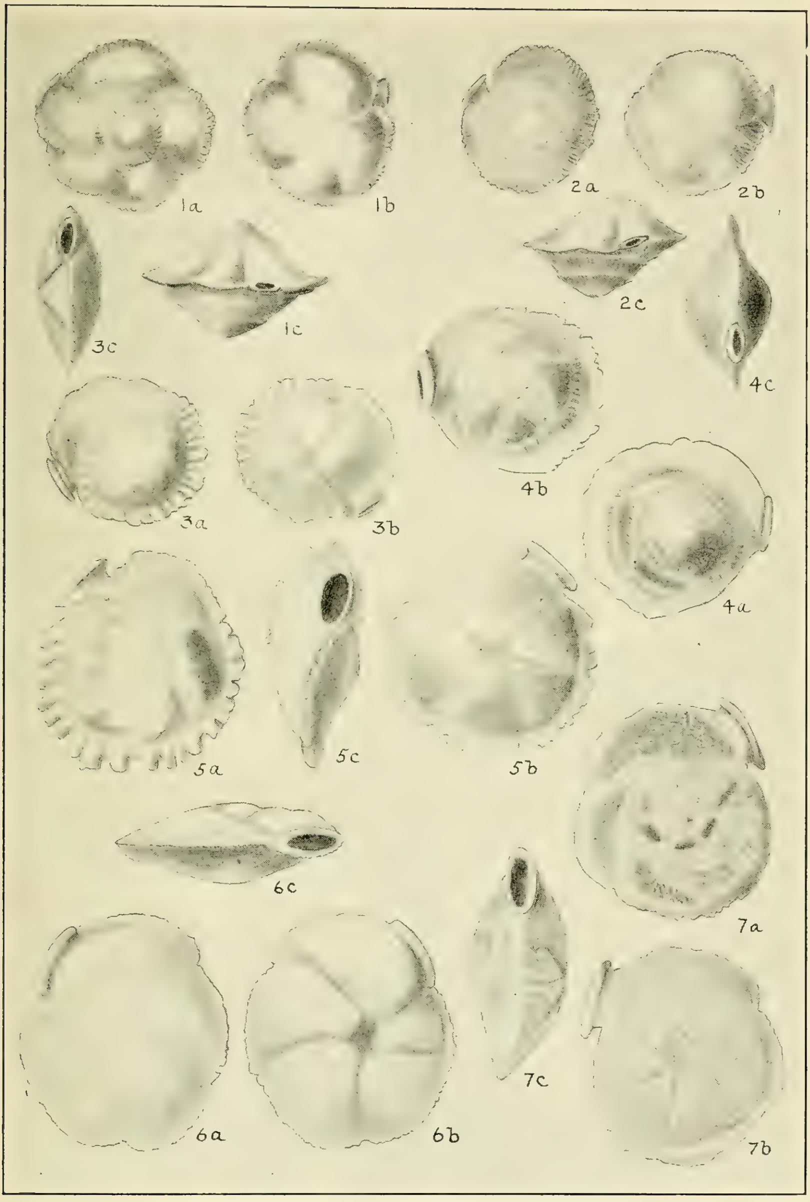
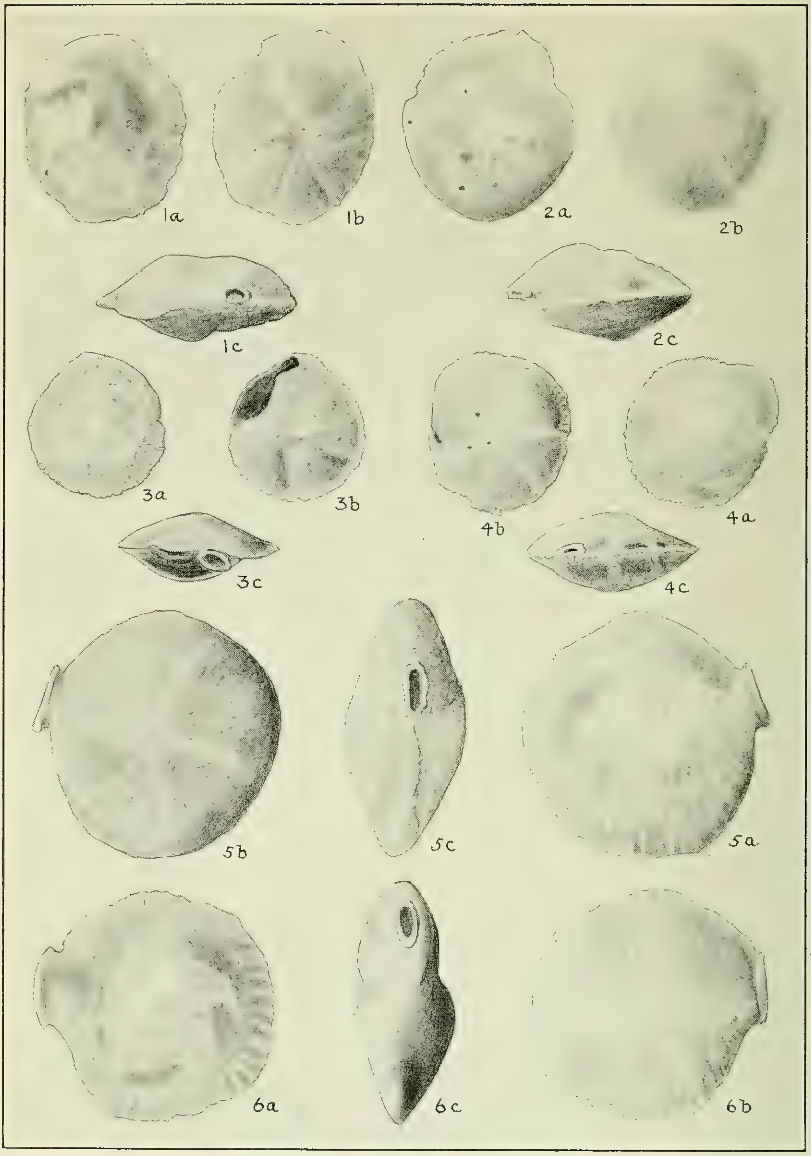


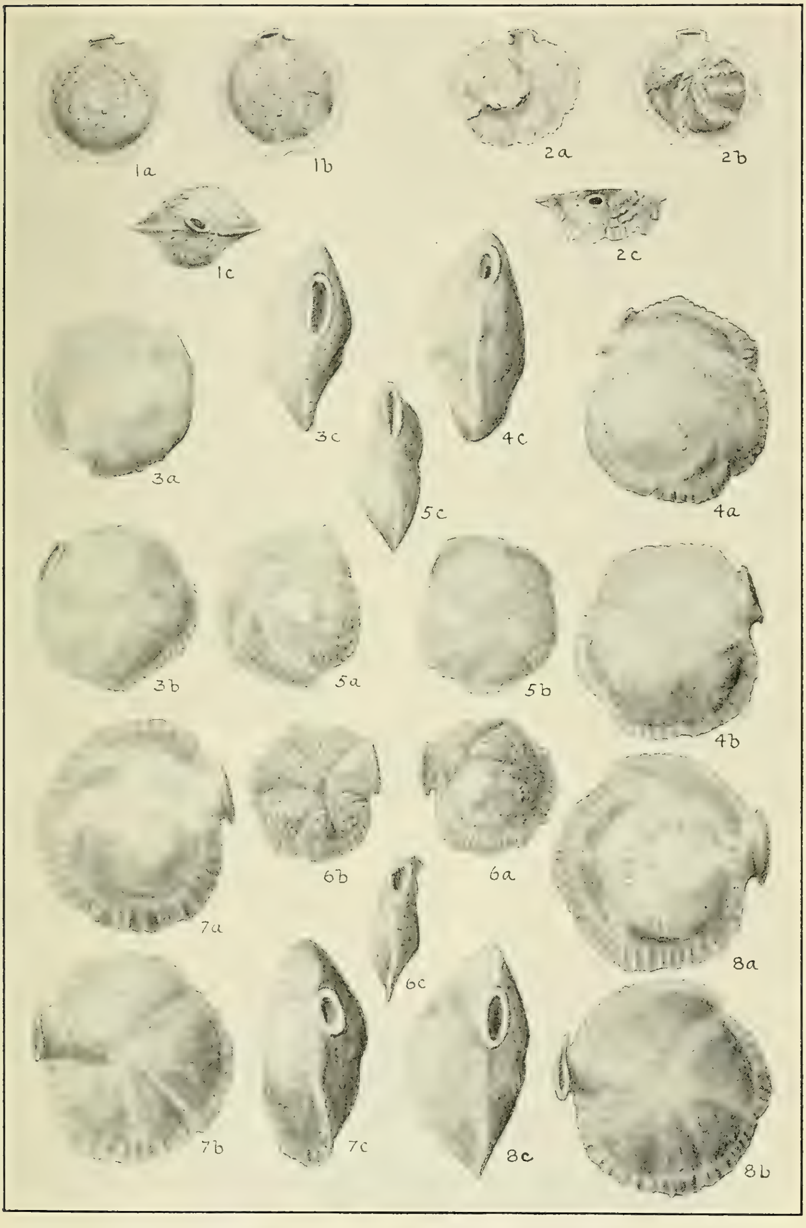
FORAMINIFERA OF THE GENUS SIPHONINA

FOR EXPLANATION OF PLATE SEE PAGE 14



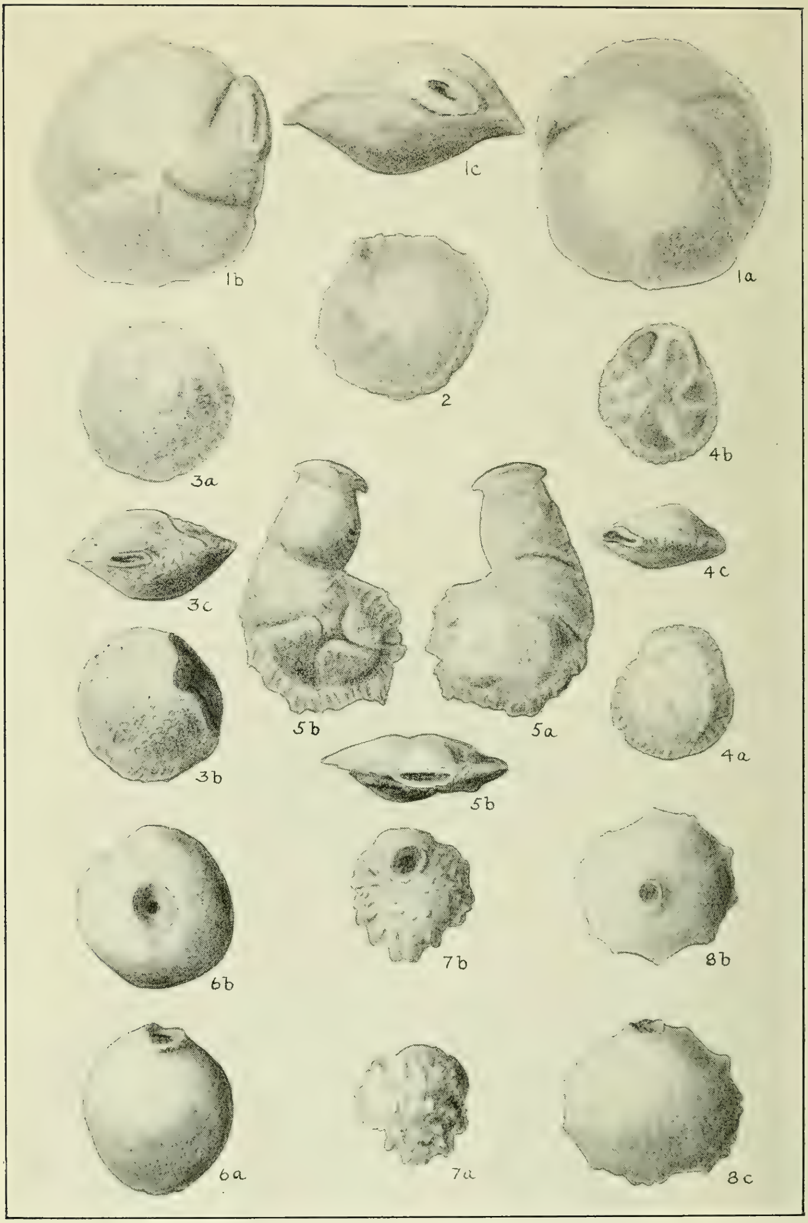
FORAMINIFERA OF THE GENUS SIPHONINA

FOR EXPLANATION OF PLATE SEE PAGE 14



FORAMINIFERA OF THE GENUS SIPHONINA

FOR EXPLANATION OF PLATE SEE PAGE 15



FORAMINIFERA OF THE GENUS SIPHONINA

FOR EXPLANATION OF PLATE SEE PAGE 15

THE OXIDATION OF METEORIC IRONS WITH COMPARATIVE DESCRIPTIONS OF TWO NEW EXAMPLES OF MAGNETIC IRON OXIDES FROM TERRESTRIAL SOURCES

By Earl V. Shannon

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INTRODUCTION

Meteorities are divided into three major subdivisions, briefly the irons, the stony irons, and the stones. These differ from each other in degree rather than in kind and all contain more or less iron in the form of a crystalline metallic alloy with an average content of nickel not far from 10 per cent. The nickel is accompanied by only minor amounts of other elements, which include cobalt, copper, phosphorus, and platinum, usually in amount in the order named. Many such have been seen to fall, and from the number and weight of those known to have reached the earth in historic times it is certain that the total number which has fallen throughout geologic ages is enormous. However, like a lump of ordinary manufactured iron or steel exposed to atmospheric agencies, the metal of meteorites is subject to rapid alteration and their forms and identities are soon lost by mechanical and chemical disintegration. The meteorities are even more prone to chemical alteration, under the influence of the weather, because of the fact that they almost invariably contain some ferrous chloride, which hastens the change, as has been pointed out repeatedly. Of those iron meteorites which have fallen during geologically recent times the very latest have almost invariably a very thin oxide scale or crust. Those of intermediate age may consist of oxide masses inclosing cores of unaltered metal, while the older are entirely oxidized and hydrated and their provenance is only established by the presence of minor constituents or an inherited structure.

The earliest published reference to the nature of the oxidation products arising from the alteration of meteoric iron appears to have been the statement by Merrill[1] that, in the oxidation of the Admire pallasite "the first product of the oxidation of the iron is not limonite, but a highly lustrous—on polished surfaces, blue—material which crushes down readily to a fine brown magnetic powder." While this was an original observation of some importance, Doctor Merrill overgenerously credited priority to J. Lawrence Smith, while the paper by Smith cited deals not with the natural products of oxidation but with the properties of the oxide prepared from the metal of meteoric irons in the laboratory. The attention of the present writer has from time to time been directed to the subject of the oxidation products of meteorites through work under Doctor Merrill's direction and received impetus through examination of the Coldwater, Kans., material described below and considered by him to be in all probability a completely oxidized meteoric iron. This shortly preceded the appearance of a paper by Sosman and Posnjak[2] on "ferromagnetic ferric oxide, artificial and natural." Almost simultaneously with the appearance of the latter paper there was received at the United States National Museum a very striking example of magnetic ferric oxide, the polarized iron ocher from Durant, Okla., as described in detail below. In previous descriptions of oxidized meteorites it has been assumed that the iron oxidized first to magnetite which gradually went over to limonite on further oxidation and hydration despite the very low content of ferrous oxide shown by analysis. In describing the "shale balls" of the Canon Diablo locality Farrington assumed to account for this the presence of magnetites into which the nickel, cobalt, and copper occupied the place of the bivalent iron of ordinary magnetite. The emphasis placed by Sosman and Posnjak on the fact that magnetite might readily oxidize to an anhydrous ferric oxide retaining the magnetic properties of the magnetite suggested the propriety of a further investigation into the nature of the material formed from meteoric iron. There are accordingly considered in detail below the Canon Diablo shale balls; the Coldwater oxidized iron and the scale from the York, Greenland, iron. In comparison there are described the Durant, Okla., ocher and a martite iron ore typical of the great deposits of Durango, Mexico.

PURPOSE OF THE INVESTIGATION

The problems presented for solution were briefly:

First. Does meteoric iron oxidize to fine-grained magnetite as the first product of atmospheric weathering?

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[1] George P. Merrill. A newly found meteorite from Admire, Lyon County, Kans. Proc. U. S. Nat. Mus., vol. 24, p. 910, 1902.

[2] R. B. Sosman and Eugene Posnjak. Journ. Wash. Acad. Sci., vol. 15, pp. 329–342, August, 1925.

Second. Does such magnetite, if formed, further oxidize to anhydrous ferric oxide of ferromagnetic character?

Third. Were there formed any nickel or other analogues of magnetite of the type of trevorite ($NiO.Fe_2O_3$) in the process of oxidation?

Fourth. Could a second ferromagnetic ferric oxide similar in atomic grouping or space lattice to metallic iron be formed without the intermediate formation of magnetite through the oxidation of crystalline metallic iron?

Fifth. Could intermediate stages of ferrous chloride (lawrencite) or of ferric chloride (molysite) influence the space lattice or the magnetic properties of the oxide formed?

Sixth. Do terrestrial examples, as known, compare with iron meteorites in the nature of their oxidation products?

SUMMARY OF CONCLUSIONS

The results attained and the conclusions deduced therefrom may, in brief, be tabulated as answers to the above queries:

First. Magnetite forms only in relatively small amounts as a transitory and unstable stage in the oxidation.

Second. The magnetite and the iron itself rapidly change to limonite or ferric hydrate without the intervention of appreciable amounts of ferromagnetic ferric oxide.

Third. The formation of trevorite ($NiO.Fe_2O_3$) and of analogous compounds of cobalt and copper—persistent ferrites—seems to be established and that these are strongly ferromagnetic and account for the magnetic properties of the whole.

Fourth. There is no evidence in support of the assumption that any ferromagnetic oxide of any kind is formed except the ferrites of bivalent oxides above mentioned.

Fifth. Owing to the lack of evidence and the unstable nature and deliquescent character of the chlorides it is doubtful that they have any action other than to promote the formation of amorphous hydrated ferric oxide from the iron.

Sixth. The terrestrial occurrences of ferromagnetic ferric oxide are different in composition and origin and present no analogies to the oxidation of meteorites.

ACKNOWLEDGMENTS

The writer is indebted to Doctor Merrill for the free use of material and data and for the time and opportunity to prosecute the present investigation. To Dr. Eugene Posnjak he is indebted for free discussion and advice regarding the points involved and to Mr. Forrest A. Gonyer for much valuable assistance in the preparation and analysis of the samples studied.

CANON DIABLO SHALE BALLS

Among the most widely known and thoroughly studied examples of oxides derived from the alteration of meteoric iron are the so-called "iron shale" masses which are common around the rim of the meteoric crater of Coon Butte near Canon Diablo, Ariz. These masses of iron oxide are scattered concentrically around the crater for a distance of several miles from the rim.[3] The origin of the smaller masses of the "shale" is inferred from the fact that they all contain nickel and cobalt and have similar form and occurrence to larger masses which either include cores of unoxidized meteoric iron or scattered plates of the nickel-iron phosphide schreibersite or show on polished surface, even when completely oxidized, ghostlike outlines of the widmanstatten structure of octahedral meteoric iron.

The oxides from this source have been described by Farrington,[4] who gives the following analysis, made by H. W. Nichols:

Analysis of "iron shale"

Fe_2O_3	74.63
FeO	3.91
NiO	9.79
CoO	.49
CuO	-----
CaO	1.27
Al_2O_3	.05
SiO_2	1.09
CO_2	.35
P	.10
C	.15
Cl	.08
H_2O	8.02
	99.93

In the interpretation of the above results, Farrington assigns all of the nickel and cobalt oxides to form "magnetite" along with the ferrous iron, arriving at the following composition:

Limonite	52.99
Magnetite	42.39
Schreibersite	.64
Graphite	.15
Lawrencite	.14
Aragonite	.80
Andradite	2.45
Quartz	.21
	99.77

[3] See George P. Merrill. The meteor crater of Canyon Diablo, Ariz., its history, origin, and associated meteoric irons, Smithsonian Misc. Coll., vol. 50, pp. 461–498, particularly pp. 484–487, 1908.

[4] O. C. Farrington. Analysis of "iron shale" from Coon Mountain, Ariz. Amer. Journ. Sci., vol. 22, pp. 303–309, 1906.

Assuming 42.39 per cent of iron, nickel, and cobalt ferrites, all strongly magnetic, in fine distribution through the stone, Farrington explains the magnetic character of the material as assignable to this cause.

Barringer and Tilghman[5] had previously described these shale balls and had, without giving analyses, concluded that the central cores of unoxidized metallic iron were surrounded by a crust of magnetic iron oxide which they presumed to be magnetite, surrounded by an outer scaly and peeling crust of hydrated oxide or limonite. Many of the masses are described by these authors as containing green nickel hydroxide scattered through their mass. No such green nickel compound was observed in the material examined by Farrington.

Barringer and Tilghman concluded that the magnetic oxide or magnetite crust was formed while the meteorites were passing through the atmosphere and that this magnetic oxide was later decomposed to limonite by atmospheric weathering. Farrington dissents from this opinion and assigns all of the oxides to long weathering of the metal. The latter seems the more reasonable view in consideration of the thinness of the crust visible on all meteorites known to have fallen within historic times.

Wirt Tassin[6] analyzed and described examples of the iron shale, his first analysis being from the crust of a shale ball having a metal core, while the second is of a platy mass of iron oxide having a structure thought to be due to schreibersite. These analyses gave the following results:

Analyses of shale balls by Tassin

	1.	2.
Fe_2O_3	78.82	81.07
FeO	.65	.00
NiO	8.85	4.66
CoO	.39	.00
MgO	.02	.00
SiO_2	.76	1.47
S	.01	.00
P	.20	.09
Cl	.03	-----
C	.10	-----
H_2O	10.00	12.81
	99.83	100.10

These results differ from those of Farrington, above, and of the writer, below, in the very low ferrous iron content of the one and the

[5] D. M. Barringer and B. C. Tilghman. Proc. Phila. Acad. Nat. Sci., vol. 57, pp. 861–914, 1925. Amer. Journ. Sci., June, 1906, p. 402.

[6] Wirt Tassin: See George P. Merrill and Wirt Tassin. Contributions to the study of the Canyon Diablo meteorites. Smith. Misc. Coll. (quarterly issue), vol. 50, pt. 2, pp. 213–214, 1907.

absence of this constituent in the latter. If we interpret Tassin's results in mineralogic terms, the following results are obtained:

	1.	2.
Limonite ($2Fe_2O_3.3H_2O$)	69.27	88.73
Magnetite ($FeO.Fe_2O_3$)	2.69	None.
Trevorite ($NiO.Fe_2O_3$)	27.53	14.50
Cobalt trevorite ($CoO.Fe_2O_3$)	1.26	-----
Schreibersite (Fe_2NiP)	1.30	.58

There is no excess of Fe_2O_3 in the above interpretation. In fact there is not quite enough shown by either analysis to use up all of the water as a limonite with the formula above used for this mineral. Limonite is an amorphous material having the composition $Fe_2O_3.H_2O$, usually with approximately the additional amount of water necessary to approximate the formula above used. This mineralogic interpretation is of interest in comparison with Tassin's discussion of his results. He disagrees thoroughly with Farrington's interpretation and regards the shale as made up essentially of limonite and some turgite, saying that this opinion is based upon the physical characters of the shale in preference to data derived by the arbitrary combining of the bivalent bases to form ferrites. Tassin says positively that, in the portions analyzed by him, the magnetic character of the samples was certainly due to the relatively large amount of unaltered schreibersite present and which was plainly visible in many sections of the iron shale. The inconsistency of this reasoning is patent from his analytical figures. His results for phosphorus are equivalent to only 1.30 per cent of schreibersite in the first sample and 0.58 per cent in the second. To these small amounts certainly can not be credited the strong magnetism of the samples.

The specimen supplied for examination to the writer by Doctor Merrill is a nodule of blackish-brown color and brecciated appearance. Its main mass is composed of hard lustrous brownish to blue-black homogeneous-appearing material of submetallic luster. The cracks and interstices are filled with a little yellow ocher and pinkish material of clayey appearance which contains some carbonate. When crushed to pass 80 mesh the powder is near Mars brown, Ridgway (13′*m*) and is entirely picked up with an ordinary horseshoe hand magnet. The material is not polarized. Fairly large chunks of the unground material are easily lifted by the magnet. The partial analysis was made by the following procedure. One-half gram of the sample was dissolved in boiling 1:3 sulphuric acid in an iron reduction flask through which a current of CO_2 was passed. After titration for ferrous iron, the whole solution was reduced by hydrogen sulphide, the hydrogen sulphide expelled with carbon dioxide and again titrated for total iron. The insoluble was filtered out, ignited and weighed, after which citric acid was added to the solution and the nickel determined with dimethylglyoxime. Water was determined as loss on ignition of a separate portion and corrected for oxidation of the ferrous iron. The results were as follows:

Insoluble	0.36
Fe_2O_3	79.50
FeO	3.68
NiO	6.44
H_2O	8.19
Undetermined	1.83
	100.00

Mineralogically combined, following the same assumptions as used in the interpretation of Tassin's analyses above, the figures give the following:

Limonite ($2Fe_2O_3.3H_2O$)	56.73
Magnetite ($FeO.\ Fe_2O_3$)	11.86
Trevorite ($NiO.Fe_2O_3$)	20.03
Fe_2O_3 (excess)	8.36
Insoluble (SiO_2 etc.)	.36
	97.34

In the absence of appreciable amounts of schreibersite and of any residual unoxidized metallic iron, the magnetism exhibited by the material must be attributed to the oxides themselves. The 8.36 per cent of free Fe_2O_3 indicated above is very probably not present as such, but is in the limonite, the variability of that mineral in water content making water a very unsatisfactory index to the amount of hydroxide present. The ferrous oxide, equivalent to only 11.86 per cent of ordinary magnetite, is not sufficient to account for the degree of magnetic susceptibility. If the nickel oxide be combined as ferrite, it adds 20.03 per cent of trevorite, giving a total of 31.89 per cent of magnetic ferrites. The excess of Fe_2O_3 may or may not be the ferromagnetic form of this compound, but its amount is small enough to be disregarded, especially as it is quite probably limonite, as stated above. If, however, the existence of magnetic nickel ferrite is not admitted, it is necessary to assume the presence of ferromagnetic Fe_2O_3 to account for the properties of the material.

There is considerable evidence in support of the assumption of the existence of nickel ferrite in this material. J. Lawrence Smith [7] as long ago as 1875 pointed out certain magnetic peculiarities of ferric

[7] J. Lawrence Smith. Singular anomaly of the sesquioxide of iron as prepared from meteoric iron. Amer. Chemist, vol. 5, 1875, pp. 356–358; Chem. News, vol. 31, 1875, pp. 210–212; Compt. Rend., vol. 53, 1875, pp. 301–304.

oxide prepared by the precipitation of the iron of solutions of meteoric iron. These results were summarized as follows:

1. The artificial hydroxide of iron, prepared from pure iron and dried at low temperatures, is attracted feebly by the hand magnet, but loses this property at and below red heat.

2. Ferric oxide, prepared in the ordinary manner, from solutions of meteoric iron and dried at a low temperature, acts similarly to the ordinary oxide, but becomes decidedly magnetic on being heated from 400° C. to a red heat.

3. The ferric oxide from ordinary iron, mixed with nickel or cobalt or both, from whatever source, exhibits magnetic properties identical with that from meteoric iron.

4. Ferric oxide from meteoric iron, freed entirely from traces of nickel and cobalt, corresponds to the ordinary ferric oxide in its behavior to the magnet.

5. Ferric oxide made from iron mixed with copper resembles that from meteoric iron.

6. Ferric oxide made from iron mixed with manganese, gold, platinum, zinc, or calcium differs in no way from the pure ferric oxide in its behavior to the magnet.

By reducing the oxides in hydrogen and analyzing the resultant metal, Smith found 2 or 3 per cent of cobalt, nickel, or copper in the magnetic oxides, and he expresses the opinion that these in some manner act to reduce a small part of the ferric iron to magnetic oxide. Only in a footnote does he mention that it has been suggested to him by Prof. F. C. Chandler that the nickel, cobalt, and copper oxides present may form, with ferric oxide, a magnetic oxide as $NiO.Fe_2O_3$, analogous to $FeO.Fe_3O_2$.

It is clear that the magnetic character of the ignited oxides is due to the formation of ferrites. In the analysis of meteoric irons it is very difficult to quantitatively separate the nickel and cobalt by precipitation of the iron with ammonia even when the precipitation is repeated several times. With a single precipitation the nickel is largely held by the precipitate, and it is not uncommon to find more nickel in the second ammoniacal filtrate than in the first.

Artificially prepared ferrites of copper, nickel, and cobalt have been found to be strongly ferromagnetic[8] while the analogous ferrites of K_2O, Na_2O, Cu_2O, CaO, BaO, MgO, ZnO, and PbO were nonmagnetic.

Natural and relatively pure nickel ferrite of terrestrial origin from South Africa has been recently described by Crosse[9] and

[8] S. Hilpert and P. Beyer. Uber eisenoxyduloxyde und eisenoxyde. Ber. Deut. Chem. Ges., vol. 42, pt. 4, 1909, pp. 4893–4895.

[9] A. F. Crosse. A rich nickel ore. Journ. Chem Met. and Mining Society of South Africa, vol. 21, p. 126, 1921.

Walker,[10] who makes it a distinct species, a nickel equivalent of magnetite with the formula $NiFe_2O_4$ or $NiO.Fe_2O_3$. The mineral is black, very strongly magnetic, and has a metallic luster, hardness about 5 and specific gravity 5.165.

These ferrites of nickel, copper, and cobalt are also referred to by Frebold and Hesemann,[11] in their paper on the iron oxides which is further referred to below.

The natural trevorite yielded the following results upon analysis:

Fe_2O_3	66.24
FeO	1.96
NiO	29.71
MgO	.24
SiO_2	1.40
H_2O	.36
	99.91

RESIDUAL MASS OF IRON OXIDES, PRESUMABLY METEORIC, FROM COLDWATER, COMANCHE COUNTY, KANS.[12]

The mass, upon which the following discussion and description are based, was submitted for examination to Dr. George P. Merrill by Prof. H. H. Nininger, of McPherson College, Kansas. If meteoric it was obviously of an old fall regarding which no historical data were to be had. The severed mass, weighing 18.545 kilos, had the appearance of a somewhat flattened septarian nodule, the surface of which had been checked by weathering and oxidation. Tests showed the presence of nickel, but a sawing of the mass through the middle showed it to be composed essentially of iron oxides, compact externally but more porous within with no structure indicating meteoric origin, although there were revealed a few specks of minute size of a material of tin white color and high metallic luster. Further slicing, however, revealed other surfaces traversed by platy areas of softer and more porous nature than the surrounding material which were arranged in lines giving triangular intersections reminiscent of the medium coarse octahedral structure of meteoric irons. Since the evidence seemed to suggest a meteoric origin for the mass of iron oxides of which the individual was composed it was submitted for analysis to Dr. J. Edward Whitfield. Doctor Whitfield's analysis gave the following results:

[10] Thos. L. Walker. Trevorite a distinct mineral species. Contrib. to Canadian Mineralogy. Univ. Toronto Geol. Ser. No. 16, pp. 53–54, 1923.

[11] G. Frebold and J. Hesemann. Uber magnetischen und nichtmagnetischen eisenglanz, etc. Centralbl. Min. Abt. A. No. 10, pp. 314–321, 1926.

[12] The writer is indebted to Doctor Merrill for the notes on the present material and for the analysis by Doctor Whitfield.

Analysis of Coldwater Meteorite

By J. E. Whitfield

Insoluble	3.361
SiO_2	2.910
Al_2O_3	1.610
Fe_2O_3	81.595
P_2O_5	.621
CuO	.038
NiO	1.999
CoO	.113
MgO	.331
SO_3	.219
H_2O	7.205
	100.002

Disregarding the minor constituents and calculating the oxides on a combined basis this analysis gives:

Limonite ($2Fe_2O_3.3H_2O$)	49.89
Magnetite ($FeO.Fe_2O_3$)	None.
Trevorite ($NiO.Fe_2O_3$)	6.22
Co trevorite ($CuO.Fe_2O_3$)	.35
Cu trevorite ($CuO.Fe_2O_3$)	.12
Hematite (Fe_2O_3)	34.36
	90.94

Since the above analysis showed no value for ferrous iron it was not known whether the state of oxidation had been directly determined or whether the whole of the iron had been presumed to be in the ferric state. Another portion of the specimen was accorded partial chemical examination in the United States National Museum laboratory. This material was blackish-brown in color, compact, and with a somewhat metallic luster, especially on polished surfaces. Fairly large pieces are easily lifted by a hand magnet. The result of this partial analysis was as follows:

Insoluble	5.02
Fe_2O_3	75.12
FeO	1.77
NiO	4.32
H_2O	12.38
	98.61

The last analysis, interpreted in mineralogic terms gives the following:

Magnetite ($FeO.Fe_2O_3$)	5.70
Trevorite ($NiO.Fe_2O_3$)	13.44
Limonite ($2Fe_2O_3.3H_2O$)	85.86
	105.00

It will be seen from the last total that there is not sufficient ferric iron to form limonite with all of the water if the formula $2Fe_2O_33H_2O$ is assumed for the latter. Limonite is variable in water content, however, it being the amorphous equivalent of goethite with the formula $Fe_2O_3H_2O.nH_2O$. The difference in the water content of this and Whitfield's results suggest that he dried his sample at or near 100° before analysis. It is obvious that enough water is present in the last sample to form limonite with all of the ferric oxide so that the magnetic susceptibility of this portion at least must be credited to the 19.14 per cent of trevorite and magnetite shown by the last tabulation.

The powder obtained by grinding the Coldwater material to pass an 80 mesh sieve was between cinnamon brown (XV–15′–*k*) and Prout's brown (XV–15′–*m*) Ridgway in color. By working over it with a hand magnet it was found to be attracted 88.3 per cent, unattracted 11.7 per cent. The attracted and unattracted portions were identical in color and appearance.

OXIDIZED OUTER CRUST OR SCALE FROM THE YORK METEORITE

For comparison with the foregoing a sample of the scale from the York, Greenland, meteoric iron consisting of flat brown flakes was examined. The flakes were up to 3 centimeters broad by 1 to 3 millimeters thick and, although consisting principally of oxides, they showed metallic particles upon grinding. The metal was removed in large part by screening out the flattened particles from the agate mortar, and only a small part of the metal passed through an 80-mesh sieve. The powder which passed 80 mesh was separated into magnetic and nonmagnetic portions with a horseshoe magnet. Both these powders were about Mars brown (13′*m*) Ridgway, in color. The proportions of the rough separation were as follows:

	Per cent
Metal	11.4
Magnetic	85.0
Nonmagnetic	3.6
	100.0

Only the magnetic oxide was further examined, and this, partially analyzed by the method of procedure above, gave the following results:

	Per cent
Insoluble	1.86
Fe_2O_3	65.97
FeO	9.52
NiO	6.78
H_2O	12.44
	96.57

These figures are less satisfactory for mineralogical interpretation as there was unquestionably some metallic iron in the material analyzed, increasing the ferrous iron content by its amount as well as by the hydrogen generated by its solution in acid. The results interpreted in combination are, however:

	Per cent
Magnetite ($FeO.Fe_2O_3$)	30.68
Trevorite ($NiO.Fe_2O_3$)	21.09
Fe_2O_3	30.50
H_2O	12.44
Insol	1.86
	96.57

Since there is much too little remaining Fe_2O_3 to form the compound $2Fe_2O_3.3H_2O$ with all of the water, these constituents are stated separately above. Calculation shows the Fe_2O_3: water ratio to be 1:3.82. There can thus be represented in this meteorite scale no anhydrous Fe_2O_3 either magnetic or nonmagnetic. The magnetic content indicated above, even were it corrected for the effect of metal in the powder, is much higher than in the two preceding examples, a condition which may depend to a considerable degree to the peculiarities of weathering under the climate of Greenland as compared with the climates of Arizona and Kansas. The magnetite and the trevorite, together amounting to over 50 per cent are ample to explain the magnetic properties of the material.

FERROMAGNETIC POLARIZED ANHYDROUS IRON OCHER FROM OKLAHOMA

In a lot of materials received for examination from Mr. O. C. Duncan of Durant, Okla., was a specimen of impure oxide of iron which proved to be of unusual interest. The sample was accompanied by a number of other materials, chiefly bentonitic clays, and was said to have come from near Durant, but no additional information regarding the occurrence has been received.

At first observation the material has the appearance of an ordinary compact red-brown ocher. Its color, both in mass and finely ground, is cinnamon rufous (11′*i*) Ridgway and the mineral is entirely dull and lusterless. It forms small rounded masses up to 1 centimeter across which are frangible enough to be broken with the fingers and are easily crushed in an agate mortar by only moderate pressure of the pestle. Ordinarily this would have been reported as a common ocher but it was observed that the grains had a strong tendency to cohere and the finer powder attached itself to larger grains in mossy aggregates after the manner of lodestone. The material was not only highly ferromagnetic but it was also strongly polarized. Microscopic examination showed the sample prepared for analysis to contain a considerable amount of finely granular quartz as the only notable impurity. The partial analysis made in the museum laboratory gave the following results:

Analysis of ferromagnetic ocher

Insoluble (quartz)	17.80
Fe_2O_3	72.20
FeO	1.64
Al_2O_3	3.12
CaO	Trace.
NiO	None.
H_2O above 110°C	2.80
H_2O below 110°C	1.10
Undetermined	1.34
	100.00

Mineralogically interpreted as in the above, this analysis gives:

Quartz	17.80
Fe_2O_3	46.07
Limonite ($2Fe_2O_3.3H_2O$)	26.38
Magnetite ($FeO.Fe_2O_3$)	5.29
Al_2O_3	3.12
Loss	1.34
	100.00

This interpretation indicates that not more than 5.29 per cent of magnetite can be present so that the strongly magnetic and polarized character of the material can not be attributed to this constituent either as mechanically admixed magnetite or as magnetite present in solid solution in hematite.

This appears to be a rather good example of ferromagnetic ferric oxide of natural origin. The 3.90 per cent of water tabulated in the analysis actually represents loss on ignition and may include some carbon dioxide or other volatile material. Although this amount of water is equivalent to 26.38 per cent of limonite of an assumed composition of $2Fe_2O_3.3H_2O$, it is doubtful that any such amount of limonite is present. Any material of such fine grained structure is bound to hold some hygroscopic water and the alumina indicated in the analysis is probably present as a clay which may be highly hydrous.

Although no information as to the occurrence or origin of this material could be obtained it seems unquestionably native and not produced by the heating or other treatment of any of the other forms of iron oxide. The subject of ferromagnetic ferric oxide has been thoroughly discussed by Sosman and Posnjak,[13] their studies being

[13] Robert B. Sosman and E. Posnjak. Ferromagnetic ferric oxide, artificial and natural. Journ. Wash. Acad. Sci., vol. 15, No. 14, pp. 329–342, Aug. 19, 1925.

based largely upon the artificially prepared material, although they describe one natural example. The materials of their experiments were obtained by shaking precipitated magnetite with oxidizing agents at ordinary temperatures. They found that heating destroys the magnetic character of ferromagnetic ferric oxide and that hematite can not be converted into the magnetic modification of the compound. It was also found that dehydration of goethite and limonite would yield only nonmagnetic Fe_2O_3, although lepidocrocite, when dehydrated, did yield the magnetic Fe_2O_3.

The example of natural magnetic ferric oxide described by Sosman and Posnjak was also polarized. It was in the form of a light chocolate-brown powder containing yellowish brown specks and came from a gossan deposit at Iron Mountain in the Shasta County copper district, Calif., where it was collected by Drs. L. C. Graton and B. S. Butler. This material upon analysis gave the following:

Insoluble	1.80
Fe_2O_3	85.30
FeO	2.40
CaO	Trace.
H_2O to red heat	3.10
Other volatile matter	2.50
	95.10

No discussion of the probable origin of this material is given by these authors beyond the statement that it is in a gossan and contains some pyrite. They suggest the advisability of giving the material a new mineral name but consider it desirable, before so doing, to have a type specimen less contaminated with impurities.

MARTITE FROM CERRO MERCADO, DURANGO

In connection with his studies of the iron ores of the Cerro Mercado, near the city of Durango, Durango, Mexico, Dr. W. F. Foshag found material, evidently martite since it showed the crystal form of magnetite yet revealed little magnetite on polished surface. This had a magnetic susceptibility in excess of that which could be explained by the visible magnetite inclusions. For comparison with the ferromagnetic ocher from Oklahoma and the oxidized meteoric irons, a sample was briefly examined.

The specimen, from "Penascos de la Industria" is a heavy cellular mass of reddish black color and metallic luster. The cavities are lined with lustrous and brilliant octahedral crystals which are thinly coated with small amounts of various later minerals. When ground to pass 80 mesh the color of the powder is chocolate ($7''$-m) Ridgway. Upon being worked over with a hand magnet 78 per cent was separated as attracted while the remaining 22 per cent was unattracted. No color difference could be detected between the attracted and the unattracted portions.

The attracted portion was analyzed partially with the following results:

Martite ore, Durango

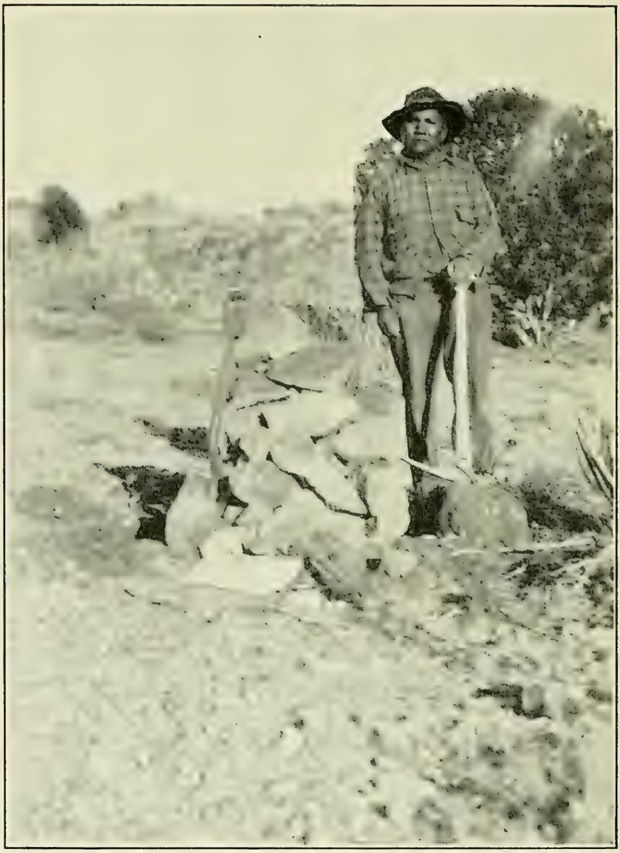
Insoluble	10. 84
Fe_2O_3	80. 72
FeO	2. 58
H_2O	1. 36
Undetermined	4. 50
	100. 00

These figures, combined as previously, gave:

Quartz, etc	10. 84
Magnetite	8. 31
Limonite	9. 42
Hematite	66. 93
Undetermined	4. 50
	100. 00

The amount of magnetite indicated in this table is just about what can be observed in polished surfaces under the reflecting microscope so that this constituent is present in mechanical admixture and not in solid solution. This is not enough to explain the magnetic attraction exhibited by the whole material and it seems certain that a considerable portion of the ferric oxide above tabulated as hematite must be the ferromagnetic form. The martites have been carefully studied by Sosman and Hostetter[14] who found a number of martites which consisted of granular or fibrous aggregates of homogeneous material apparently contained ferrous iron in solid solution.

[14] R. B. Sosman and J. C. Hostetter. The ferrous iron content and magnetic susceptibility of some artificial and natural oxides of iron. Bull. Amer. Inst. Min. Eng., No. 126, June, 1927.



THE INDIAN, DICK GROVER, WITH THE LARGER OF THE WALLAPAI METEORIC IRONS

ON NEWLY DISCOVERED METEORIC IRONS FROM THE WALLAPAI (HUALAPAI) INDIAN RESERVATION, ARIZONA

By George P. Merrill

Head Curator of Geology, United States National Museum

The iron meteorite here described was first brought to public attention through Mr. William A. Light, superintendent of the Truxton Canon Agency, who, early in the spring of 1927, sent a fragment from the larger mass to the Bureau of Mines in Washington, where it came into the hands of Mr. Frank L. Hess, and through him passed to the United States National Museum. A letter addressed to Mr. Light brought the information that there were two masses, recently discovered by an Indian named Dick Grover (Pl. 1) on the Wallapai Indian Reservation. He also sent the following detailed account:

I am glad to submit all the information I have regarding these specimens. I have the smaller of the two at the school. It is an irregular body with triangular sides and weighs 273 pounds. Its color is dark brown, and its surface is irregular, resembling metal that has been heated to the melting point and cooled quickly. Its shape is somewhat like an egg. Length is 19 inches, width 14 inches, greatest circumference 4 feet. These specimens were found on the slope of a limestone mountain, about 6 miles from the rim of the Grand Canyon of the Colorado River, in Mohave County, Ariz. Both of them were protruding from the earth so as to be readily seen, but three-fourths of the body of each is buried in the earth and stone. They were about 5 feet apart.

The larger specimen is three or four times the size of the smaller one. It lies where found, undisturbed. These bodies have lain in their present position for many years. The earth is level where they lie, and there is no indentation to indicate that they have fallen recently. They both show a weather-beaten appearance. * * * The earth where they lie appears to have been washed into a crack or indentation. There is very little surface stone on this mark, but the specimens were surrounded by soft earth which extends along the mountain side for 10 or 12 feet. We did not excavate in this soft earth, but left it as we found it. Because the mountain slope is composed of broken and disintegrated limestone, this "crack" filled with softer material, which would have washed into it in a series of years, indicates that it may have been an open crack or indentation at one time.

In the course of further correspondence, Mr. Light gave the following account by a Mr. R. C. Jacobson, which is of interest as bearing upon the possible date of fall.

When he [Jacobson] was a young mining engineer, just out of the University of Arizona, he was employed by the Gold Basin Mining Co. on a location in the north central part of this [Mohave] County, Ariz. This mine is located about 40 miles north of Hackberry, Ariz., a few miles from the Colorado River. Hackberry was the point of supply and the post office for this camp. One of his duties was to make trips to and from Hackberry with mail, subsistence supplies, and small articles, using a team of mules to an old fashioned "buckboard."

This was in the year 1904 or 1905. One evening he was driving from the mine to Hackberry, in the afternoon, about 4.30 to 5 p. m., and he was startled by a distant roar and his mules were frightened by it. He looked up and to his rear, and observed a great "red body" falling obliquely toward him from the northwest. It was emitting sparks, but was not as bright as meteorites seen to fall in darkness. He was fearful that it would strike him; his mules ran and he let them go to get away from danger. The body passed over him to the southeast, and when it passed over the east rim of the valley (which, by the way, is the Wallapai Valley; the same is bordered on the east by the Music Mountains; they are the east rim mentioned) the red mass was high enough to clear the top of the rim. He states that it passed over this rim, directly over a mine known as the Music Mountain Mine, and he felt very sure that it struck the earth just a short distance after it had passed over this rim. He was so sure of this that he spent several days searching the part of the Music Mountain rim where it disappeared, in an attempt to locate it. He was unable to find it.

The interesting part of the story is that the meteorite that you have was discovered by Dick Grover, about 10 or 12 miles directly southeast of the Music Mountain mine, and in line with the direction the body was seen to fall by Mr. Jacobson. From my knowledge of the country and Mr. Jacobson's description of the falling of this body, and the direction and line given by him, I feel confident that the meteorite found by Grover is the one seen by Mr. Jacobson to fall in 1904 or 1905. He failed to search far enough from the point on the rim of the mountains where it disappeared from his view. The startling impression made upon him when the red-hot body passed over him, caused him to think it was closer to the earth than it really was, and its actual altitude permitted it to clear the rim of the mountains, and continue for 10 to 15 miles before coming to a stop by coming in contact with the surface of the earth.

With reference to the disposition of the iron Mr. Light suggested that the smaller of the two should become the property of the University at Tucson and offered his services in securing the larger for the United States National Museum, kindly making a recommendation to this effect in his letter to the Indian Commissioner in Washington. Through these combined agencies the iron reached Washington on June 9, 1927, where it was cleaned, weighed, cut, photographed, and analyzed with the results given below.

The iron as shown in the photograph is in form of an elongated rounded mass with abundant shallow pittings, but with no marks by which its orientation in flight can be estimated for a certainty; too much obscurity has been produced by terrestrial oxidation. The maximum length, or height of the mass, as it stands in Plate 2 is 22 inches; the width 16 or 17 inches, the form in cross section being rudely triangular with roughly curving sides. Weight, as received, 672 pounds, or 305,454 grams. The fragment first received which had been "sledged" off weighed 535 grams, but whether this was all of it is uncertain. Considering its oxidized condition it would seem sufficient to say that its original weight was upwards of 306 kilograms. The weight of the smaller mass is given as 273 pounds, or 124 kilograms.

The weight of the mass under description made it somewhat difficult to handle, but nevertheless it was put upon the table of the bandsaw and three slices cut parallel with the rough broken face from which the fragment had been removed by hammering. The etched surface of the first of these is shown natural size in Plate 3. As will be noted it is a fine octahedrite (Of) of exceptional beauty. The sharply angular irregular enclosures are of schreibersite, an analysis of which yielded Mr. F. A. Gonyer, student analyst in the Museum laboratory, as follows: Fe, 63.62 per cent; Ni, 22.36 per cent; P, 14.37 per cent.

Of the three slices cut not one showed visible troilite or other enclosures than the schreibersite noted. The iron is soft, malleable, and etches very easily, with a uniformly dull surface.

The chemical composition of the iron, as a whole, as determined by Mr. Shannon in the Museum laboratory is given in column I below. In columns II and III are given the analyses of two other fine octahedrites made with equal care and reference to the presence of rarer elements.

REPORT BY MR. SHANNON ON THE ANALYSIS OF METEORITE FROM INDIAN RESERVATION IN ARIZONA

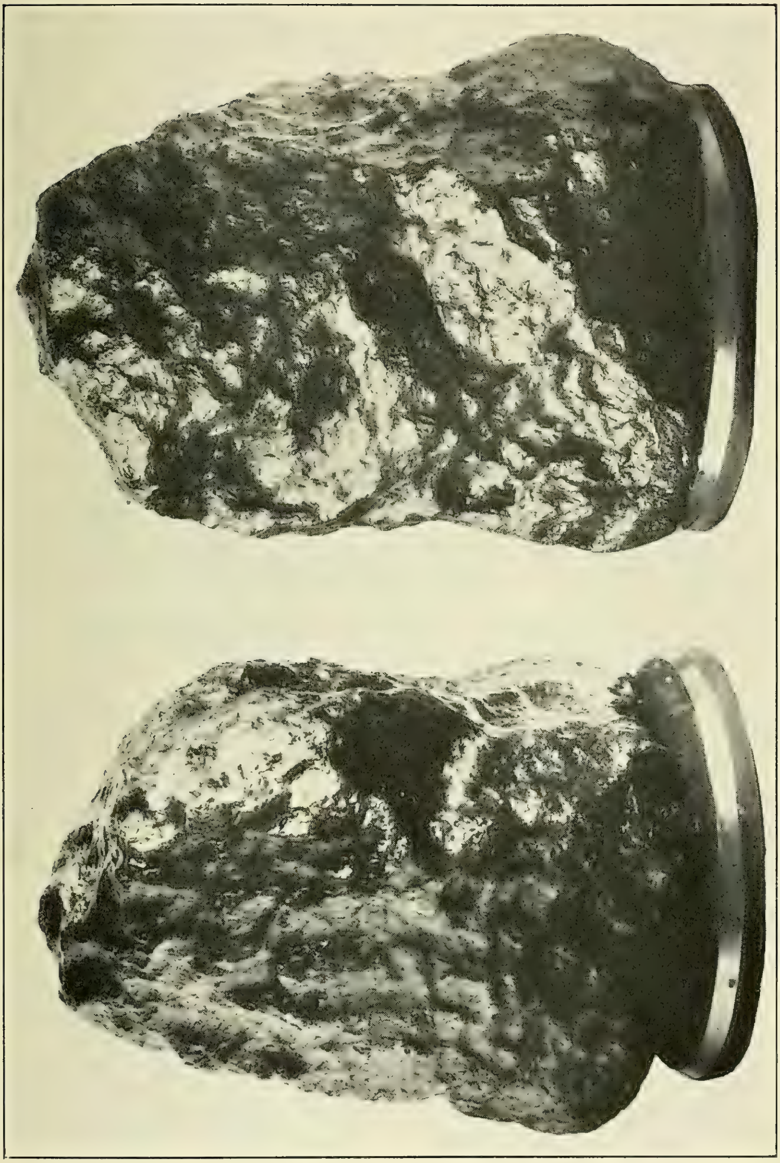
A piece of the iron weighing 70.2033 grams when freed as far as possible from scale, was dissolved for the analysis. This solution was made up to 1,500 c. c. Aliquot parts of 25 c. c., equivalent to 1.1701 grams, were taken for most constituents. In some cases checks were run on portions equivalent to .4680 grams. The results obtained are as follows (col. I):

	I	II [1]	III [2]
Insoluble	0.032	0.003	0.003
Iron	90.118	90.94	89.015
Nickel	9.118	8.122	9.660
Cobalt	.147	.462	.545
Copper	.002	----------	.025
Platinum	Trace.	Trace.	Trace.
Manganese	None.	None.	None.
Sulphur	.006	----------	.002
Phosphorous	.402	.255	.365
Carbon	----------	.032	.015
Total	99.825	99.814	99.630

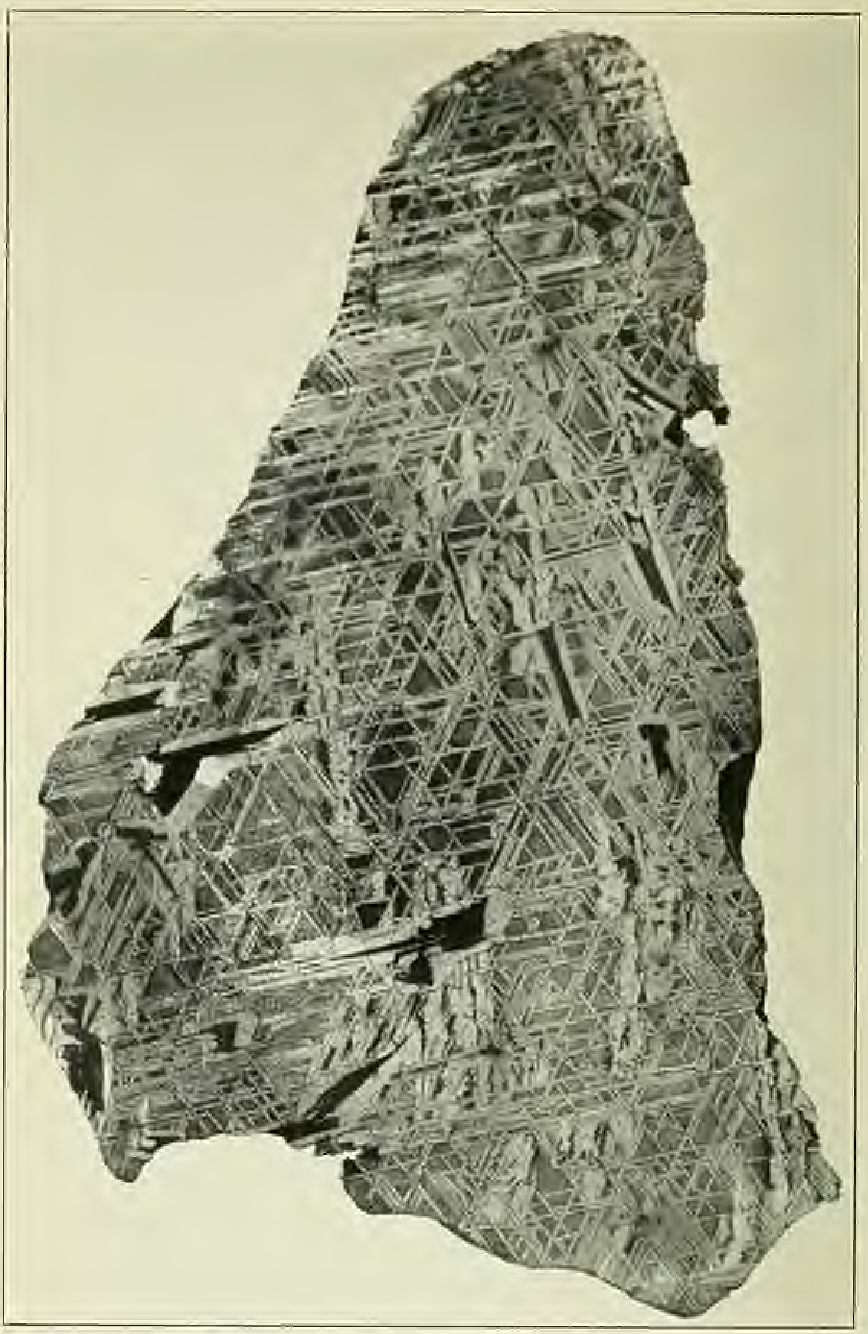
[1] Owens Valley, Calif., Mem. Nat. Acad. Sci., vol. 19, 1922.
[2] Perryville, Mo., Proc. U. S. Nat. Museum, vol. 43, 1912.

The residuum of the solution equivalent to 46.8022 grams of the iron was used for the determination of platinum and copper. The copper content is unusually low. A faint reaction was obtained for platinum by the very delicate potassium iodide test. The insoluble matter was examined microscopically and found to be chiefly dust. No chromite, graphite, or diamonds could be recognized. Although the nickel is moderately high, the cobalt content is small. Most of the determinations were repeated at least once. The sulphur result is perhaps too low, due to loss as hydrogen sulphide. No trace of manganese could be detected colorimetrically by the persulphate method.

O



Two Views of the Larger Mass of the Wallapai Meteoric Irons



ETCHED SLICE OF WALLAPAI, ARIZONA, METEORIC IRON, NATURAL SIZE

THE FLORA OF THE ESMERALDA FORMATION IN WESTERN NEVADA

By Edward W. Berry
Of the Johns Hopkins University, Baltimore, Md.

INTRODUCTION

The beds to which the name Esmeralda formation was given comprise sandstones, shales, lacustral marls, with local fanglomerates and conglomerates on a large scale. These outcrop at intervals over a large area in the Great Basin of western Nevada. They were described by H. W. Turner in 1900, and their thickness was estimated as exceeding 14,000 feet. It was suggested that deposition may have covered parts of Miocene and Pliocene time, since the fossils, namely: Fresh-water mollusks, a fish, and fossil plants, were all from near the base of the formation.[1] The fossil plants were described by Knowlton [2] in the same report.

Fourteen species were recognized, and all but one of these were regarded as new. An additional small collection was made from these beds by S. H. Cathcart in 1924, and this forms the basis of the present paper. The Esmeralda flora as now revised comprises the following species:

REVISED FLORA OF THE ESMERALDA FORMATION

Pteridophyta.
- Hydropterales.
  - Salviniaceae.
    - *Azolla tertiaria* Berry.
- Polypodiales.
  - Polypodiaceae.
    - *Dryopteris obscura* Knowlton.

Spermatophyta.
- Monocotyledonae.
  - Pandanales.
    - Typhaceae.
      - *Typha lesquereuxi* Cockerell.

[1] Turner, H. W., U. S. Geol. Surv. 21st Ann. Rept., pt. 2, pp. 191–208, 1900. A preliminary account appeared in vol. 25 of the American Geologist in the same year.
[2] Knowlton, F. H., Idem., pp. 209–220, pl. 30.

Naiadales.
Naiadaceae.
Potamogeton knowltoni Berry.
Dicotyledonae.
Choripetalae.
Salicales.
Salicaceae.
Salix inquirenda Knowlton.
Salix knowltoni Berry.
Salix sp., Knowlton.
Salix (?) sp., Knowlton.
Populus lacustris (Knowlton) Berry.
Fagales.
Fagaceae.
Quercus simulata truncata Berry.
Quercus turneri Knowlton.
Quercus argentum Knowlton.
Ranales.
Ceratophyllaceae.
Ceratophyllum fossilium Berry.
Nymphaeaceae.
Castalia (?) sp., Berry.
Rosales.
Rosaceae.
Chrysobalanus pollardiana Knowlton.
Caesalpiniaceae.
Cercis (?) nevadensis Knowlton.
Sapindales.
Anacardiaceae.
Rhus (?) nevadensis Knowlton.
Sapindaceae.
Sapindus lancifolius Lesquereux.
Myrtales.
Hydrocaryaceae.
Trapa americana Knowlton.
Gamopetalae.
Ericales.
Vacciniaceae.
Vaccinium ellipticum Berry.
Vaccinium vaccinifolia (Knowlton) Berry.
Rubiales (?).
Rubiaceae (?).
Cinchonidium (?) turneri Knowlton.

CHARACTER OF THE ESMERALDA FLORA

As shown in the foregoing list, this flora contains but 22 species. These represent 16 genera in 15 families and 12 orders. Two are Pteridophytes and the balance Spermatophytes. The seed plants represent 2 monocotyledons and 18 dicotyledons, there being no traces of conifers. Fifteen of the dicotyledons belong to the choripetalous division.

The flora is remarkable in containing representatives of six genera of hygrophilous plants, and since aquatic vegetation is largely conditioned by the presence or absence of water, it does not conform closely to life zones based upon terrestrial forms. Thus the following genera found in the Esmeralda formation, namely, *Azolla*, *Typha*, *Potamogeton*, and *Ceratophyllum* are all present in the present-day semiarid Upper Sonoran zone; *Castalia*, a genus tentatively recognized in the Esmeralda flora, occurs in the transition to the Hudsonian zone; and the sixth genus—*Trapa*—has been extinct in North America since the Pliocene.

These aquatic plants show conclusively the presence of a permanent water body in western Nevada in the Miocene, and this is reinforced by the presence in these deposits of the leaves of such stream and lakeside types as *Salix* and *Populus*, and mesophytic genera such as *Cercis*. This being so, the plants can not give us much definite information about the regional climate, beyond the fact that it was temperate and there was a sufficient source of supply to maintain permanent bodies of fresh water. The abundance of silicified wood, the presence of tree trunks said to be 6 to 8 feet in diameter, and the very considerable thickness of coal seams would seem to indicate a much greater humidity than prevails at the present time in this region, and perhaps justifies Turner's picture of the environment of Lake Esmeralda, as he christens it. This is rendered more probable by the wide distribution of diatomaceous beds throughout the Esmeralda formation. Frequently the matrix of the present collection is unusually rich in fresh-water diatoms.

Dicotyledonous leaves are prevailingly macerated, coriaceous forms, and are not abundant. Of the oaks, *Quescus turneri* suggests a chapparral form; and *Chrysobalanus*, *Rhus*, and *Sapindus* are all forms that are at home in a semiarid environment. The sparsity and in general broken character of these last-mentioned forms suggest that they may have been brought into the basin of sedimentation by streams, but the willow and *Cercis* leaves are equally rare and broken, so that the temptation to press the evidence further than is warranted must be resisted, and the conclusion is reached that the present flora does not furnish conclusive evidence regarding the regional environment.

AGE OF THE FLORA

The age of this flora can now be much more decisively indicated. Sixteen of the 22 species of plants recorded from the Esmeralda formation are not known in other areas and are therefore of slight value in correlation. The remainder show the following distribution:

	Florissant, Colo.	Mascall, Oreg.	Latah, Wash.	Payette, Idaho
Typha lesquereuxi, Cockerell	×		(?)	
Salix inquirenda Knowlton, (?)		×	×	
Salix knowltoni Berry				×
Quercus simulata truncata Berry			(?)	×
Sapindus lancifolius Lesquereux	×			
Trapa americana Knowlton				×

The exact age of Florissant, the Mascall, Latah, and Payette formations has been the source of considerable differences of opinion in the past. Both the Florissant and Mascall beds are now generally considered to be middle Miocene, although Knowlton's latest unpublished opinion was that the Florissant flora was upper Miocene, and I think the evidence for this is reasonably conclusive. The Latah and Payette floras are similarly considered Miocene, although agreement has not been reached as to just what part of the Miocene they represent. After studying large recent collections from the Latah formation I have concluded that it is not older than middle Miocene and probably younger, so that the Esmeralda flora seems to me to show conclusively that it is not older than middle Miocene and is almost certainly upper Miocene. This conclusion from the plant evidence coincides with J. W. Gidley's age determination of the Esmeralda vertebrates.

Phylum PTERIDOPHYTA

Order HYDROPTERALES

Family SALVINIACEAE

Genus AZOLLA Lamarck

AZOLLA TERTIARIA, new species

Plate 1, figs. 9, 10

The basis of this species is a considerable number of whole plants and scattered plant fragments at certain horizons in the clay where they are preserved as impressions. The plant body in the best-preserved examples is about a centimeter in diameter and consists of a flat branched stem covered with tiny oval leaves somewhat variable in shape, slightly under a millimeter in length, generally crowded and imbricated, becoming densely so around the periphery where they are more rounded and distinctly concavo-convex.

The certain remains of sporocarps have not been detected because of the poorness of preservation, but certain parts of the fossils distinctly suggest that they represent microsporocarps since they show impressions of small globular bodies that resemble microsporangia, although they may be massulae.

It is most unfortunate that this interesting form which looks so convincing to the naked eye fails to fulfill its promise of detail when magnified. I am quite sure that it is an *Azolla*, and it is of especial interest since no fossil species of this genus, except the remains of an existing species in the European Pleistocene, have been known until recently. Last year Reid and Chandler[3] described the very complete remains of a species, *Azolla prisca*, from the Oligocene of the Isle of Wight, in which they were able to make out, most conclusively, most of the details of organization. It was this discovery and the resemblance of the Esmeralda fossils to the English material which convinced me of the nature of the former.

Occurrence.—Coal prospect 4 miles southeast of Morgan Ranch and 15 miles west of Hawthorne, Mineral County, Nev.

Holotype.—Cat. No. 37299, U.S.N.M.

Order POLYPODIALES

Genus DRYOPTERIS Adanson

DRYOPTERIS OBSCURA (Knowlton) Berry

Gleichenia (?) *obscura* KNOWLTON, U. S. Geol. Surv. 21st Ann. Rept., pt. 2, p. 210, pl. 30, figs. 1–4, 1901.

Dryopteris (?) *gleichenoides* KNOWLTON, U. S. Geol. Surv. 21st Ann. Rept., pt. 2, p. 211, pl. 30, figs. 5–7.

These two nominal species of ferns are clearly different parts of the pinnae of a single botanical species. They are not represented in the recent collections studied by me. In the absence of fruiting characters the reference to *Dryopteris* is not conclusive, although their form and venation suggest such a reference. They are certainly not related to *Gleichenia* aside from the improbability of the occurrence of this genus in Nevada in Miocene time associated with a flora such as that indicated by the other Esmeralda plants.

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[3] Reid, E. M., and Chandler, M. E. J., The Bembridge flora, p. 40, figs. 2, 3, pl. 1, figs. 14–24, 1926.

Phylum SPERMATOPHYTA

Order PANDANALES

Family TYPHACEAE

Genus TYPHA Linneaeus

TYPHA LESQUEREUXI Cockerell

Plate 1, figs. 13–15

Typha latissima Lesquereux, U. S. Geol. Surv. Terr. Rept., vol. 8 (Cretaceous and Tertiary floras), p. 141, pl. 23, figs. 4, 4*a*, 1883.—Penhallow, Tert. Pl. British Columbia Rept., p. 93, 1908.

Typha lesquereuxi Cockerell, Torrey Bot. Club. Bull., vol. 33, p. 307, 1906; Univ. Colorado Studies, vol. 3, p. 175, 1906.—Knowlton, U. S. Nat. Mus. Proc., vol. 51, p. 251, 1916.

Spathyema? nevadensis Knowlton, U. S. Geol. Surv. 21st Ann. Rept., pt. 2, p. 211, pl. 30, figs. 17, 18, 1900.

There are numerous fragmentary leaves of this genus in the Esmeralda formation. Associated with these are numerous flattened rhizomes, with rootlet scars, which I have tentatively considered to represent the same species, although they might, perhaps, equally well be considered to be the rhizomes of some large semiaquatic grass. Their precise identification is not so important as the fact that they undoubtedly represent the peculiar fragments from these beds which Knowlton called *Spathyema* (*?*) *nevadensis* and thought were fragments of a spadix of some monocotyledonous plant.

The present leaves are referred to the same species as those from Florissant, Colo., with which they are in entire agreement, although it is obvious that the leaves of *Typha* show no trustworthy specific characters.

The genus embraces about a dozen existing species of marsh and aquatic plants, widely distributed in temperate and tropical regions. There are two species in eastern North America, and one survives on the Pacific slope in California.

A variety of uncertainly identified leaf fragments from the mid-Cretaceous upward have been referred to *Typha*. More recently Reid and Chandler[4] have described characteristic fruits and seeds associated with leaves from the Oligocene of southern England.

Occurrence.—Coal prospect 4 miles southeast of Morgan Ranch and 15 miles west of Hawthorne, Mineral County, Nev.

Plesiotypes.—Cat. No. 37,300, U.S.N.M.

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[4] Reid, E. M., and Chandler, M. E. J., The Bembridge flora.

Order NAIADALES

Family NAIADACEAE

Genus POTAMOGETON Linneaeus

POTAMOGETON KNOWLTONI, new species

Plate 1, figs. 5–8

I have referred to a single botanical species the abundant leaves and fruits of an unusually well preserved *Potamogeton*, a description of which Doctor Knowlton was contemplating publishing at the time of his death. This may appropriately be named in his honor and may be described as follows:

Floating leaves narrowly to broadly elliptical in outline, narrowly to broadly rounded distad; the entire margins decurring proximad to the broad flat petioles, which are sometimes preserved for lengths of 6 centimeters. These leaves range in size from 2.5 by 0.6 centimeters to 5 by 2.25 centimeters, average sized specimens being shown in the accompanying figures. The petioles, which are about 2 millimeters wide, consist of a central, fairly stout vascular strand, bordered throughout by the winged margins extending downward from the leaf lamina and these show three or four thin parallel vascular strands on each side. The mid vein of the lamina is about twice as thick as the laterals. These are four to nine in number on each side, diverging in the base and converging in the tip at about equally acute angles. They are usually simple and acrodrome and approximately equally spaced, but occasionally one will fork a considerable distance above the base. In the better preserved material each alternate lateral is thinner than its adjacent fellows. All are connected by thin obliquely transverse veinlets.

The leaves are present in abundance in the clays and are strikingly similar to the floating leaves of a number of still existing American species such as *Potamogeton nuttalli* Chamisso and Schlechtendal, which, however, has shorter petioles, and *Potamogeton faxoni* Morong. Species of *Potamogeton* are wide-ranging and variable in their foliar characters, and no especial significance, either systematic or ecologic, can be attached to the above comparisons.

The associated fruits, of which four or five specimens have been detected among the leaves, are compressed as preserved in the clays, about 3 millimeters in length and 2 millimeters in maximum diameter. The exocarp is rather delicate and frequently incompletely preserved, with a smooth surface. The ventral margin appears to have normally been nearly straight or slightly excavated, although it is somewhat rounded in the second specimen figured. It is produced into a short and stout recurved style. There is a more or well-developed sinus at the base resulting in a blunt point on the ventral side and a more prominent and sharper point on the dorsal side. The dorsal margin or keel is smooth and nearly semicircular in profile. The endocarp or seed was obviously crustaceous, since it usually stands out sharply and distinctly from the collapsed exocarp. It is pronouncedly campylotropous, the radicular end, twice the diameter of the much curved distal end lying close to the basal sinus and toward the dorsal margin. In the second, and what is believed to be the more typical, form figured a portion of the resistant seed coat offset and reversed along the upper dorsal margin.

These fruits are much like those of a large number of existing species of *Potamogeton* without being significantly like any particular one.

The genus contains about 70 widely distributed existing species of temperate regions. It is not infrequent in the geological record, although few fossil species are as well preserved as the present one. Upwards of 50 fossil species have been described ranging in age from the Upper Cretaceous to the Pleistocene, and the genus is very well represented by still existing species at the latter horizon. A characteristic species, *Potamogeton ripleyensis* Berry,[5] from the Ripley Upper Cretaceous of western Tennessee is quite similar in its foliage to the present Esmeralda form.

Occurrence.—Coal prospect 4 miles southeast of Morgan Ranch and 15 miles west of Hawthorne, Mineral County, Nev.

Cotypes.—Cat. No. 37301, U.S.N.M.

Order SALICALES

Family SALICACEAE

Genus SALIX Linnaeus

SALIX INQUIRENDA Knowlton (?)

Salix inquirenda Knowlton, U. S. Geol. Surv. Prof. Paper 140, p. 32, pl. 11, figs. 1, 2, 1926.

Salix angusta Al Braun, Knowlton. U. S. Geol. Surv. 21st Ann. Rept., pt. 2, p. 212, pl. 30, fig. 22, 1901.

Knowlton referred a fragment of a small willow leaf from the Esmeralda formation to *Salix angusta* Al. Braun—a European Tertiary form. The fact that it has been recorded from as various western American horizons as the Mesaverde, Lance, Green River,

[5] Berry, Edward W., The flora of the Ripley formation: U. S. Geol. Surv. Prof. Paper 136, p. 34, pl. 3, fig. 5; pl. 23, figs. 1–3, 1925.

and Mascall formations is in itself sufficient evidence of the vagueness of such long-range identifications. There can not be the slightest doubt but that this Esmeralda willow is a different species from Braun's European form.

In a recent study of the flora of the Latah formation of eastern Washington I have referred exactly similar small *Salix* leaves to the normally larger *Salix inquirenda*, and since the Esmeralda and Latah formations are not especially remote geographically and are of approximately the same age, I have made a similar disposition of this Esmeralda form.

SALIX KNOWLTONI, new species

Plate 2, fig. 1

Myrica lanceolata Knowlton, U. S. Geol. Surv. 18th Ann. Rept., pt. 3, p. 724, pl. 99, figs. 5, 6, 1898.

This species was described from the Payette formation of Idaho as a *Myrica*, which it is not. It is represented in the Esmeralda formation by numerous fragments, which show it to have been a linear-lanceolate, entire margined *Salix*.

Occurrence.—Coal prospect 4 miles southeast of Morgan Ranch and 15 miles west of Hawthorne, Mineral County, Nev.

Holotype.—Cat. No. 37302, U.S.N.M.

Genus POPULUS Linnaeus

POPULUS LACUSTRIS (Knowlton) Berry

Ficus lacustris Knowlton, U. S. Geol. Surv. 21st Ann. Rept., pt. 2, p. 215, pl. 30, fig. 26, 1901.

The single incomplete specimen which is the type and only known specimen of this species has no features warranting it reference to the genus *Ficus*. On the other hand, so far as they are shown the form, margin, and venation are characteristic of the genus *Populus*, to which I have accordingly transferred it.

Order FAGALES

Family FAGACEAE

Genus QUERCUS Linnaeus

QUERCUS SIMULATA TRUNCATA, new variety

Plate 2, fig. 3

Leaves of various sizes, represented in the Esmeralda formation by several fragments and by the single complete leaf figured. This differs from the type, which came from the Payette formation near

Marsh, Idaho,[6] merely in its more truncate base, a feature of doubtful value. Since, however, the numerous leaves of what has been considered by Knowlton [7] to be this species in the Latah formation of Washington fail to show the basal features of this Esmeralda form, I have felt constrained to give it a varietal name.

Occurrence.—Coal prospect 4 miles southeast of Morgan Ranch and 15 miles west of Hawthorne, Mineral County, Nev.

Holotype.—Cat. No. 37303, U.S.N.M.

Order RANALES

Family CERATOPHYLLACEAE

Genus CERATOPHYLLUM Linnaeus

CERATOPHYLLUM FOSSILIUM, new species

Plate 1, figs. 2–4

Nut or achene moderately compressed, elliptical in profile, highly but variably spined over much of the surface. The style is persistent and becomes a beak, which in one specimen is preserved for a length of 5 millimeters. The margin is narrowly winged and bears a variable number of spines of various lengths; some mere mucronate teeth, others long and slenderly incurved or recurved. The basal spine on each side, usually termed spurs, are invariably present and well developed and in instances are preserved for a length of 4 millimeters. Four specimens have been available for study, and these are rather uniform in size and form but show considerable variation in the degree of development of the marginal spines. The average length of the four fruits is extremely close to 6 millimeters, and the maximum width ranges from 3.5 to 4 millimeters. The fossil is thus well within the limits of size of the nuts of the existing species. The beak, spurs, and those spines which are developed beyond the tooth stage become exceedingly slender distad, and in no case is it certain that their delicate tips have been fossilized. This is all the more probable since in those existing species which are spinose the beak and spurs are relatively longer than they are in the fossil. Three of the four specimens are figured to show the variations exhibited. All three contain lignified portions of the original fruit showing that is was decidedly resistant and that, allowing for compression during fossilization, it has retained a thickness of

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[6] Knowlton, F. H., The fossil plants of the Payette formation: U. S. Geol. Surv. 18th Ann. Rept., pt. 3, p. 728, pl. 101, figs. 3, 4; pl. 102, figs. 1, 2, 1898.

[7] Knowlton, F. H., Flora of the Latah formation of Spokane, Wash., and Coeur d'Alene, Idaho: U. S. Geol. Surv. Prof. Paper 140, p. 38, pl. 22, figs. 3, 4, 1926.

slightly under 1 millimeter. The fourth specimen is an impression and the punctate surface of the matrix shows that the surfaces of the fruit were spinose. The clays are in places packed with the macerated slender linear plant tissues which, in part at least, are believed to represent the foliage of *Ceratophyllum*. In some cases these are seen to be dichotomously forked, and I have illustrated two of the clearer of these objects. (Cat. No. 37309, U.S.N.M.) They are obviously incomplete, as is definitely shown by the larger of the two, in which the artist has attempted to indicate the disintegration of the more delicate distal portions of the leaf as it is preserved in the clay.

The existing hornwort is a gregarious, completely submerged aquatic of ponds and slow streams, which is of rather unusual botanical interest, since it is one of the few aquatic vascular plants which has altogether lost the habit of aerial pollination. In *Ceratophyllum* the pollen is carried to the surface by the buoyant stamens which then dehisce, and the released pollen sinks slowly through the water until it comes in contact with the stigmas of the ovulate flower. This represents possibly the highest degree of aquatic specialization in a descendant of a terrestrial ancestor and is correlated with rootlessness and the entire loss of vascular tissue in the stem.

Ceratophyllum is practically cosmopolitan in the existing floras, occurring on all of the continents (except Antarctica) and on oceanic islands such as the Bermudas and Fijis, which raises interesting questions with respect to its means of dispersal and possible antiquity. The fruits sink at once and the plant is soon killed by sea water or exposure to the atmosphere, so that currents can hardly be the agents of dispersal over great distances, which would seem to have been due to the transportation of the seeds by wading birds.

The systematic position of the genus has also been a mooted point which seems now to be fairly well settled as a much reduced relative of the Cambombaceae.

Systematists recognize from one to three existing species based on the presence or absence of the marginal wing and basal spurs, but it must be admitted that a great variability in these features prevails. In North America *Ceratophyllum demersum* Linnaeus is found in appropriate environments everywhere except in the far northern part. Although the in general great geographical range of most aquatics is fully recognized it would seem that cosmopolitanism would demand some specific differentiation. The geological history of *Ceratophyllum* is exceedingly obscure.

The known geological occurrences of *Ceratophyllum* at pre-Pleistocene horizons have been few and unconvincing. Ettingshausen recorded some stem nodes and very indefinite fruits from the supposed

Cretaceous of Australia as *Ceratophyllum australe*, but these are hardly convincing enough to have any weight.[8] This same author identified equally indefinite leaf fragments and stem nodes from the Miocene of Leoben and Schönegg in Styria as *Ceratophyllum tertiarium*.[9] Saporta described some stem impressions with verticillate leaves from the Aquitanian of France as *Ceratophyllum aquaticum*.[10] Certain spiny fruits from the lower Eocene of Tennessee have been described by the present writer (*Ceratophyllum incertum* Berry *MS.*) which if actually related to *Ceratophyllum* are by far the oldest record of the genus.

During the Pleistocene numerous occurrences of fruits not to be distinguished from the variations seen in the fruits of the existing plant have been recorded from Canada and the United States, England, and Germany.

Occurrence.—Coal prospect 4 miles southeast of Morgan Ranch and 15 miles west of Hawthorne, Mineral County, Nev.

Cotypes.—Cat. No. 37304, U.S.N.M.

Family NYMPHAEACEAE?

Genus CASTALIA? Salisbury

CASTALIA? sp.

Plate 1, fig. 1

Small elliptical, equilateral, and apparently somewhat compressed seeds with a dense coat, about 3.25 millimeters long and 2.5 millimeters in width. There are several of these seeds in the collection. Their preservation does not disclose features sufficient to substantiate their supposed affinity, and they are therefore tentatively identified.

The genus *Castalia* has about 30 existing species of large aquatic herbs, widely distributed in fresh water but absent on the present Pacific slope, although present in eastern Asia. It is present in the former region in the earlier Tertiary but has not been detected in the Miocene or later epochs.

Occurrence.—Coal prospect 4 miles southeast of Morgan Ranch and 15 miles west of Hawthorne, Mineral County, Nev. (Cat. No. 37305, U.S.N.M.)

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[8] Ettingshausen, C. von, Kreideflora von Australien. Denkschr. K. Akad. Wiss., vol. 62, p. 14, pl. 1, figs. 14, 15, 1895.

[9] Ettingshausen, C. von, Fossile Flora von Schonegg in Steiermark. Denkschr. K. Akad. Wiss., vol. 57 (Foss. Fl. Schönegg, pt. 1), p. 87 (27), pl. 3, figs. 4–15, 1890.

[10] Saporta, Gaston de, Recher. Végét. niv. Aquitanien de Manosque. Mém. Soc. Géol. France, vol. 2, p. 19, pl. 2, figs. 8–10, 1891.

Order SAPINDALES

Family SAPINDACEAE

Genus SAPINDUS Linnaeus

SAPINDUS LANCIFOLIUS Lesquereux

Plate 2, fig. 2

Sapindus lancifolius LESQUEREUX, U. S. Geol. Surv. Terr. Rept., vol. 8 (Cretaceous and Tertiary floras), p. 182, pl. 32, figs. 3–6, pl. 37, fig. 9, 1883.—KNOWLTON, U. S. Nat. Mus. Proc., vol 51, p. 283, 1916.

This species was described from Florissant, Colo., to which locality it has hitherto been confined. Similar leaflets are present in the Esmeralda formation, the only observable difference being the shorter petiolule of the latter. It is undoubtedly a *Sapindus* and not sufficiently distinct from the Florissant form to warrant considering it to represent a different species.

The genus is an old one, found throughout North America in the older Tertiary and abundant at Florissant and in the Mascall beds of Oregon during the Miocene. The existing species number about 40, widely distributed through the Tropics of both Hemispheres, most abundant in the Asiatic region, and extending for considerable distances into the temperate zone, as in the case of the three species found in the United States, one of which (*Sapindus drummondi* Hooker and Arnott) is found as far north as southern Kansas, New Mexico, and Arizona.

Occurrence.—Coal prospect 4 miles southeast of Morgan Ranch and 15 miles west of Hawthorne, Mineral County, Nev.

Plesiotypes.—Cat. No. 37306, U.S.N.M.

Order MYRTALES

Family HYDROCARYACEAE

Genus TRAPA Linnaeus

TRAPA AMERICANA Knowlton

Plate 2, figs. 5, 6

Trapa americana KNOWLTON, U. S. Geol. Surv. 18th Ann. Rept., pt. 3, p. 733, pl. 102, fig. 7*a*, 1898.

Trapa? occidentalis Knowlton, U. S. Geol. Surv. 18th Ann Rept., pt 3, p. 734, pl. 102, fig. 7*b*, 1898.

This species was described by Knowlton from the Payette formation near Idaho City, Idaho. He fancied that he had representatives of two distinct species, but in the light of the abundant remains now found in the Esmeralda formation, which are of all sizes and of every conceivable shape and attitude due to their compression in the clays after having been rendered slightly plastic by maceration there can be no doubt but that only a single species is represented.

There are three species of *Trapa* in the existing flora, none of which is native to the Western Hemisphere, although the European species is more or less naturalized in the northeastern United States. *Trapa natans* Linnaeus, which normally has four horns, is now endemic in central and southern Europe, although during the Pleistocene it was abundant in England, Scandinavia, Denmark, and Russia. The two existing Asiatic species—*Trapa bicornis* Linnaeus and *Trapa bispinosa* Roxburg—of eastern and southern Asia and Africa are normally two-horned.

Considerable of the geological history of the genus is known. Rosettes supposed to represent floating leaves, but of doubtful identity, are widespread in the Rocky Mountain region of North America in formations of late Upper Cretaceous to early Eocene age (*Trapa ? microphylla* Lesquereux, *Trapa ? cuneata* Knowlton). The oldest fruits are relatively small ones from the lower Eocene (Wilcox) of the Mississippi embayment. There is a two-horned species in the Upper Eocene of Alaska and western Canada, an Oligocene species in Saxony, several Miocene species in Japan, Europe, and the western United States, and a fine Pliocene species from southern Alabama, marking the latest known occurrence of the genus in North America.

Occurrence.—Coal prospect 4 miles southeast of Morgan Ranch and 15 miles west of Hawthorne, Mineral County, Nev.

Plesiotypes.—Cat. No. 37307, U.S.N.M.

Order ERICALES

Family VACCINIACEAE

Genus VACCINIUM Linnaeus

VACCINIUM ELLIPTICUM, new species

Plate 2, fig. 4

Leaves small, elliptical in outline. Margins entire. Texture coriaceous. Apex full and evenly rounded. Base less full and conceivably narrowed if there was material of this form to show variations. Length 1.25 centimeters. Maximum width 8 millimeters. Mid vein stout, immersed, becoming thin distad. Secondaries thin, three or four ascending pairs, camptodrome.

The species is based upon the single small leaf figured, which shows the features of this genus. It may have been carried into the basin of sedimentation from higher levels, since it is both tiny and coriaceous. The genus has not before been found in the later Tertiary of western North America, although it occurs in the Pleistocene of that region, as well as in the existing flora of the Pacific slope from Alaska southward. The modern species are shrubs or small trees, about 125 in number, and holarctic in their distribution, occurring also in the Southern Hemisphere, and from their present distribution obviously of ancient lineage, although their geological history is very imperfectly known. The present species is not unlike some of the leaves of the wide-ranging existing *Vaccinium uliginosum* Linnaeus and *Vaccinium vitis-idaea* Linnaeus.

Occurrence.—Coal prospect 4 miles southeast of Morgan Ranch and 15 miles west of Hawthorne, Mineral County, Nev.

Holotype.—Cat. No. 37308, U.S.N.M.

VACCINIUM VACCINIFOLIA (Knowlton) Berry

Salix vaccinifolia KNOWLTON, U. S. Geol. Surv. 21st Ann. Rept., pt. 2, p. 212, pl. 30, figs. 8, 20, 1901.

These small, entire, subcoriaceous leaves are not those of a willow, and I have therefore transferred them to the genus *Vaccinium*, which they resemble in size, texture, margins, and venation.

EXPLANATION OF PLATES

PLATE 1

FIG. 1. *Castalia* (?) sp. seed, ×2.
2–4. *Ceratophyllum fossilium* Berry, natural size.
5–8. *Potamogeton knowltoni* Berry.
Figs. 5, 6. Leaves, natural size.
7, 8. Fruits ×5.
9, 10. *Azolla tertiaria* Berry.
Fig. 9. Plant natural size.
10. Same ×6.
11, 12. Leaves referred to *Ceratophyllum*.
Fig. 11, ×2; Fig. 12, ×3.
13–15. Rhizomes referred to *Typha*.
Figs. 13, 14, natural size; Fig. 15, ×2.

PLATE 2

FIG. 1. *Salix knowltoni* Berry.
2. *Sapindus lancifolius* Lesquereux.
3. *Quercus simulata truncata* Berry.
4. *Vaccinium ellipticum* Berry, ×2.
5, 6. *Trapa americana* Knowlton, ×2.
7. An alga, *Fontinalis* or submerged foliage, ×2.

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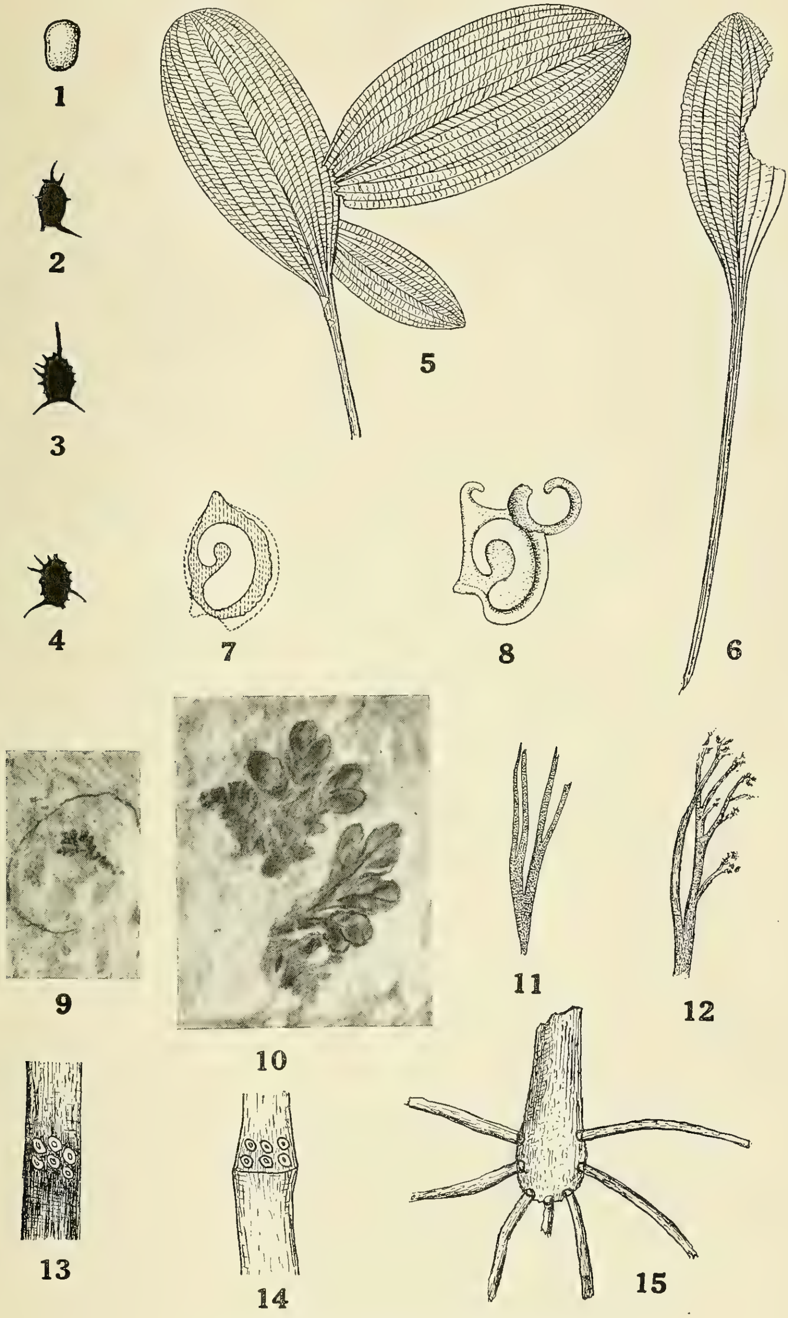
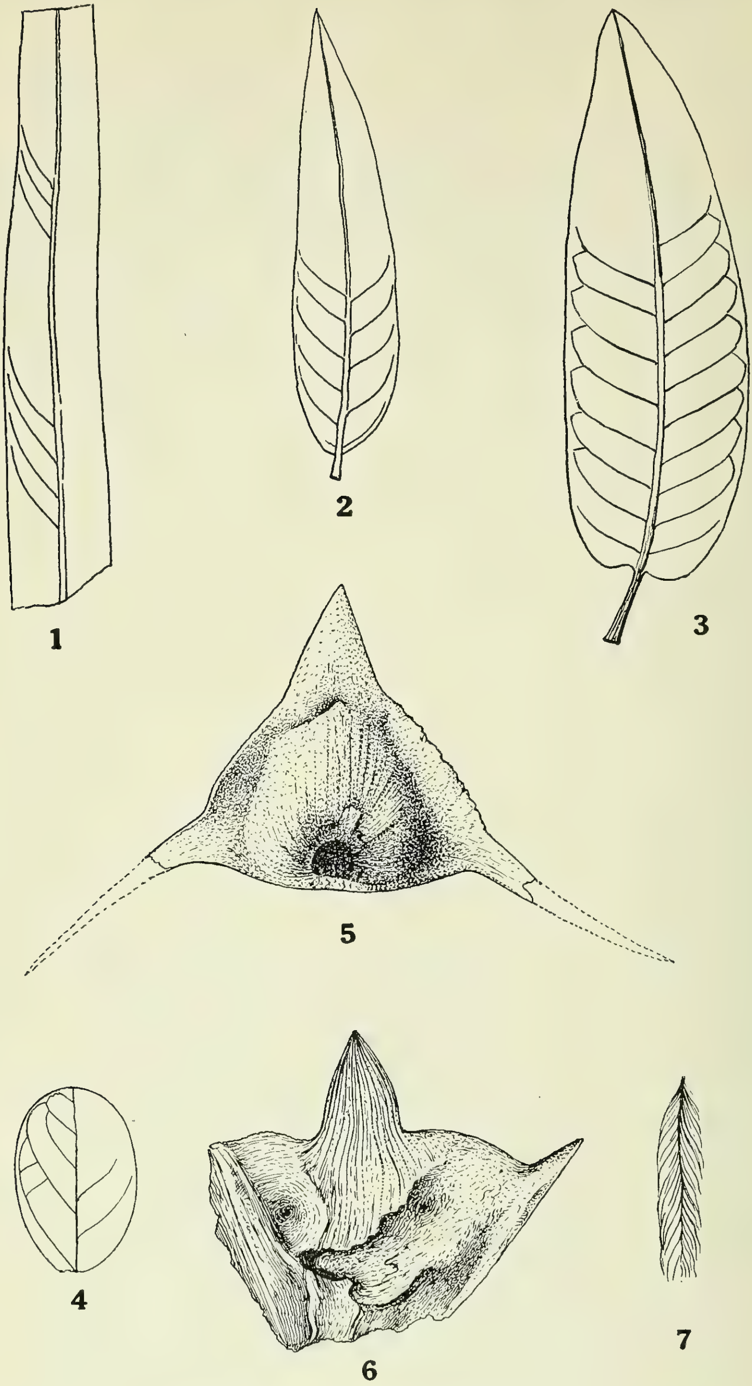


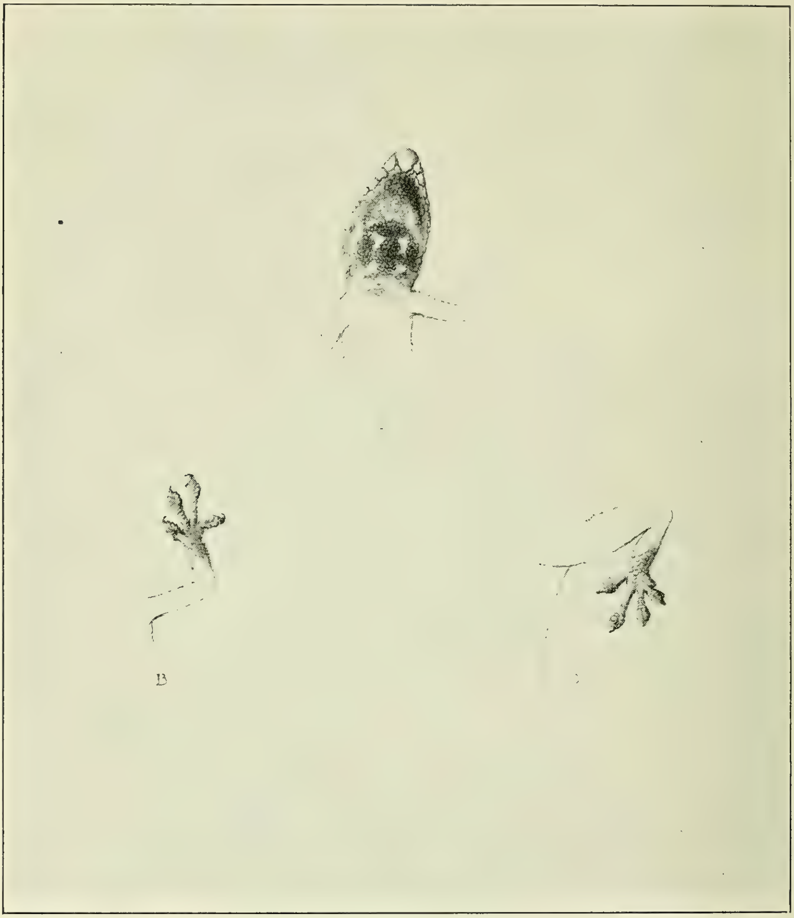
FLORA OF THE ESMERALDA FORMATION

FOR EXPLANATION OF PLATE SEE PAGE 15



FLORA OF THE ESMERALDA FORMATION

FOR EXPLANATION OF PLATE SEE PAGE 15



LYGODACTYLUS MANNI, TYPE

FOR EXPLANATION OF PLATE SEE PAGE 1

DESCRIPTION OF A NEW SPECIES OF GECKO FROM TANGANYIKA TERRITORY, AFRICA

By Arthur Loveridge

Member of the recent Smithsonian-Chrysler African Expedition

Among the reptiles collected in the course of field work during the Smithsonian-Chrysler Expedition to Tanganyika Territory, Africa, in 1926, is one specimen of a gecko which differs conspicuously from the species hitherto known. It may be named and described as:

LYGODACTYLUS MANNI, new species

Type.—Male, No. 72760, U.S.N.M., collected at Saranda, Dodoma District, Tanganyika Territory, Africa, July 15, 1926, by Arthur Loveridge.

Diagnosis.—Differs from all other East African members of the genus by the striking gular markings of the male. Its transversely enlarged subcaudal scales cause it to fall into the *picturatus-gutturalis* group, from the members of which it differs in its much shorter, blunter head.

Description.—Head short, blunt, longer than broad, snout a little less than twice the diameter of the eye, longer than the distance between the eye and the ear opening; ear opening very small, vertically oval; rostral broad but without a median groove; nostril pierced above and behind the suture behind rostral and first labial, separated from the rostral by a narrow rim situated between a large swollen supranasal, a postnasal and the first labial; two small scales separate the enlarged supranasals behind the rostral; seven upper labials, seven lower labials; mental large, subtriangular, not extending back beyond the posterior borders of the first pair of infralabials, and bounded posteriorly by three granular scales. Scales of upper surface small, granular, larger on the snout; abdominal scales large, imbricate, smooth. Digits unequal, fourth longest, second and fifth about equal, four lamellae under median digit. Preanal pores very indistinct, apparently six. Tail tapering, rounded above, flattened below, covered with juxtaposed scales above, below by a median series of transversely enlarged subcaudals except at the very tip.

Coloration.—Above, slaty (or greenish) gray with a row of light, dark-edged ocelli along the sides, and a few indistinct brown marks on back, these forming transverse bars on tail. Below, pure white except throat; lower labials white but throat black with a white, semicircular inverted U-shaped mark, in the center of which are two pairs of conspicuous white spots.

Measurements.—Head and body 27 mm.; tail 27; head 7; hind limb 14.

Remarks.—This animal is named in honor of Dr. W. M. Mann, leader of the expedition. Nothing is known of its distribution or habits.

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SYNOPSIS OF PENTATOMID BUGS OF THE SUBFAMILIES MEGARIDINAE AND CANOPINAE

By W. L. McAtee and J. R. Malloch
Of the United States Biological Survey

INTRODUCTION—ACKNOWLEDGMENTS

Manuscript covering most of the species included in the present report was completed in July, 1926. It was based primarily on material contained in the National Collection (of which W. L. McAtee is acting custodian of Hemiptera), supplemented by loans from the Carnegie Museum in Pittsburgh (through Hugo Kahl), American Museum of Natural History (through H. G. Barber), the Museum National d'Histoire Naturelle de Paris (through Dr. E. L. Bouvier and E. Seguy), and the Deutsches Entomologisches Institut (through Dr. Walther Horn). In the spring of 1927 the United States Bureau of Entomology made it possible for W. L. McAtee to visit various European museums where type and other material could be consulted. Museums from which material is cited in the present synopsis, together with the name of the officer in charge of Hemiptera or more inclusive groups, are: Magyar Nemzeti Museum, Budapest (Dr. G. Horvath); Zoologisches Museum, Johann Kasimir Universität, Lwow (Dr. Jan Hirschler); Museum fur Naturkunde, Berlin (Dr. W. Ramme); Zoologisches Museum, Christian Albrecht's Universität, Kiel (Dr. A. Schröder); Universitetets Zoologiske Museum, Copenhagen (Dr. W. Lundbeck); Naturhistoriska Riksmuseet, Stockholm (Dr. B. Y. Sjöstedt); Museum Zoologici Universitatis, Helsingfors (Dr. Richard Frey); and the British Museum of Natural History, London (W. E. China). We gratefully acknowledge these loans, and assistance from the officials listed, and wish to record our appreciation of favors in connection with the work received also from J. Ujhelyi, of Budapest; Dr. K. L. Henriksen, of Copenhagen; and Dr. Hakan Lindberg, of Helsingfors. The museums listed here are referred to in the text merely as "Paris Mus.," "Lwow Mus.," and the like, rather than by their full designations.

LIMITS OF GROUP

As to the insects treated we may remark that the Heteroptera can logically be grouped into a limited number of comprehensive assemblages. These are often called superfamilies, but in our opinion family rank in most cases is sufficient. Adverting to Pentatomidae in particular we believe that since the principal subdivisions of this group differ from each other for the most part by relative characters or merely by different combinations of similar characters, they are preferably treated as subfamilies.

We have found only one character that holds throughout the vast assemblage of Pentatomids, namely, the presence on the sternites near the spiracles, of sensory hairs which are not closer to the median line on the first and second visible sternites than on the others. (Figs. 3, 23, 24.) These hairs are normally 2 in number on each side while in most of the other families possessing them they are normally 3 in number.[1] In Pentatomidae the spiracles are almost always on the ventral surface and equally or almost equally distant from the sensory hairs on all sternites, the only known exceptions occurring in the genus *Corimelaena* in which there are some species that have the spiracles of the posterior segments situated in the margins of the sternites. In all Pentatomidae known to us, with the exception of the Urolabidinae and the genus *Amnestus*, there is a group of four or more short, usually stout, and curved spines or bristles, frequently set in a notch, at varying distances from the apex, on the anteroventral surface of the fore tibia. These bristles we have not found in any other family we have examined. The number of antennal and tarsal segments are not constant enough to be available for recognition of the group Pentatomidae in the broad sense.

The assemblage of Pentatomidae treated in this paper are distinguished from the remainder of the family by the fore wings being about twice as long as the abdomen and having thinned areas (almost fractures) adapting them for folding. These characters may not have phylogenetic significance, but they serve for recognition of two interesting and little understood subfamilies of New World heteroptera, and of one from the Old World with which they might be confused. These insects, for the most part, are relatively broad in proportion to their length (figs. 1–3), a character which, with the complete covering of the abdomen by the scutellum and the usually inflated shape of the latter (figs. 13–17), gives them a semiglobose appearance. This is especially true of the nymphs of Canopinae and Megaridinae, while those of the Coptosomatinae (some of

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[1] For fuller discussion and illustration of the "trichobothria" see Tullgren, A., Ent. Tidskr., vol. 39, 1918, pp. 113–133, 11 figs., and Malloch, J. R., Bull. Brooklyn Ent. Soc., vol. 16, 1921, pp. 54–56, 16 figs.

the imagines of which are rather depressed) are relatively flattened. The nymphs of all have 2-segmented tarsi.

The coptosomatine nymphs agree with those of Pentatominae in having all of the sutures between segments of the dorsum of the abdomen well marked, and in having three about equally separated pairs of dorsal ostioles. They are thus more closely linked with the Pentatominae in the nymphal than in the adult state, and all things considered must yield the palm for specialization to Canopinae and Megaridinae which are as strongly distinguished in the immature, as in the adult stages. The nymphs of these latter two subfamilies are as much as, or even more, inflated than the adults, and are heavily chitinized and highly polished dorsally.

In nymphs of Canopinae there are three pairs of ostioles, the anterior pair being about twice as far apart as the other two pairs (fig. 25), and the sutures of the abdomen basad of those bearing the ostiolar openings are extremely difficult to distinguish. A striking character of these nymphs is the distinct central division of the basal two exposed sternites. We figure (figs. 24–25) both the ventral and dorsal aspects to show the anatomical features.

In nymphs of Megaridinae the segmentation of the dorsum of the abdomen is still more obscured, being visible with any distinctness only on a small definitely marked-off section of extreme apex of abdomen. Material is too scanty to permit of clearing a specimen to reveal ostiolar characters. The basal segments of the venter are undivided.

SYSTEMATIC TREATMENT

KEY TO IMAGINES OF THE THREE SUBFAMILIES

1. Thinning of fore wing extending from radial side, the costa produced far beyond base of membrane, there thickened and broadened (though the apex is acute), and serving as a support to the numerous longitudinal veins, most of which are directed obliquely across membrane from costal to radial side, and the bases of which are connected by a long curved vein (fig. 18) ; almost the entire sternal surface opaque; anterior and interior margins of propleura not elevated; first sternite in some cases broadly exposed laterally and evanescent medianly, in others entirely concealed; sutures between abdominal segments in some cases traceable, in others not, to margins of venter; antenna obviously 5-segmented, short segment between first and third antennal segments easily distinguishable; tarsi with 2 segments; sensory hairs longitudinally arranged___Coptosomatinae.

   Thinning of fore wing extending from costal side (figs. 6, 20), the costa not produced, truncate apically, the fewer veins of membrane, the bases of which are not connected by a curved vein, arising from the radial region of corium and curving toward costal margin; notable portions, or all, of sternal surface not opaque; anterior and interior margins of propleura elevated, forming a deep sulcus (fig. 2) ; antenna 5-segmented, the short segment between first and third segments more difficult to see than in Coptosomatinae, it being necessary to clear the antenna in some cases to reveal it____2

2. Thinned area at about middle of costa, which is there slightly angulate-emarginate, membrane with a slightly thickened band proceeding from radial portion of corium and nearly paralleling radial margin, and with few or no strong veins (fig. 6) ; metapleural ostiole like a puncture, and difficult to see, with no opaque area adjacent; first sternite well exposed for its entire width (except in *M. majuscula*), half as wide as second, sutures between sternites terminating laterally at about level of spiracles (fig. 3) ; antenna apparently 4-segmented, ring segment indistinguishable without clearing; tarsi with 2 segments; sensory hairs transversely arranged ---Megaridinae.

Thinned area at end of costa; radial apex of corium rather heavily chitinized and somewhat produced, serving as a base for several strong veins, the course of which is as shown in Figure 20; metapleural ostiole prominent, with more or less extensive opaque area adjacent; first sternite briefly exposed, evanescent both medially and laterally; sutures between sternites not extending laterad to level of spiracles (fig. 23) ; antenna obviously 5-segmented; ring segment of antenna distinguishable without clearing; tarsi with 3 segments; sensory hairs longitudinally arranged.—Canopinae.

Subfamily MEGARIDINAE

There is only one genus known, namely:

Genus MEGARIS Stäl

Cyrtaspis STÄL, C., Bidrag till Rio Janeiro-traktens Hemipter-Fauna, Svenska Vet.-Akad. Handl., vol. 2, No. 7, 1860, p. 9 [Monobasic, genotype, *C. nigritula* n. sp. Brazil].

Megaris STÄL, C., Svenska Vet.-Akad. Handl., vol. 3, No. 6, 1862, p. 57.

"The name *Cyrtaspis* has previously been used for another genus," is Stäl's remark. The genus in question is one of Orthoptera described by Fischer in 1853.

Besides the characters mentioned in the key to subfamilies, common characters of the species of Megaridinae before us are: punctures of pleural surfaces ringlike [2] giving a somewhat dull appearance to these surfaces, though of an entirely different type from that of the opaque, corrugated, and apparently less heavily chitinized areas surrounding the ostioles in the other subfamilies here treated, and in many other Pentatomids; anterior margin of the head, and anterior and lateral margins of pronotum, carinate and slightly reflexed; the apex of head usually is more or less emarginate (figs. 8, 9, 12, 15) ; the costa has a prominent rounded margin, and the corium bears a single central longitudinal series of large punctures; the pronotum is emarginate near the posterior lateral angle for reception of base of fore wing, and has a prominent polished convexity

[2] This appearance is due to greater prominence of the central papilla of each puncture which reaches the same elevation as the remainder of the surface and is flattened above; in the other groups the papilla is lower and does not destroy the pitlike appearance of the puncture.

above the insertion of wing. The males have the eyes and ocelli larger, and the hairs on antennae much longer than do the females.

Megaridinae are scarce, at least in collections, and we have not had sufficient material to permit dissection to work out the structural basis of classification as thoroughly as we should like. Besides the characters mentioned in the key to genera, we have noticed interesting differences in puncturing of the propleurum, which are noted in the descriptions, but we can scarcely say at present what taxonomic value these may have. In several of the species the anterior outer angle of mesopleurum is impunctate and in all there is an oblique impunctate stripe running from same angle of metapleurum to a short distance from posterior outer angle, which is associated with a more or less evident impressed line.

KEY TO THE SPECIES

1. Larger species 4.5 mm. in length and 3.75 mm. in width; antenna chiefly black, apical segment whitish; practically the entire surface of pronotum and scutellum with large, rather widely spaced punctures; clavus with some distinct punctures; ventral abdominal sutures impunctate; shape of head as in Figure 5; each prosternal carina almost straight, not very noticeably angulate near middle, the two forming a V (fig. 3).
majuscula, new species.

   Smaller species, not exceeding 2.5 mm. in length; antenna otherwise colored; clavus wrinkled or granulate, rarely punctate; ventral abdominal sutures punctate; prosternal carinae angulate near middle, their anterior sections widely divergent ---------- 2

2. Vertex, pronotum, and disk of scutellum entirely impunctate, the scutellum distinctly punctate on sides; long hairs of male antenna scarcely as long as the segment bearing them; meso- and meta-sterna impunctate, anterior lateral angles of mesopleurum impunctate and striate ---- **laevicollis Stål.**

   Pronotum with distinct punctures on some part of its surface ---------- 3

3. Pronotum and scutellum each with a large bright red discal spot, that on scutellum sometimes longitudinally divided by a black line; shape of head, as in Figures 12, 15; some of the hairs on antenna of male nearly as long as the segments bearing them (fig. 4); meso- and meta-sterna coarsely striato-punctate; mesopleurum punctate almost to lateral edge.
trinotata Distant.

   Pronotum and scutellum unicolorous, castaneous to black ---------- 4

4. Pronotum and scutellum punctate almost throughout ---------- 5

   Pronotum not so uniformly, and scutellum less decidedly punctate ---------- 7

5. Pronotum distinctly more than half as long as wide; outline of insect as seen from above and the side as in Figures 1 and 13; length 1.5 mm.
longula, new species.

   Form less elongate (in fact, almost hemispherical); length 2 mm. or more -- 6

6. Scutellum quite, and pronotum less, conspiculously wrinkled, with rows of punctures between the wrinkles ---------- **nigritula Stål.**

   Dorsum punctate but not wrinkled ---------- **punctulata Horvath.**

7. Pronotum without group of punctures on that part just behind head and no transverse series on disk ---------- 8

   Pronotum with punctures on that part just behind head, and a more or less pronounced band of punctures across disk ---------- 9

8. Scutellum without punctures along or paralleling anterior margin.
hemisphaerica, new species.
Scutellum with punctures along anterior margin except at middle.
peruviana Horvath.
9. Scutellum lacking a transverse impressed line paralleling anterior margin at any part---10
Scutellum with a distinct transverse impressed and punctate line close to and paralleling anterior margin centrally, diverging from it laterally, or with a shallower punctate line parallel to it and not diverging laterally.
10. Front margin of vertex rounded; scutellum with anterior disk nearly free from punctures; dull black; length 2 mm------------stälii, new species.
Front margin of vertex distinctly emarginate; scutellum with an isolated, narrow, transverse band of punctures near anterior margin; shining fusco-castaneous; length 1.5 mm--------------------------atratula Stål.
11. Band of punctures across disk of pronotum consisting of only a single row in middle, the impression shallow; outline from side as in Figure 16; apical and subapical segments of antenna terete_semiamicta, new species.
Band of punctures across disk of pronotum consisting of about 4 rows at middle; apical and subapical segments of antenna distinctly fusiform; thicker than fore tibia; lateral outline as in Figure 14---------------12
12. Longer segments of antenna nearly as long as fore tibia, with long hairs, unicolorous (fig. 11)---------------------------constricta, new species.
Longer segments of antenna distinctly shorter than fore tibia, with short hairs, bicolorous (fig. 7)-----------------------antennata, new species.

MEGARIS MAJUSCULA, new species

Nearly twice the dimensions of the largest of the other species of the subfamily before us and greatly exceeding them in bulk. Black, extreme apex of second segment, short ring segment between the second and third long ones, base and apex of subapical, and all of apical segment of antenna whitish; tarsi and apices of tibiae brownish. Head shaped as in Figure 5, with impressed lines near margins, and marking off tylus, almost impunctate; two long segments of antenna of about equal length, apical segment shorter, more fusiform. Pronotum with large punctures, more numerous near antero-lateral margins, less numerous in an arcuate area somewhat behind head, and also posteriorly near the humeral angles. Scutellum with large punctures, almost evenly, but rather sparsely, distributed over its whole surface; an irregular transverse impression across base of scutellum about the length of head from anterior margin. Ventral aspect as in Figure 3. Propleura punctate about like meso- and meta-pleura; prosternal sulcus with ring punctures like the pleural surfaces, the anterior ones in transverse furrows, meso- and meta-sterna granulose, with similar punctures. Beak reaching to or beyond hind coxae. Length 4.5 mm.; width 3.75 mm.

Holotype.—Female, Novaliches, Guantanamo, Cuba, December 16. 1916, C. T. Ramsden (Amer. Mus.).

MEGARIS LAEVICOLLIS Stål

Megaris laevicollis Stål, C., Hemiptera Mexicana, Ent. Zeit. (Stettin), vol. 23, 1862, p. 84 [Rio de Janeiro].

The color varies from castaneous to black; the fore wing (fig. 6) has the corium hyaline discally, brownish near the heavily chitinized base, and reddish apically; the membrane is fumose, with a crinkled dusky band paralleling radial margin; hind wing as in Figure 10. Antenna testaceous; tibiae and tarsi pale brownish. Head seen from above as in Figure 8. Scutellum somewhat impressed near antero-lateral angles; punctures most numerous and deepest near these angles, thence they become shallower and sparser, the anterior disk being quite impunctuate. Exposed corium with a prominent medial longitudinal carina. Propleurum with a few coarse punctures in a series across middle and in a group at each end of this series, otherwise impunctate in contrast to the uniformly punctate meso- and meta-pleura. Length 2 mm.; width 2 mm.

Holotype.—Male, Rio de Janeiro, F. Sahlberg (Stockholm Mus.); other specimens; Esperitu Santo, Staudinger, 1898 (Budapest Mus.); New Friburg, February, 1884, Caraca, Second Semester, 1884; Rio de Janeiro, 1883, all in Brazil, collected by P. Germain (Paris Mus.); San Bernardino, Paraguay, K. Fiebrig (U.S.N.M.). The last specimen bears the following freely translated note: "14 Nov. In a cluster of leaves, together with a cassid and some * * * which were lost."

MEGARIS TRINOTATA Distant

Cyrtaspis trinotata Distant, W. L., Biologia Centrali-Americana. Insecta. Rhynchota. Hemiptera-Heteroptera, vol. 1, p. 309, August, 1889. [Panama; Volcan de Chiriqui.]

Brownish black, with red spots as described in key; beak, antennae, and legs, testaceous. Head seen from above as in Figures 12 (male), 15 (female), with sparse, shallow punctures; second and third antennal segments of male as in Figure 4. Pronotum with more numerous and deeper punctures, rather evenly distributed, except for a discal spot, anterior areas in the position occupied in many Heteroptera by callosites, and rather prominent swellings near posterior angles, which are smooth; a slightly impressed punctate line extends entirely across hind margin of pronotum. Scutellum copiously and rather deeply punctate, except on discal color spot, with a distinct transverse impression paralleling front margin. Propleurum less copiously punctate, especially anteriorly, than meso- and meta-pleura; prosternal sulcus with a few punctures. Length, 2 mm.; width, 2 mm.

Holotype.—Volcan de Chiriqui, Panama, Champion; other specimens: Motzorongo, Vera Cruz, Flohr (British Mus.); Porto Bello, Panama, March 6, 10, 1911, E. A. Schwarz; March 17, 1912, A. Busck (U.S.N.M.)

MEGARIS LONGULA, new species

Dark castaneous, legs and antennae a little paler. Dorsal and lateral outlines as in Figures 1 and 13. Front margin of vertex slightly emarginate medially and slightly concave laterally. Head impunctate, but remainder of upper surface provided with numerous shallow and almost evenly distributed punctures. Scutellum distinctly constricted all the way across near anterior margin. Propleurum punctate uniformly with remainder of pleural surface. Length, 1.5 mm.; width, 1 mm.

Holotype.—Male, Santarem, Brazil (Carnegie Mus.).

MEGARIS NIGRITULA Stål

Cyrtaspis nigritula, Stål, C., (In part) Bidrag till Rio Janeiro-traktens Hemipter-Fauna, vol. 1, 1860, p. 9 [Brazil].

There are two specimens in the type material, which, although male and female and possibly of the same species, must in the present state of knowledge of the genus be treated as two species. The female specimen is selected as holotype, because it is labeled Rio and is therefore from the area treated in the memoir in which the original description was published, and the length (2.5 mm.) agrees better with the original statement.

Black; antennae and legs distally, paler. Front margin of vertex truncate medially, concave laterally, upper surface wrinkled and shallowly punctate except on occiput; pronotum except callosities finely and irregularly transversely wrinkled and punctate, and with fine rastration posteriorly; scutellum conspicuously wrinkled and punctate throughout peripheral areas, less markedly so on disk; clavus punctate; pleura entirely punctate, propleura less copiously so; sternites impunctate even along incisures, 6 broadly rounded anteriorly, all of the others more or less shortened medially; genital plates transverse, punctate, almost oblong in shape.

Holotype.—Female, Rio de Janeiro, January (Stockholm Mus.).

MEGARIS PUNCTULATA Horvath

Cyrtaspis punctulata Horvath, G., Analecta ad cognitionem Cydnidarum, Ann. Mus. Nat. Hung., 1919, p. 209 [Trinidad].

Dark castaneous. Form hemispherical; front margin of vertex slightly angulate-emarginate medially, then convex on each side to eyes, disk moderately punctate; pronotum except callosities and posterior disk, and scutellum almost entirely, copiously and distinctly punctate; pleura punctate throughout, the propleura less copiously so; sternites punctate along anterior margins. Length 2 mm.

Holotype.—Sex undeterminable from the damaged specimen, Trinidad, Brancsik (Budapest Mus.).

MEGARIS HEMISPHAERICA, new species

Castaneous to black, legs castaneous, antennae testaceous, corium brownish basally, reddish apically. Front margin of vertex distinctly emarginate medially, moderately convex laterally. Head practically impunctate; pronotum with only faint traces of punctures anywhere except near antero-lateral margins, where there is a group of strong punctures, and a line along posterior margin, conspicuous laterally, evanescent medianly; scutellum with a broad band of punctures near periphery, most conspicuous anteriorly, and reaching highest on sides, disk practically impunctate. Lateral aspect as in Figure 17. Segments of antenna increasing slightly in length successively, from the basal one, apical one decidedly fusiform; all with moderately long hairs. Propleurum with a row of coarse punctures across middle and scattered punctures about its inner end, otherwise impunctate; meso- and meta-pleura copiously punctate. Length 1.9 mm.; width 1.7 mm.

Holotype.—Botanical Garden, Georgetown, British Guiana, October 3, 1918, Harold Morrison (U.S.N.M.), paratypes, Caracas; Laguaizo, Venezuela, E. Simon, 1897 (Paris Mus.); Iguarassu, Brazil, 1888, G. Ramage (British Mus.).

Holotype.—Cat. No. 40536 U.S.N.M.

MEGARIS PERUVIANA Horvath

Cyrtaspis peruviana HORVATH, G., Analecta ad cognitionem Cydnidarum, p. 209 [Peru].

Pale castaneous. Front margin of vertex truncate medially, straight laterally, angulate-emarginate just inside each eye; pronotum with a group of punctures on each lateral area and a single row along posterior margin, impunctate elsewhere; scutellum moderately punctate throughout except on anterior disk; propleurum sparsely punctate anteriorly, remainder of surface, and that of meso- and metapleura thickly punctate; sternites each with a row of punctures along anterior margin. Length 1.75 mm.

Holotype.—Male, Vilcanota, Peru (Budapest Mus.); other specimens, San Esteban, March, 1888, E. Simon (Helsingfors Mus.).

MEGARIS STALII, new species

Cyrtaspis nigritula STÅL, C., (part) Bidrag till Rio Janeiro-traktens Hemipter-Fauna, vol. 1, 1860, p. 9 [Brazil].

Dull black, antennae and tarsi testaceous. Front margin of vertex convex medially, and slightly concave laterally, disk shallowly punctate and wrinkled anteriorly, puncturing practically obsolete on posterior half; pronotum coarsely punctate laterally, a few smaller punctures just behind head, a band of 4–5 rows across middle, and a single line of fine punctures along posterior margin; scutellum coarsely punctured from margin to rather high up on sides, but smoother medially, and almost impunctate on anterior disk; there is no wrinkling of the upper surface as in *nigritula;* clavus impunctate; pleura coarsely punctate, the propleura only interiorly and in a narrow transverse median band, metapleura smooth near posterior angles; sternites punctate along incisures, 6 broadly rounded anteriorly, with a few transverse wrinklings. Length 1.8 mm.

Holotype.—Male, Brazil, F. Sahlberg (Stockholm Mus.); paratype, Pernambuco (Berlin Mus.).

MEGARIS ATRATULA Stäl

Megaris atratula Stål, C., Hemiptera Mexicana, Ent. Zeit. (Stettin) vol. 23, 1862, p. 84 [Tabasca].

Fusco-castaneous, dorsum polished; antennae and tibiae paler; front margin of vertex rather deeply emarginate medially, rounded angulate each side of the emargination, then slightly concave to eyes, disk of vertex with the usual radiate wrinklings but practically impunctate; pronotum glossy, with numerous punctures laterally, a compact band of 4–5 rows just behind head, a diffuse band of 4–5 rows across middle, and a single line along hind margin; scutellum with numerous distinct punctures near antero-lateral angles, and numerous finer punctures elsewhere except on anterior disk, which is polished and crossed by a distinct band of punctures narrowed to 2 rows at middle; clavus punctate; pleura (partly hidden) apparently entirely coarsely punctate, sparsely so on propleurum; sternites feebly punctate along incisures, 6 subangulate anteriorly, all the others slightly shortened medially.

Holotype.—Female, Tabasco (Stäl) (Stockholm Mus.); Belize and Rio Hondo, British Honduras, Blancaneau (British Mus.).

MEGARIS SEMIAMICTA, new species

Dark castaneous, tibiae, tarsi, and antennae, testaceous. Head impunctate, the anterior margin only slightly emarginate medially, also slightly concave laterally. Punctures of pronotum distributed in a single row around almost the entire margin; in a narrow band behind head and in another across the disk; remainder of surface of pronotum polished. Dorsal and lateral outlines as in Figures 2 and 16. Punctures of scutellum most evident on sides, nearly obsolete discally; otherwise as described in key. Propleurum almost impunctate anteriorly, increasingly punctate posteriorly until hind margin which is almost as copiously punctate as meso- and meta-pleura. Length 1.9 mm.; width 1.8 mm.

Holotype.—Male, Cacao Trece Aguas, Guatemala, April 13, E. A. Schwarz and H. S. Barber; paratype, male, Porto Bello, Panama, March 12, 1911, E. A. Schwarz (U.S.N.M.).

Holotype and paratype.—Cat. No. 40537, U.S.N.M.

MEGARIS CONSTRICTA, new species

Color almost uniform castaneous, the legs, distally, and antennae, more testaceous. Front margin of vertex shallowly concave both medially and laterally. Punctures rather deeper than in most of the other species, and almost uniformly distributed, being obsolete only on anterior and posterior parts of disk of pronotum, and semiobsolete on a very small central portion of disk of scutellum. Some of the hairs on antennae as long as the segments (fig. 11). Lateral aspect as in figure 14. Propleurum nearly smooth anteriorly, coarsely punctate posteriorly. Length, 1.5 mm.; width, 1.2 mm.

Holotype.—Male, Livingston, Guatemala, May 6, E. A. Schwarz and H. S. Barber (U.S.N.M.).

Holotype.—Cat. No. 40538, U.S.N.M.

MEGARIS ANTENNATA, new species

Piceous; legs reddish-brown, the tarsi testaceous; antennae piceous, apices of the longer segments stramineous (fig. 7). Punctures distributed about as in *M. constricta* but less distinct; polished areas of pronotum somewhat larger. Dorsal aspect of head as in Figure 9. Puncturing of pleura as in *constricta*. Length, 1.5 mm.; width, 1.2 mm.

Holotype.—Female, Cacao, Trece Aguas, Guatemala, April 2, E. A. Schwarz and H. S. Barber (U.S.N.M.). This may be the female of the preceding species.

Holotype.—Cat. No. 40539, U.S.N.M.

Subfamily CANOPINAE

There is only one genus known, namely,

Genus CANOPUS Fabricius

Canopus FABRICIUS, J. C., Systema Rhyngotorum, 1803, p. 127 [monobasic, genotype, *C. obtectus*, new species, Middle America].

Chlaenocoris BURMEISTER, H., Handbuch der Entomologie II, Pt. 1, 1835, p. 383 [monobasic, genotype, *Tetyra impressa* Fabricius, Middle America]. Burmeister's specimens were from Brazil.

Cursula WALKER, F., Catalogue of the Specimens of Heteropterous-Hemiptera in the Collection of the British Museum, Pt. 1, 1867, p. 81 [monobasic, genotype, *C. globifera*, new species, Brazil].

The general practice, which seems almost a necessary one in entomological taxonomy, is to recognize only those genera that are based on identifiable species. Use of the generic term *Canopus* is an eclecticism possibly justified by the certainty that it does apply to the insects under consideration, even if the genotype, because a nymph, is with present knowledge, unidentifiable. If the holotype continues to exist until identification of nymphs becomes possible, then and not till then will the genus have a definite genotype. If in the end the holotype proves unidentifiable, there should be used for the genus the name *Canopus*, or a synonym, dating from the earliest publication in which a positively identifiable species is included. *Cursula* Walker also was founded on immature specimens. *Chlaenocoris* was based on an adult of a species described by Fabricius in the genus *Tetyra*.

Besides the characters mentioned in the key to subfamilies the following are common to all of the species of *Canopus* seen by the writers: Outline, as seen from above, obovate, slightly narrower posteriorly than anteriorly; dorsal outline, as seen from side, almost evenly curved; part of head in front of eyes as long as, or longer than, an eye, vertex with more or less impressed lines defining the tylus, and oblique impressions each side, but scarcely punctate; head and pronotum with slightly reflexed margins; corium carinate costally, showing one definite longitudinal vein, with a definite longitudinal series of punctures exterior, and scattered punctures interior, to it; pronotum with a median longitudinal impressed line anteriorly, and a more or less defined transverse impression, in or along which are fewer or more numerous punctures, and at each end of which is a smaller or larger group of punctures; scutellum with a row of punctures or traces thereof along basal margin, with a distinct lunate, impressed and punctate line, marking off an area near the base which is polished discally, but contains some punctures laterally, surface of scutellum behind this line more or less punctate. Color black, and in most species, perhaps in all, there are individuals with aeneous or purplish reflections.

KEY TO THE SPECIES

1. Metapleural ostiole with a broad lip; the opaque ostiolar field but little extended upon mesopleurum, attenuate laterally, ending upon suture between meta- and meso-pleura, and not extending to lateral margin; head smoother on the average than in the contrasted group; apical segment of antenna not pale at base; subcostal series of punctures on corium not in a depression, the area bearing them almost flat__________________2

   Metapleural ostiole with a narrow lip; the opaque ostiolar field occupying nearly half of mesopleurum and extending to lateral margin where it has the form of a narrow strip entirely across end of mesopleurum; oblique impressed lines on head more evident on the average than in the contrasted group, apical segment of antenna more or less pale at base; subcostal series of punctures on corium in a rather pronounced depression, the area between them and the impressed vein markedly elevated ---------- 9

2. Males ---------- 3

Females ---------- 5

3. Head more pointed apically (fig. 29), the pronotum with a slight shoulder, sides posteriorly almost straight (fig. 27); hind margin of hypopygium, as seen from below, with two rather prominent posterior angulations, the section between them longer than that part of the border laterad of either angle, the distinctly emarginate median section, as seen from behind, thin and carinate (figs. 34, 35) ---------- germari, new species.

Head more rounded apically (fig. 30), pronotum regularly rounded on sides or almost so, sides not straight posteriorly (fig. 28); hind margin of hypopygium, as seen from below, with two slight, rounded posterior extensions, the section between them shorter than that part of the border laterad of either angle (fig. 40) ---------- 4

4. Median section of hind margin of hypopygium, as seen from above, rather thick and rounded, the ventral exposure not wrinkled nor punctate (figs. 40, 41); femora unicolorous ---------- fabricii, new species.

Median section of hind margin of hypopygium thinner; ventral exposure quite conspicuously transversely striate, wrinkled posteriorly, and with a few coarse punctures each side (figs. 38, 39); femora each with a median pale annulus ---------- burmeisteri, new species.

5. Head more rounded apically, pronotum evenly rounded on lateral margin, less noticeably so in *burmeisteri;* highest point of the swollen inner margins of genital plates at apex, or at least the apical inner angles not depressed, the margins thick ---------- 6

Head more pointed apically (fig. 29), pronotum not evenly rounded on lateral margins (fig. 27); inner apical, or posterior, angle of genital plates generally depressed so that the edge is sharp and the highest point of the swollen inner margins is before the apex ---------- germari, new species.

6. Inner swollen margins of genital plates most elevated at about the middle, constricted posteriorly, so that together (as seen from rear) they form an elliptical figure ---------- fabricii, new species.

Inner swollen margins of genital plates most elevated posteriorly ---------- 7

7. Each genital plate forming a broadly triangular figure, with a transverse depression across base, the central angles quite prominently elevated and produced posteriorly, a conspicuous depression just laterad of same in margin (fig. 42); femora each with a distinct median pale annulus.
burmeisteri, new species.

Genital plates not triangularly produced posteriorly; femora unicolorous -- 8

8. Brachial field distinctly punctate; genital plates nearly flat except for moundlike swellings near the most elevated portions of inner margins, which are more abruptly elevated than in the contrasted species.
andinus Horvath.

Brachial field only obsoletely punctate; genital plates tumid anteriorly, with swollen, polished inner margins, which are most elevated, and also widest, posteriorly, so that together they form a narrowly triangular figure, the most elevated portion of which is by no means produced so far as in *burmeisteri* ---------- globosus Horvath.

9. Males ---------- 10

Females ---------- 12

10. Median portion of hind margin of genital plate, as seen from rear (actual dorsal view), fused almost from the extreme edge with an internal median thickening (fig. 33) ---------- impressus Fabricius.
   Hind margin of genital plate, as seen from rear, forming a thin shelf, with no thickening visible at all near the edge (fig. 32) ---------- 11
11. Fourth and fifth veins of membrane of fore wing fused for some distance near base (a character variably present in *impressus* also); hind wall of hypopygium concave inwardly ---------- orbicularis Horvath.
   Fourth and fifth veins of membrane of fore wing not fused near base (fig. 20); hind wall of hypopygium distinctly convex inwardly -- caesus Germar.
12. Genital plates angularly produced at the middle of their hind margins, the projecting portions overlying and almost entirely concealing the accessory genital plates (fig. 37) ---------- impressus Fabricius.
   Genital plates not angularly produced, the accessory plates fully exposed -- 13
13. Inner margins of genital plates most elevated and broadest posteriorly, their posterior margins concave (fig. 36); fourth and fifth veins of membrane of fore wing fused for some distance near base (a character of variable occurrence in *impressus* also) ---------- orbicularis Horvath.
   Inner margins of genital plates most elevated medianly, their posterior margins not concave (fig. 31); fourth and fith veins of membrane not united near base ---------- caesus Germar.

CANOPUS FABRICII, new species [3]

With aeneous to purplish reflections; tibiae and tarsi, basal segment of antenna, ring segment (2) and apices of 3 and 4, testaceous. Head rather smooth, with only traces of oblique impressions; pronotum laevigate, indistinct punctures visible only along transverse impression. Dorsal view of head as in Figure 30; outline of margin of pronotum as in Figure 28. Dorsal and ventral views of male hypopygium, as in figures 40 and 41. Length, 5.5–6.5 mm.

Holotype.—Male, Bocas del Toro, Panama, July 4, 1908, W. Robinson; paratype, male, Turrialba, Costa Rica; paratype, male and female, San Carlos, Costa Rica, Schild and Burgdorf (U.S.N.M); Bugaba, Volcan de Chiriqui, Panama, Champion; Chontales, Panama; Bogota, Colombia; Paramba, Ecuador, January 1896, April 1897; Cachabe, Ecuador, November 1896, February 1897, Rosenberg (British Mus.).

Holotype and paratypes.—Cat. No. 40540 U.S.N.M.

CANOPUS GLOBOSUS Horvath

Canopus globosus HORVATH, G., Analecta ad cognitionem Cydnidarum, 1919, p. 207 [Mapiri, Bolivia; Pachitea, Peru].

Head, pronotum, and anterior disk of scutellum, highly polished, no punctures evident; scutellum except anterior disk with scattered subobsolete punctures; specimens may be with, or without, aeneous

[3] There are seven as yet unidentified names available for species of *Canopus*, six of them based on nymphs; if these ever become identifiable, the new names proposed in this paper are very likely to pass into synonymy; they are presented therefore in a provisional sense.

reflections; basal two segments of antennae testaceous. Length, 6–7 mm.

Holotype.—Female, Mapiri, Bolivia; paratype, female, Pachitea, Peru (Budapest Mus.); other specimens seen are from Turrialba, Costa Rica, Schild and Burgdorf (U.S.N.M.); Bahia, Brazil, R. Oberthur, 1901 (Paris Mus.); Chanchamayo, Peru, A. Heyne (Deutsches Entomologisches Institut); Bugaba, Panama, Champion; Costa Rica (British Mus.).

CANOPUS ANDINUS Horvath

Canopus andinus HORVATH, G., Analecta ad cognitionem Cydnidarum, 1919, p. 208 [Peru; Bolivia].

Head of the shorter, more rounded type; pronotum coarsely but sparsely punctate near sides, with a single row of punctures in the transverse impression; scutellum with coarse, but sparse and shallow punctures everywhere except on anterior disk; legs pale from middle of femora distally; apical four-fifths of each of last two antennal segments fuscous, remainder pale. Length 6 mm.

Holotype.—Female, Marcapata, Peru; other females labeled Bolivia and Peru (Budapest Mus.).

CANOPUS BURMEISTERI, new species

Without aeneous reflections; basal and ring segments, and apex of segment three of antenna, tarsi, tibiae, and femoral annuli, testaceous. There are more punctures in the transverse band on pronotum, and especially near lateral margins, than in the preceding two and the next succeeding species of the same group. Dorsal and ventral views of male hypopygium as in figures 38, 39. Female genitalia as in figure 42. Length 5.5–6 mm.

Holotype.—Female Tumupasa,, Bolivia, December, M. R. Lopez (U.S.N.M.); paratypes, Sao Paulo de Olivencia, Brazil, May, 1923, S. M. Klages (Carnegie Mus.); Marcapata, Peru; Bolivia, coll. Breddin (Deutsches Entomologisches Institut); Venezuela (Stettin Mus.).

Holotype.—Cat. No. 40541, U.S.N.M.

CANOPUS GERMARI, new species

Numerous specimens, some without, some with, greenish to purplish reflections; bases of femora dark, distal portions testaceous; basal and ring segments of antenna and apices of other segments, usually testaceous; both legs and antennae in some specimens more extensively pale. Margin of pronotum as in figure 27; dorsal view of head as in figure 29. Dorsal and ventral views of male hypopygium as in figures 34 and 35. Length 6–7 mm.

Holotype.—Male, Cachali, Ecuador; paratypes, Rio Dagua, Colombia, W. F. H. Rosenberg; Cano Saddle, Panama, March 9, 1923, R. C. Shannon; San Carlos, Costa Rica, Schild and Burgdorf (U.S.N.M.); Colombia (Paris Mus.); Colombia, April–June, 1908, E. Pehlke (Stettin Mus.); Bogota (Stockholm Mus.).

Holotype.—Cat. No. 40542, U.S.N.M.

CANOPUS IMPRESSUS Fabricius

Cimex impressus Fabricius, J. C. in Coquebert, A. J., Illustratio iconographica Insectorum quae in Musaeis parisinis observavit et in lucem edidit Joh. Christ. Fabricius praemissis ejusdem descriptionibus; accedunt species plurimae, vel. minus aut nondum cognitae, Tabularum Decas secunda, 1801, p. 80, pl. 18, fig. 15 [America meridionali].

T. [*etyra*] *impressa* Fabricius, J. C., Systema Rhyngotorum, 1803, pp. 141–142 [Amer. merid.].

Canopus asphaltinus Horvath, G., Analecta ad cognitionem Cydnidarum, 1919, p. 207 [Amazonas].

Numerous specimens, some without, some with, aeneous to purplish reflections. Basal three segments or antenna often wholly pale, the basal ½–¾ of the third segment sometimes, all of 4 but the extreme base, and the apical half or more of 5, dark. Legs chiefly testaceous. Puncturing is much as in *burmeisteri*, there being a few rows in transverse band on pronotum, noticeable groups of punctures near lateral margins, and rather more evident along margins and in ends of anterior lunate area of scutellum, than in the more laevigate species. Dorsal view of male hypopygium as in figure 33; ventral view of female genitalia as in figure 37. Length 5–6 mm.

In this and the next succeeding species the scutellum is rather rugulose posteriorly, the punctures in the furrows, a character in which they differ from all the other species treated in this paper.

There are four specimens in the Universitetets Zoologiske Museum, Copenhagen, labeled "Amer. mer. mus. Schmidt, Dom. Sehestedt," of which the first, a female, is regarded as the holotype; of the other specimens, one is a female and two are males; there are also two specimens labeled "S. America, Mus. Westermann," which are correctly placed; at Kiel (Zool. Mus. Univ.) there are two females labeled Brazil, one bearing the determination *impressus* in Fabricius' handwriting; other specimens examined are from Maroni River, French Guiana, William Schaus; Para, and Amazonas, Brazil; Cachuela Esperanza, Beni, Bolivia, March, 1922, W. M. Mann; Tumupasa, Bolivia, December, M. R. Lopez (U.S.N.M.); Santarem, Brazil, July, 1919, and undated, S. M. Klages; Mana River, French Guiana, June, 1917 (Carnegie Mus.); Cayenne, Coll. Bosc; French Guiana, R. Oberthur, 1899; Camopi, French Guiana, F. Geay, 1900; Mexico, Parzudacki, 1840 (Paris Mus.); Amazonas, type of *Canopus asphaltinus* Horvath (Budapest Mus.); Para (Berlin Mus.).

CANOPUS ORBICULARIS Horvath

Canopus orbicularis HORVATH, G., Analecta ad cognitionem Cydnidarum, 1919, p. 208 [Mallali, British Guiana].

Canopus hypocrita HORVATH, G., Analecta ad cognitionem Cydnidarum, 1919, pp. 208–209 [Pachitea, Peru].

The description of the next preceding species (*impressus*) fits the present in almost every respect; all of the tangible differences are pointed out in the key. Hind wing as in Figure 22; ventral view of male abdomen (fig. 23); dorsal view of same (fig. 26); dorsal view of male hypopygium (fig. 32); internal genitalia of male (fig. 19); ventral view of female genitalia (fig. 36).

Holotype of obicularis.—Male, Mallali British Guiana, and *hypocrita* female, Pachitea Peru (Budapest Mus.); other material examined from Para, Brazil, May, June, July; Sao Paula de Olivencia, Brazil, April, May, 1923, S. M. Klages; Mana River, French Guiana, May, 1917 (Carnegie Mus.); Costa Rica, E. Poisson, 1899 (Paris Mus.); Para, Brazil, July; Kaieteur, British Guiana, August 4, 1911 (Amer. Mus.); Bahia, Brazil, Freir, Sieber; Central Brazil, Doctor Ehrenreich (Berlin Mus.); Brazil, Broom (Lwow Mus.).

CANOPUS CAESUS Germar

Chlaenocoris caesus GEMAR, E. F., Zeitschr. f. Ent., vol. 1, pt. 1, 1839, p. 23 [Middle America].

Numerous specimens showing considerable variety of metallic reflections; tibiae and tarsi usually, and sometimes all of legs, testaceous; antennal segments 1–3 usually pale, as is also more or less basally each of 4 and 5; 3 is sometimes darkened for ½–¾ its length from base, and 4 and 5 are sometimes wholly dark. Fore wing as in figure 20; female genitalia from below as in figure 31. Length, 5–6 mm.

The first specimen labeled type in the Museum für Naturkunde Berlin, and the only specimen at Lwow (Mus. Johann Kasimir Universität) agree as to species, indicating the correctness as well as the desirability of selecting the former as holotype of the species. The Berlin specimen is labeled Para, Seiber, and that at Lwow, Brazil; the Berlin series contains two of the present species and three of *orbicularis*; other material examined includes specimens from Santarem, Brazil, April, May, June, July, 1919; Nova Olinda, Rio Purus, Brazil, June, 1922, S. M. Klages; Mana River, French Guiana, June, 1917; Paracary, Amazonas, Brazil, June; Para, Brazil, June, July, August; Taperina, Brazil, December; Tonantins, Amazon River, Brazil, July, 1923, S. M. Klages (Carnegie Mus.); Mexico; Cachuela Esperanza, Beni, Bolivia, March, 1922, W. M. Mann; Para, Brazil (U.S.N.M.); Para, Brazil, June, July; Kaieteur, British Guiana, July 31, Aug. 3, 1911; Tukeit, British Guiana, July 21, 1911; Kangaruma, British Guiana, August 18, 1911 (Amer. Mus.); Mexico, Parzudacki, 1840; French Guiana, R. Oberthur, 1899, Les Roches de Kouron, E. Le Moult, June, 1905; Para, Brazil, Reiche; Riviere Lunier, Guiana, F. Geay, 1889 (Paris Mus.); Coco, Ecuador, R. Heansch (Deutsches Entomologisches Institut); Para, Santarem (British Mus.).

NOTES ON PREVIOUSLY DESCRIBED SPECIES

1803. Fabricius, J. C. Systema Rhyngotorum.

Canopus obtectus, Middle America, pp. 127–128; nymphs, type seen.

Tetyra impressa, Middle America, pp. 141–142; see p. 16.

1819. Leach, W. E., [Dr. Leach's Notice of Reptiles, Insects, etc.] in Mission from Cape Coast Castle to Ashantee, etc., by T. E. Bowdich, Appendix No. 4.

Canopus punctatus, Gaboon, p. 496. This is a Coptosomatid placed by Lethierry and Severin in the genus *Plataspis*. It is figured by George Gray in Griffith, Edward, the Animal Kingdom, vol. 15, 1832, p. 233, pl. 92, fig. 2.

1824. Dalman, J. W., Ephemerides entomologicae, 1.

Canopus obtectus Fabricius, Brazil, pp. 34–36. Redescription: his specimen also was a nymph.

1832. Castelnau (i. e. DeLaporte, F. R.), Essai d'une Classification Systematique de l'Ordre des Hémiptères (Hémiptères Héteroptères, Latr.), Magasin de Zoologie, 2nd year, 88 pp., pls. 51–55.

Platycephala metallica, n. gen. et. sp., Amerique du Nord (?) pp. 73–74, assigned to genus *Canopus* on p. 85, is a Coptosomatid, and is not from North America.

Canopus coccinelloides proposed on p. 85, and figured plate 55, fig. 5, for a specimen supposedly from Brazil, also is a Coptosomatid and not from North America.

The former is placed in *Brachyplatys* and the latter in *Plataspis* by Lethierry and Severin.

1834. Guerin, F. E., Dictionnaire pittoresque d'Histoire naturelle I. He is convinced that the synonymizing of *Platycephala* with *Canopus* by Castelnau is an error, and that the species figured by himself in the Atlas to vol. 1 (pl. 72, fig. 3), is not *Canopus* as there named but *Platycephala*. The specific name is *madagascariensis* and it is placed in *Plataspis* of the Coptosomatinae by Lethierry and Severin.

1834. LEFEBVRE, AL., Lettre de M. Al. Lefebvre à M. Audinet-Serville sur le *Canopus obtectus* de Fabricius, Magasin de Zoologie (Guerin), 4th year, 1834, cl. IX, pl. 126, 23 pp., 1 pl. In the set available to us this plate is in 5th year, 1835.

Canopus westermannii, p. [10], no locality, is a nymph. The purport of this paper is that *Canopus obtectus* Fabricius was founded on nymphs; there are illuminating remarks also on species placed in this genus by Leach and Castelnau; the twenty figures are very good.

1835. BURMEISTER, H. Handbuch der Entomologie, vol. 2, p. 1.

Canopus involutus, Brazil, p. 382; nymphs, type seen.

Chlaenocoris impressus Fabricius, Brazil, p. 383; a specimen so determined in Museum für Naturkunde, from Para, possibly the basis of this Burmeister record, is correctly named.

1835. HAHN, C. W., Die Wanzenartigen Insekten, vol. 3, 1835.

Chlaenocoris impressus Fabricius, Brazil, pp. 24–25, pl. 8, fig. 248.

1839. GERMAR, E. F., Zeitschrift fur die Entomologie, vol. 1, p. 1.

Chlaenocoris impressus Fabricius, Brazil, p. 23; specimens under this name in Johann Kasimir Universität, Lwow are *orbicularis* Horvath.

Chlaenocoris apicalis, Brazil, p. 23; no specimens under this name either at Lwow or Berlin.

Chlaenocoris caesus, Middle America, p. 23; see p. 17.

1839. HERRICH-SCHAEFFER, G. A. W., Die Wanzenartigen Insecten, V.

Chlaenocoris impressus Fabricius, Brazil, p. 27, pl. 152, fig 480.

Chlaenocoris caesus Germar, South America, p. 28, pl. 102, fig. 479.

Chlaenocoris apicalis Germar, Brazil, pp. 28–29.

1867. WALKER, FRANCIS, Catalogue of Heteropterous Hemiptera in the British Museum, pt. 1.

Cursula globifera, Brazil, p. 81; nymphs, type seen.

Coenina variolosa, Birmannia, p. 82; cited in this group by Lethierry and Severin does not belong in this subfamily but near the genus *Eysarcoris*.

1889. DISTANT, W. L., Biologia Centrali-Americana, Insecta Rhynchota, Hemiptera-Heteroptera, I, Supplement.

Chlaenocoris caesus Germar, p. 310; the specimens so named in British Museum are *fabricii*, new species.

Chlaenocoris dissimilis, Nicaragua, Panama, p. 310, pl. 30, fig. 3; nymphs, type seen.

1889. *Chlaenocoris compressus*, Panama, p. 310, pl. 30, fig. 11; nymphs, type seen.

1893. DISTANT, W. L., Biologia Centrali-Americana, Insecta Rhynchota, Hemiptera-Heteroptera, I, Supplement.

Chlaenocoris arctatus, Panama, p. 454; nymphs, type seen.

1919. HORVATH, G., Ann. Mus. Nat. Hung., 17.

Canopus impressus Fabricius, p. 206; the specimens under this name in Budapest Museum are *fabricii*, new species.

Canopus caesus Germar, p. 206; correct.

Canopus globosus, Bolivia, Peru, p. 207; see p. 14.

Canopus asphaltinus, Brazil, p. 207; equals *C. impressus* Fabricius.

Canopus orbicularis, British Guiana, p. 208; see p. 17.

Canopus andinus, Peru, Bolivia, p. 208; see p. 15.

Canopus hypocrita, Peru, pp. 208–209; see p. 17.

EXPLANATION OF PLATES

Plate 1

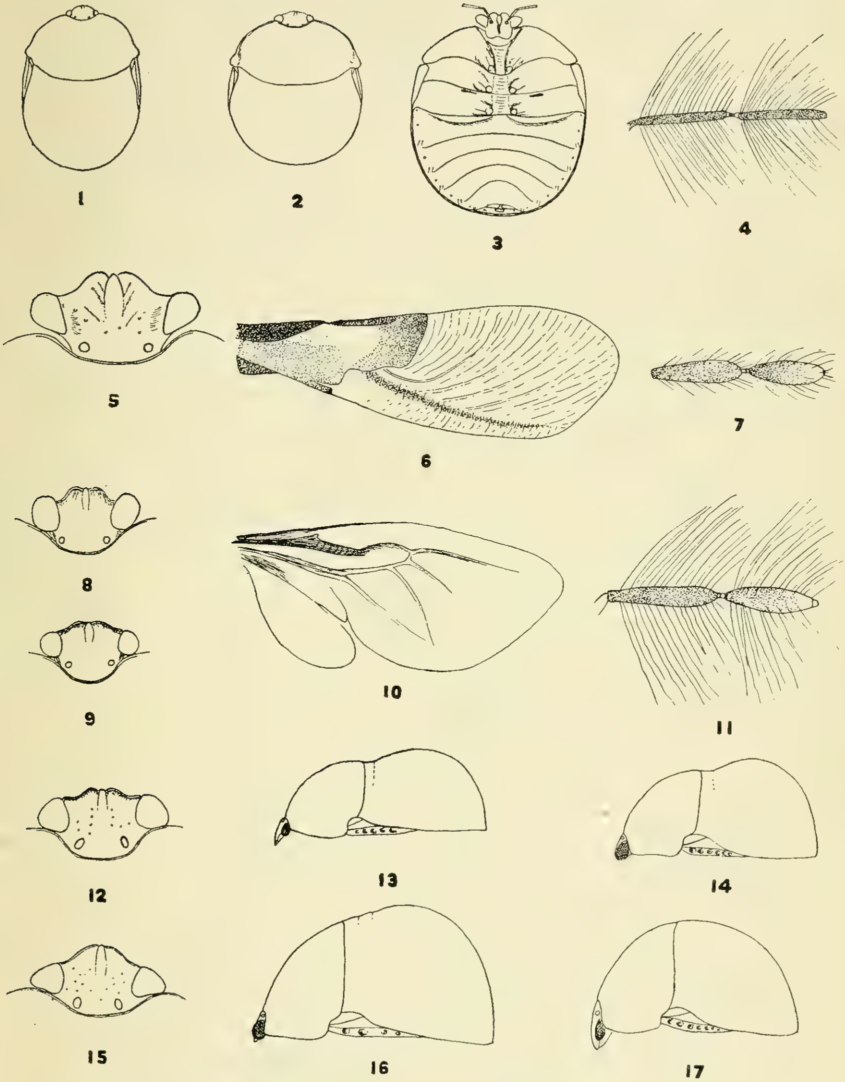
Structural details of Megaridinae

Fig. 1. *Megaris longula,* dorsal outline.
2. *Megaris semiamicta* dorsal outline.
3. *Megaris majuscula,* ventral aspect.
4. *Megaris trinotata,* 2nd and 3rd antennal segments of male.
5. *Megaris majuscula,* dorsal aspect of head of female.
6. *Megaris laevicollis,* fore wing.
7. *Megaris antennata,* 2nd and 3rd antennal segments of female.
8. *Megaris laevicollis,* dorsal aspect of head of male.
9. *Megaris antennata,* dorsal aspect of head of male.
10. *Megaris laevicollis,* hind wing.
11. *Megaris constricta,* 2nd and 3rd antennal segments of male.
12. *Megaris trinotata,* dorsal aspect of head of male.
13. *Megaris longula,* lateral aspect.
14. *Megaris constricta,* lateral aspect.
15. *Megaris trinotata,* dorsal aspect of head of female.
16. *Megaris semiamicta,* lateral aspect.
17. *Megaris hemisphaerica,* lateral aspect.

Plate 2

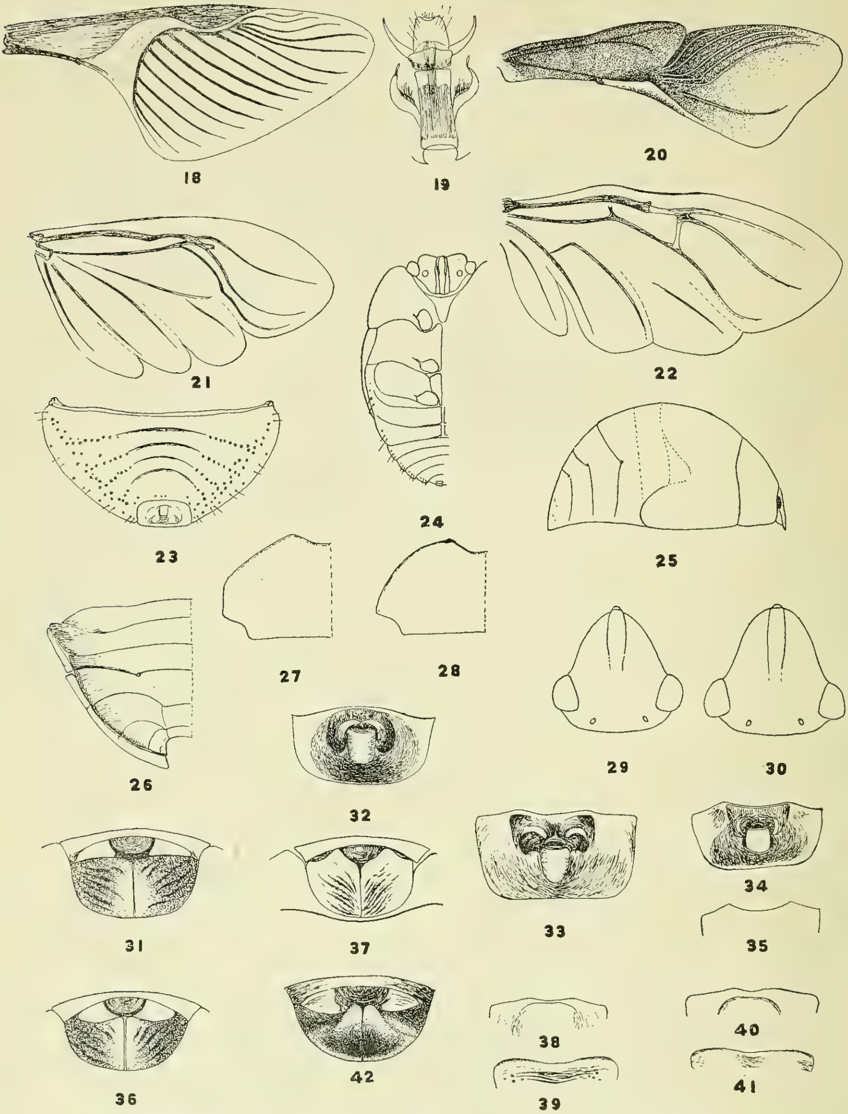
Structural Details of Canopinae and Coptosomatinae

Fig. 18. *Brachyplatys subaeneus,* fore wing.
19. *Canopus orbicularis,* internal genitalia of male.
20. *Canopus caesus,* fore wing.
21. *Brachyplatys subaeneus,* hind wing.
22. *Canopus orbicularis,* hind wing.
23. *Canopus orbicularis,* ventral view of abdomen of male.
24. *Canopus* sp. ventral view of nymph, one side, legs omitted.
25. *Canopus* sp. lateral view of nymph, legs omitted.
26. *Canopus orbicularis,* dorsum of abdomen of male, one side.
27. *Canopus germari,* outline of pronotum, one side.
28. *Canopus fabricii,* outline of pronotum, one side.
29. *Canopus germari,* head, dorsal view.
30. *Canopus fabricii,* head, dorsal view.
31. *Canopus caesus,* female genitalia.
32. *Canopus orbicularis,* hypopygium of male from above.
33. *Canopus impressus,* hypopygium of male from above.
34. *Canopus germari,* hypopygium of male from above.
35. *Canopus germari,* hypopygium of male from below.
36. *Canopus orbicularis,* female genitalia.
37. *Canopus impressus,* female genitalia.
38. *Canopus burmeisteri,* male hypopygium from above.
39. *Canopus burmeisteri,* male hypopgium from below.
40. *Canopus fabricii,* male hypopygium from above.
41. *Canopus fabricii,* male hypopygium from below.
42. *Canopus burmeisteri,* female genitalia.



STRUCTURAL DETAILS OF MEGARIDINAE

FOR EXPLANATION OF PLATE SEE PAGE 21



STRUCTURAL DETAILS OF CANOPINAE AND COPTOSOMATINAE

FOR EXPLANATION OF PLATE SEE PAGE 21